ASSAM DON BOSCO UNIVERSITY

REGULATIONS AND SYLLABUS 2022 - 2023

SCHOOL OF FUNDAMENTAL AND APPLIED SCIENCES
SCHOOL OF LIFE SCIENCES
SCHOOL OF HUMANITIES AND SOCIAL SCIENCES
SCHOOL OF PROFESSIONAL STUDIES

DON BOSCO
Celebrating 100 Years in North East
ASSAM DON BOSCO UNIVERSITY

REGULATIONS AND SYLLABUS

2022-2023

School of Fundamental and Applied Sciences

School of Life Sciences

School of Humanities and Social Sciences

School of Professional Studies
NOTE
This handbook contains important information to help guide and inform you during your programme of study. We recommend that you keep this handbook for the duration of your studies in the University so that you can refer to it as needed. Please note that the onus of ignorance of the regulations and information contained in this handbook will be on the student and will not be ground for any consideration. You are also required to keep abreast of the amendments and additions to the regulations and syllabus that will be officially notified from time to time.

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ASSAM DON BOSCO UNIVERSITY REGULATIONS

GRADUATE DEGREE PROGRAMMES

The following are the regulations of the Assam Don Bosco University concerning the Graduate Programmes leading to the award of the Bachelor’s Degree in various disciplines made subject to the provisions of its Statutes and Ordinances.

1.0 Academic Calendar
1.1 Each academic year is divided into two semesters of approximately 18 weeks duration: an Autumn Semester (July – December) and a Spring Semester (January – June). The Autumn Semester shall ordinarily begin in July for students already on the rolls and the Spring Semester shall ordinarily begin in January. However, the first semester (Autumn, for newly admitted students) may begin later depending on the completion of admission formalities.
1.2 The schedule of academic activities approved by the Academic Council for each semester, inclusive of the schedule of continuing evaluation for the semester, dates for the conduct of end-semester examinations, the schedule of publication of results, etc., shall be laid down in the Academic Calendar for the semester.

2.0 Duration of the Programme
2.1 The normal duration of the Graduate Programme shall be as per the table given below:

<table>
<thead>
<tr>
<th>Programme</th>
<th>Number of Semesters</th>
<th>Number of Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor of Technology (BTECH)</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Bachelor of Computer Applications (BCA)</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Bachelor of Business Administration (BBA)</td>
<td>6</td>
<td>3</td>
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<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Bachelor of Arts (BA) Honours</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Bachelor of Science (BSc) Honours</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

2.2 However, students who do not fulfil some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to 4 more semesters (2 years) to complete all the requirements of the degree.
2.3 Under exceptional circumstances and depending on the merit of each case, a period of 2 more semesters (1 year) may be allowed for the completion of the programme.

3.0 Course Structure
3.1 The University follows Outcome Based Education with Choice Based Credit System (CBCS) for all the Graduate Degree Programmes. One credit is equivalent to 15 hours of lecture/tutorial or 30 hours of practical. The courses offered for the Graduate Degree Programmes are divided into two baskets – Core Courses and Elective Courses.
3.2 Core Courses: Core courses are those in the curriculum, the knowledge of which is deemed essential for students who are pursuing the said Degree Programme.
   3.2.1 A student shall be required to take all the core courses offered for a particular programme.
   3.2.2 The number of credits required from core courses shall be as prescribed by the competent academic authority.
   3.2.3 For UGC programmes, core courses include Discipline Specific Core Courses, Ability Enhancement Compulsory Courses and Skill Enhancement Courses. For AICTE programmes, core courses include Professional Core Courses (DC), Engineering Science Courses (IC), Basic Science Courses (IC), Humanities and Social Science Courses (IC), Mandatory Courses (IC), Project Work, Seminar and Internship in Industry.

3.3 Elective Courses: These are courses in the curriculum which give the student opportunities for specialization and which cater to his/her interests and career goals. These courses may be selected by the student and/or offered by the department conducting the programme, from those listed in the curriculum according to the norms laid down by the competent academic authority.
   3.3.1 The number of credits which may be acquired through elective courses shall be prescribed by the competent academic authority.
   3.3.2 For UGC programmes, elective courses include Discipline Specific Elective Courses and Generic Elective Courses. For AICTE programmes, elective courses include Professional Elective Courses and Open Elective Courses.
   3.3.3 It shall be the prerogative of the department not to offer an elective course which has less than 5 students opting for it.
3.4 The schema of categorization of courses is given below:

<table>
<thead>
<tr>
<th>Core Courses</th>
<th>Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discipline Specific Core (DC) or Professional Core (PC)</td>
<td>Core courses which are offered by the department conducting the programme</td>
</tr>
<tr>
<td>Discint Specific Elective (DE) or Professional Elective (PE)</td>
<td>Elective courses which are specific to the programme of study</td>
</tr>
<tr>
<td>Generic Elective (GE) or Open Elective (OE)</td>
<td>Elective courses which are offered by departments of the University from departments other than the parent department</td>
</tr>
</tbody>
</table>

3.5 In order to qualify for a Graduate Degree, a student is required to complete the minimum credit requirements as prescribed by the competent academic authority.

3.6 In addition to the prescribed credit requirement, a student shall have to complete Institutional mandatory courses with Pass grade, as prescribed by the competent academic authority, from time to time, which shall be recorded in the Grade sheet but not taken into account for computing the SGPA and the CGPA.

3.7 **Audit Courses**: Students who secure a CGPA of at least 8 at the end of the 4th semester may opt to take one audit course per semester from any Department from the 5th semester onwards, provided the course teacher permits the auditing of the course. This shall be done under the guidance of the Departmental Faculty Advisor/mentor. The student is free to participate in the evaluation process for such courses. However, an attendance of 75% is necessary for obtaining a P grade for such courses. When auditing courses offered by other departments, it shall be the responsibility of the student to attend such courses without missing courses of one’s own department and semester.

3.8 The medium of instruction shall be English and examinations and project reports shall be in English.

3.9 The course structure and syllabi of the Graduate Degree Programmes shall be approved by the Academic Council of the University. Departmental Boards of Studies (DBS) shall discuss and recommend the syllabi of all the courses offered by the department from time to time before forwarding the same to the School Board of Studies (SBS). The SBS shall consider the proposals from the departments and make recommendations to the Academic Council for consideration and approval.

3.10 The curriculum may include industry training and/or fieldwork for a specified time. This is to be satisfactorily completed before a student is declared eligible for the degree. There shall be credit allocation for such industrial training or fieldwork. Normally these activities shall be arranged by respective departments, even during semester breaks as approved by the School Board of Studies.

3.11 In addition, students may also opt for additional elective courses in consultation with their mentors (cf. 3.12). Elective courses may also be chosen from SWAYAM/NPTEL. Students are required to participate in the evaluation process of such courses. The grades obtained for such courses shall be recorded in the grade sheet, but not taken into account for computing SGPA and CGPA.

3.12 **Faculty Advisor/Mentor**: A faculty advisor/mentor (and a co-mentor to perform the duties of a mentor during the absence of the mentor) shall be assigned for groups of students. Generally the faculty advisor/mentor shall be assigned by the concerned department, in consultation with the Director of the School concerned. (For the first year students of the BTECH programme, the Director of the School of Technology may assign the faculty advisor/mentor from departments belonging to other Schools teaching at the SOT). Faculty advisors/mentors shall help their mentees to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them.

4.0 **Admission**

4.1 All admissions to the Graduate Degree Programmes of the University shall be on the basis of merit. There may, however, be provision for direct admission for a limited number of NRI/FN students.

4.2 **Eligibility Criteria**:

4.2.1 To be considered for admission to a Graduate Degree Programme a candidate should have passed the Higher Secondary examination of a recognized Board of Higher Secondary Education or an equivalent examination of any University/Board securing grades/marks as specified in the table below.

4.2.2 A candidate must also obtain qualifying marks required by the University in entrance tests/personal interview as the case may be. These marks shall be valid only for the academic year for which the test is held.

4.2.3 Admission will be on the basis of performance of the candidate at the qualifying examination, entrance test and/or personal interview.
<table>
<thead>
<tr>
<th>Programme</th>
<th>Grade /Marks requirement from qualifying examinations</th>
<th>Entrance Examinations / Personal Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTECH</td>
<td>Passed the qualifying examination with Physics/ Mathematics/ Chemistry/ Computer Science/Electronics/Information Technology/ Biology/Informatics Practices/ Biotechnology/Technical Vocational subject/ Agriculture/ Engineering Graphics/ Business Studies/Entrepreneurship with 45% in the aggregate of all subjects and 45% in the aggregate of any of the three</td>
<td>National Entrance Test such as JEE / State level entrance examination such as CEE or the ADBU Entrance Examination for Engineers</td>
</tr>
<tr>
<td>BBA, BCA, BCOM, BA Honours</td>
<td>Passed the qualifying examination in any stream with aggregate marks specified by appropriate academic body</td>
<td>Satisfactory performance in the Personal Interview</td>
</tr>
<tr>
<td>BSc Honours</td>
<td>Passed the qualifying examination in the science stream with aggregate of Physics, Chemistry and Mathematics specified by appropriate academic body</td>
<td>Satisfactory performance in the Personal Interview</td>
</tr>
</tbody>
</table>

4.3 Reservation of seats for the programme shall be as per the guidelines laid out in the Statutes of the University.

4.4 Admissions shall ordinarily close after a specified period from the date of commencement of the first semester, through a notification. However, in exceptional cases, admission of a candidate after the last date may be recommended to the University with justification, by the School / Departments concerned. Under such an event, this period shall not exceed four weeks from the date of commencement of the first semester.

   4.4.1 The attendance of such students shall be computed from the date of admission.
   4.4.2 Such students may be offered the opportunity of taking part in in-semester assessment modules which may have already been completed.

4.5 All candidates shall be required to satisfy the norms prescribed by the University for medical fitness prior to admission.

4.6 BTECH Lateral Entry into Programmes

   4.6.1 Polytechnic diploma holders in any branch of Engineering and Technology and B.Sc. Degree holders having Physics, Chemistry and Mathematics shall be eligible for admission to degree courses in Engineering and Technology in the third semester BTECH Programme against vacancies and/or seats in addition to the sanctioned intake in the first year.
   4.6.2 Such diploma holders should have been bonafide students of polytechnics duly approved by the government and should have pursued an AICTE approved three-year diploma curriculum in an appropriate branch of Technology. 4.6.3 Only diploma holders who have secured a minimum of 45% in the aggregate in the relevant discipline and B.Sc. students who have secured a minimum of 45% marks in the aggregate shall be eligible for consideration for admission. The students belonging to B.Sc. Stream, would have to clear the subjects: Engineering Graphics/Engineering Drawing and Engineering Mechanics of the First Year Engineering Programme along with the Second year subjects.
   4.6.4 Such admissions shall be on the basis of merit in the ADBU entrance test and a personal interview.

4.7 Bridge Courses: The Departments shall make provision for Bridge Courses to facilitate admission of students from varied backgrounds to a programme of their choice.

4.8 Value-added Courses: Each department shall offer value-added courses, which are optional. Certificates will be awarded to those who successfully complete the course.

4.9 BTECH Honours

A student of BTech can obtain Honours by completing additional 18-20 credits in emerging areas of the same discipline of study. Departmental Board of Studies shall finalize the emerging areas of study. Students eligible for Honours programme shall have a CGPA of 6.5 till 2nd Semester. In case of lateral entry students, they should have 1st class in their qualifying examination. Students will be permitted to enroll for Honours in 3rd or 4th semester which may continue till 8th semester until they complete 18-20 credits. In any semester, they will be advised to take not more than 6 credits of courses.

Students may be allowed to opt from SWAYAM/NPTEL courses. Teaching and evaluation of the courses will be as per university norm followed for any other courses.

For the students, who opted for Honours but could not earn the minimum 18 credits till 8th semester examination, all the
courses completed shall be printed in the Transcript to recognize the additional effort of the students. The opportunity of additional chance may be given to the willing students whose deficiency is marginal (at the most 6 credits).

4.10 BTECH Minor Engineering
A student of BTech can obtain Minor by completing additional 18-20 credits in emerging areas of another discipline of study. Departmental Board of Studies shall finalize the emerging areas of study. Students eligible for Honours programme shall have a CGPA of 6.5 till 2nd Semester. In case of lateral entry students, they should have 1st class in their qualifying examination. Students will be permitted to enroll for Minor in 3rd or 4th semester which may continue till 8th semester until they complete 18-20 credits. In any semester, they will be advised to take not more than 6 credits of courses.

Students may be allowed to opt from SWAYAM/NPTEL courses. Teaching and evaluation of the courses will be as per university norm followed for any other courses.

For the students, who opted for Minor but could not earn the minimum 18 credits till 8th semester examination, all the courses completed shall be printed in the Transcript to recognize the additional effort of the students. The opportunity of additional chance may be given to the willing students whose deficiency is marginal (at the most 6 credits).

5.0 University Registration

5.1 Candidates shall have to register as bona-fide students with the University as per the University regulations within a period specified by the University, by a formal application routed through the Director of the School concerned.

6.0 Attendance

6.1. To be permitted to appear for the end-semester examination of a particular course, a student is required to have a minimum attendance of 75% for that course.

6.2 Deficiency in attendance up to 10% may be condoned by the Director of the School in the case of leave taken for medical and other grievous reasons, which are supported by valid medical certificates and other requisite documents.

6.3 Some students, due to exceptional situations like their own serious sickness and hospitalization or death of members of the inner family circle (restricted to only father, mother, siblings), may have attendance below 65%. Such students may be given bonus attendance percentage for a particular course based on his/her attendance for that course during the remaining days of the current semester, as given in the following table:

<table>
<thead>
<tr>
<th>Attendance during the remaining days of the current semester</th>
<th>Bonus percentage available in the current semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>95% or more</td>
<td>5</td>
</tr>
<tr>
<td>90% or more but less than 95%</td>
<td>4</td>
</tr>
<tr>
<td>85% or more but less than 90%</td>
<td>3</td>
</tr>
<tr>
<td>80% or more but less than 85%</td>
<td>2</td>
</tr>
<tr>
<td>75% or more but less than 80%</td>
<td>1</td>
</tr>
</tbody>
</table>

They shall be permitted to appear for the end-semester examination of the course if on the strength of this bonus attendance percentage, they obtain 65% attendance for that course.

6.4 If the sum of the credits of the courses for which a student is unable to appear at the end-semester examinations exceeds 50% of the total credits allotted for the semester, he/she shall not be permitted to appear for the entire end-semester examinations in view of clause 10.5 of these Regulations.

6.5 The School may propose to set aside a certain portion of the in-semester assessment marks for attendance. The number of marks and modalities of their allotment shall be made known to the students at the beginning of each semester.

6.6 Leave

6.6.1 Any absence from classes should be with prior sanctioned leave. The application for leave shall be submitted to the Office of the Director of the concerned School on prescribed forms, through proper channels, stating fully the reasons for the leave requested along with supporting documents.

6.6.2 In case of emergency such as sickness, bereavement or any other unavoidable reason for which prior application could not be made, the parent or guardian must promptly inform the office of the Director of the concerned School.

6.6.3 If the period of absence is likely to exceed 10 days, a prior application for grant of leave shall have to be submitted through the Director of the concerned School to the Registrar of the University with supporting documents in each case; the decision to grant leave shall be taken by the Registrar on the recommendation of the Director of the concerned School.

6.6.4 The Registrar may, on receipt of an application, also decide whether the student be asked to withdraw from the
6.7 It shall be the responsibility of the student to intimate the concerned teachers regarding his/her absence before availing the leave.

7.0 Grading System

7.1 Three types of courses are offered in the Graduate programmes:

- **Graded courses**: For the majority of the courses, students shall be assessed and given grades.
- **Pass/Non-Pass courses**: There are some courses for which the students are expected to obtain a P grade to be eligible for the degree.
- **Audit Courses**: A third category of courses are audit courses. These are optional. However, students who opt for these courses must have the required attendance to obtain a P grade in the course.

7.2 Based on the performance of a student, each student is awarded a final letter grade in each graded course at the end of the semester and the letter grade is converted into a grade point. The correspondence between percentage marks, letter grades and grade points is given in the table below:

<table>
<thead>
<tr>
<th>Marks (x) obtained (%)</th>
<th>Grade</th>
<th>Description</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 ≤ x ≤ 100</td>
<td>O</td>
<td>Outstanding</td>
<td>10</td>
</tr>
<tr>
<td>80 ≤ x &lt; 90</td>
<td>E</td>
<td>Excellent</td>
<td>9</td>
</tr>
<tr>
<td>70 ≤ x &lt; 80</td>
<td>A+</td>
<td>Very Good</td>
<td>8</td>
</tr>
<tr>
<td>60 ≤ x &lt; 70</td>
<td>A</td>
<td>Good</td>
<td>7</td>
</tr>
<tr>
<td>50 ≤ x &lt; 60</td>
<td>B</td>
<td>Average</td>
<td>6</td>
</tr>
<tr>
<td>40 ≤ x &lt; 50</td>
<td>C</td>
<td>Below Average</td>
<td>5</td>
</tr>
<tr>
<td>x &lt; 40</td>
<td>F</td>
<td>Failed</td>
<td>0</td>
</tr>
</tbody>
</table>

In addition, a student may be assigned the grades ‘P’ and ‘NP’ for pass marks and non-passing marks respectively, for Pass/No-pass courses, or the grade ‘X’ (not permitted).

7.2.1 A student shall be assigned the letter grade ‘X’ for a course if he/she is not permitted to appear for the end semester examination of that course due to lack of requisite attendance.

7.2.2 A letter grade ‘F’, ‘NP’ or ‘X’ in any course implies failure in that course.

7.2.3 A student is considered to have completed a course successfully and earned the credits if she/he secures a letter grade other than ‘F’, ‘NP’, or ‘X’.

7.3 At the end of each semester, the following measures of the performance of a student in the semester and in the programme up to that semester shall be computed and made known to the student together with the grades obtained by the student in each course:

7.3.1 The Semester Grade Point Average (SGPA): From the grades obtained by a student in the courses of a semester, the SGPA shall be calculated using the following formula:

\[
SGPA = \frac{\sum_{i=1}^{n} GP_i \times NC_i}{\sum_{i=1}^{n} NC_i}
\]

Where \( GP_i \) = Grade points earned in the \( i^{th} \) course

\( NC_i \) = Number of credits for the \( i^{th} \) course

\( n \) = the number of courses in the semester

7.3.2 The Cumulative Grade Point Average (CGPA): From the SGPA’s obtained by a student in the completed semesters, the CGPA shall be calculated using the following formula:

\[
CGPA = \frac{\sum_{i=1}^{n} SGPI \times NSCi}{\sum_{i=1}^{n} NSCi}
\]

Where \( SGPI \) = Semester Grade point of the \( i^{th} \) semester

\( NSCi \) = Number of credits for the \( i^{th} \) semester

\( n \) = the number of semesters completed

7.3.3 The CGPA may be converted into a percentage by multiplying CGPA by 10.

7.4 Both the SGPA and CGPA shall be rounded off to the second place of decimal and recorded as such. Whenever these CGPA are to be used for official purposes, only the rounded off values shall be used.
7.5 There are academic and non-academic requirements for the Graduate programmes where a student shall be awarded the ‘P’ and ‘NP’ grades. Non-credit courses such as Service Learning, Constitution of India, Essence of Indian Traditional Knowledge etc. belong to this category. No grade points are associated with these grades and these courses are not taken into account in the calculation of the SGPA or CGPA. However, the award of the degree is subject to obtaining a ‘P’ grade in all such courses.

7.6 In the case of an audit course, the letters “AU” shall be written alongside the course name in the Grade Sheet. A student is not required to register again for passing failed audit courses.

8.0 Assessment of Performance

8.1 A student’s performance is evaluated through a continuous system of evaluation comprising tests, quizzes, assignments, seminars, minor projects, major projects and end-semester examinations.

8.2 Theory Courses: Theory courses shall have two components of evaluation – in-semester assessment of 40% weightage and an end-semester examination having 60% weightage.

8.2.1 The modalities of the conduct of in-semester assessment and weightages attached to its various components shall be as published by the School at the beginning of each semester.

8.3 Lab Courses: Lab courses (Laboratory, Drawing, Workshop, etc.) shall be evaluated on the basis of attendance, assessment of tasks assigned and end semester test/viva voce. The weightage assigned for these components of the evaluation is given in the following table:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>10</td>
</tr>
<tr>
<td>Assessment of Tasks Assigned</td>
<td>30</td>
</tr>
<tr>
<td>End-semester test / viva voce</td>
<td>60</td>
</tr>
</tbody>
</table>

8.3.1 The modalities of the conduct of evaluation under the heading “Assessment of tasks assigned”, its components and the weightages attached to its various components shall be as published by the department concerned at the beginning of each semester.

8.3.2 The evaluation of the end-semester test for a lab course may be done on the basis of criteria and weightage to be specified in the question paper, among which are included

- Organisation of the experiment
- Actual conduct of the experiment assigned and accuracy of the result
- Extent of completion
- A comprehensive viva-voce which examines the overall grasp of the subject

8.4 End-Semester examinations

8.4.1 End-semester examinations for the theory courses, generally of three hours’ duration, shall be conducted by the University. The Director of the concerned school shall make the arrangements necessary for holding the examinations.

8.4.2 In the end-semester examinations, a student shall be examined on the entire syllabus of the courses.

8.4.3 A student shall not obtain a pass grade for a course without appearing for the end-semester examination in that course.

8.5 Industry Training/Internship Programme

8.5.1 Departments may require students to undergo industry training/internship programmes.

8.5.2 Departments are to notify the students at the beginning of their programmes about the details of industry training/internship.

8.5.3 After the Industry Training/Internship programme, the student shall furnish a certificate from the organisation where he/she underwent the programme as proof of successful completion.

8.5.4 The student shall submit a training/internship report to the department in a format to be laid down by the concerned department. He/she shall also give a seminar to present the learning outcomes of the programme in the presence of the faculty members and students of the department. The student shall be evaluated on the basis of the report, the seminar and interaction during the seminar and grades shall be assigned. These grades shall be given a weightage of two credits in the subsequent semester.

8.6 The Major Project

8.6.1 Students of the BTECH programme and BCA programme shall undertake a Major Project during the
course of their graduate studies. The BTECH major project work is normally conducted in two phases during the seventh and eighth semesters of the programme and is to be done individually or in groups within the campus. A department may substitute this with two independent projects in the seventh and eighth semesters with prior permission from the statutory authority. The BCA major project work is conducted during the sixth semester of the programme, and is to be done individually or in groups within the campus.

8.6.2 Each department shall constitute a Departmental Project Evaluation Committee (DPEC) consisting of the Head of the Department, Project Co-ordinator and two senior teachers from the department, with the Project Co-ordinator as the convenor. The DPEC shall co-ordinate the conduct and assessment of the project.

8.6.3 The DPEC shall notify the schedule and modalities for the following stages in the implementation of the project.

- Submission of the topic of the project.
- Notification for assignment of project supervisors.
- Submission of the synopsis.
- Schedule and modality for the submission of weekly activity reports.
- Schedule for the seminar presentation of synopsis.
- Schedule for Progress Seminars, submission of progress reports and viva voce examination.
- Date for the submission of the project report and a brief summary.
- Dates for the external evaluation of the project.

In the case of the BTECH project, some of these activities may be performed during semester VII (Phase I) and others during Semester VIII (Phase II) as shall be notified by the DPEC.

8.6.4 The DPEC may ask a student to resubmit a synopsis if the same does not get its approval.

8.6.5 The Convenor of the DPEC shall submit to the Controller of Examinations a panel of at least three names of external examiners at least three weeks before the external examination. The Controller of Examinations shall appoint the external examiner(s) from this panel. The project supervisor shall be the internal examiner.

8.6.6 Each student shall submit to the DPEC three bound, typed copies of the project report, and prepared according to the prescribed format, after the pre-submission seminar, by the due date. The student shall also submit three copies of a brief summary of the project that shall be forwarded to the concerned examiners.

8.6.7 The DPEC shall make the arrangements necessary to conduct the external evaluation in consultation with the examiner(s) appointed by the University, during the dates notified.

8.6.8 Phase I of the project shall be evaluated through in-semester assessment only. The modality and components of the assessment and their weightages shall be determined by the School and the same shall be notified at the beginning of each semester.

8.6.9 Phase II of the project shall be evaluated through in-semester and end-semester assessments of equal weightage. The in-semester assessment shall be done by the DPEC and the project supervisor and the end-semester assessment shall be done by the external examiner(s) and the project supervisor, assisted by the DPEC. The modality and components of the in-semester assessment and their weightages shall be determined by the school and the same shall be notified at the beginning of each semester.

8.6.10 The DPEC shall forward the in-semester assessment marks to the Controller of Examinations by the date specified by the Examination Department.

8.6.11 The end-semester assessment shall have the following components:

- Project implementation: 40 marks
- Seminar presentation: 20 marks
- Viva voce examination: 20 marks
- Project documentation: 20 marks

8.6.12 Independent projects as envisaged in clause 8.6.1 shall be evaluated in the same manner as Phase II of the major project.

8.6.13 Those who obtain an ‘F’ grade for the major project shall be required to re-enrol for it in the subsequent semesters.

8.7 Minor and Mini Projects

8.7.1 Students may be assigned minor and mini projects by the department from the fourth semester onwards to ensure that their learning becomes a hands-on experience. These projects shall be executed by the students individually or in groups under the guidance of faculty members appointed by the department.

8.7.1.1 BCOM students shall undertake a Project (phase 1 & 2) spread across 5th and 6th semesters.

8.7.2 The mode of evaluation of these projects shall follow the pattern of evaluation of Lab Courses (vide clause 8.3) and the modalities for the conduct of evaluation, its components and the weightages attached to these components shall be published by the department concerned at the beginning of each semester.
8.7.3 The students may be required to submit project reports in the format specified. The evaluation of the Minor and Mini Projects shall take into consideration these project reports.

8.8 The evaluation of performance in non-credit courses shall be done by the authorities conducting them and they shall communicate the grades to the Director of the concerned School who shall forward them to the Controller of Examinations.

8.9 The Director of the concerned School shall forward the marks obtained in the in-semester evaluation to the Controller of Examinations within the prescribed time as may be notified.

8.9.1 All evaluated work in a course except the end semester answer scripts shall be returned to the students promptly.

8.10 Eligibility for appearing in the end-semester examinations: A student shall be permitted to appear for the end-semester examinations, provided that

8.10.1 A student has not been debarred from appearing in the end semester examinations as disciplinary action for serious breach of conduct.

8.10.2 He/she has satisfactory attendance during the semester according to the norms laid out in section 6 of these regulations.

8.10.3 He/she has paid the prescribed fees or any other dues of the university within the date specified.

8.11 Registration for end-semester Examinations

8.11.1 The University shall, through a notification, invite applications from students to register for the end-semester examinations.

8.11.2 Students who have registered with the University (vide clause 5) and those who have applied for such registration may apply to appear for the end-semester examinations of the university, in response to the notification issued by the University, provided that they fulfil the eligibility norms as laid down in clause 8.10.

8.11.3 All eligible candidates shall be issued an admit card for the relevant examination and for specified courses. A student who does not have a valid admit card may not be permitted to write the end-semester examinations.

8.11.4 A student who secures an ‘F’ or ‘X’ grade in any course in a semester may register for the end-semester examination for that course in a subsequent semester when that course is offered again, within the maximum period of time allotted for the completion of the programme. The in-semester assessment marks obtained by him/her in the last semester in which the said course was attended by him/her shall be retained.

8.11.5 Similarly, in case of an ‘NP’ grade in non-credit courses the student shall have to re-register for it in the appropriate semester of the next academic session.

8.11.6 When a student re-registers for the end semester examination of a course, in accordance with clause 8.11.4 above, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.12 Conduct of Examinations: The University shall conduct the end-semester examinations in accordance with the applicable regulations on such dates as are set down in the Academic Calendar or as notified.

8.13 Declaration of Results: The University shall declare the results of a semester and make available to the students their grade sheets within the time-frame prescribed by the relevant regulations of the university and specified in the academic calendar.

8.14 The University may withhold the results of a student for any or all of the following reasons

- he/she has not paid his/her dues
- there is a disciplinary action pending against him/her
- he/she has not completed the formalities for University Registration according to the requirement of section 5 of these Regulations.

8.15 Re-examining of answer scripts

8.15.1 If a student feels that the grade awarded to him/her in a course is not correct, he/she may apply to the University for the re-examining of his/her answer script.

8.15.2 Re-examining of scripts may be of two different categories – scrutiny and re-evaluation.

8.15.3 Scrutiny: The activities under this category shall ordinarily be confined to checking

- correctness of the total marks awarded and its conversion into appropriate letter grades
- whether any part/whole of a question has been left unevaluated inadvertently
- correctness of transcription of marks on the tabulation sheet and the grade sheet issued in respect of the course
under scrutiny.

8.15.4 Re-evaluation: Re-evaluation of the answer script by independent experts in the concerned subject(s).

8.15.5 Application for re-examining of answer scripts

- A student may apply for scrutiny or re-evaluation for one or more courses of the just-concluded end-semester examinations within seven calendar days from the date of publication of its results in the application form prescribed for this purpose.
- He/she shall pay the prescribed fee to the University as notified.
- A student applying for scrutiny/re-evaluation shall expressly state on the application form whether the application made is for Scrutiny or for Re-evaluation. In each case, the student may also request to see his/her answer script.
- All applications for scrutiny/re-evaluation must be routed through the Director of the concerned School.

8.15.6 If in the process of re-examining, the grade obtained in a course changes, the better of the two grades shall be assigned to the course. If there is a change, the new grade shall be recorded and a new grade sheet shall be issued to the student.

8.15.7 Without prejudice to any of the clauses of section 8.15, a student who has been found to have used unfair means during an examination shall not be eligible to apply for scrutiny or re-evaluation of answer scripts.

8.16 Repeat Examination: The University shall conduct repeat examination for those with F grade at a different time slot, as set down in the Academic Calendar or as notified. Such students should register for these examinations.

8.17 Improvement Examination

8.17.1 The University shall conduct Special Examinations to benefit the following categories of students:

- Students who, on the completion of the final semester, have some ‘F’ graded courses in the two final semesters, but no ‘F’ or ‘X’ graded courses in any of the previous semesters
- Students who have only one ‘F’ graded course in a semester other than the two final semesters and do not have ‘F’ or ‘X’ graded courses in the two final semesters.

8.17.2 The Special Examinations shall ordinarily be conducted each year within a month of the declaration of the results of the Spring Semester.

8.17.3 Students who fail to secure 50% of the credits offered in the final semester shall not be eligible to appear for the special examinations. Such students will be governed by the provisions of clause 10.5 of these regulations. However, this restriction shall not apply in the case of students who are unable to appear in the end semester examinations due to exceptional situations like their own serious illness and hospitalisation or death of members of the inner family circle (restricted to only father, mother, siblings).

8.17.4 After the improvement examination, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.17.5 If the student improves his/her grades through the improvement examination, new grade sheets and comprehensive transcripts shall be issued to the student.

8.18 Special Examination

8.18.1 The University shall conduct Special Examinations to benefit the following categories of students:

<table>
<thead>
<tr>
<th>Programme</th>
<th>Number of Courses for Improvement Examinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Autumn Semester</td>
</tr>
<tr>
<td>BTECH</td>
<td>6</td>
</tr>
<tr>
<td>BCA</td>
<td>4</td>
</tr>
<tr>
<td>BCOM</td>
<td>4</td>
</tr>
<tr>
<td>BBA</td>
<td>4</td>
</tr>
<tr>
<td>BA</td>
<td>4</td>
</tr>
<tr>
<td>BSc</td>
<td>4</td>
</tr>
</tbody>
</table>

8.18.2 The Special Examinations shall ordinarily be conducted each year within a month of the declaration of the results of the Spring Semester.

8.18.3 Students who fail to secure 50% of the credits offered in the final semester shall not be eligible to appear for the special examinations. Such students will be governed by the provisions of clause 10.5 of these regulations. However, this restriction shall not apply in the case of students who are unable to appear in the end semester examinations due to exceptional situations like their own serious illness and hospitalisation or death of members of the inner family circle (restricted to only father, mother, siblings).

8.18.4 After the improvement examination, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.18.5 If the student improves his/her grades through the improvement examination, new grade sheets and comprehensive transcripts shall be issued to the student.

8.18.6 The Special Examinations shall be conducted as per the guidelines provided by the University.
Programme.
8.17.5 Students who do not obtain pass grades in any course at the special examinations shall have to apply in the prescribed format and appear for the end-semester examination of these courses when they are scheduled by the University during subsequent relevant end-semester examinations.

9.0 Change of Branch (only for BTECH)
9.1 Normally a student admitted to a particular branch of the BTECH programme shall continue studying in that branch till completion. However, in special cases the university may permit a student to change from one branch of studies to another after the first two semesters.
9.2 Students shall be allowed a change in branch subject to the limitation that the strength of a branch should not fall below the existing strength by more than ten percent and should not go above the sanctioned strength by more than ten percent.
9.3 Only those students shall be eligible for consideration of a change of branch, who have completed all the credits required in the first two semesters of their studies, in their first attempt.
9.4 Applications for a change of branch must be made by intending eligible students in the prescribed form. The Office of the Registrar shall call for applications at the beginning of the third semester and the completed forms must be submitted by the last date specified in the notification.
9.5 Students may enlist up to two choices of branch, in order of preference, to which they wish to change over. It shall not be permissible to alter the choice after the application has been submitted.
9.6 Change of branch shall be made strictly in order of merit of the applicants. For this purpose the CGPA obtained at the end of the second semester shall be considered. In case of a tie, the following shall be considered in the given order: the SGPA of the second semester, the SGPA of the first semester, grades obtained by the applicants in the courses of the second semester in an order to be determined by the Office of the Registrar.
9.7 A committee consisting of the Director and heads of departments of the concerned School, chaired by the Registrar shall examine the applications and consider them on the basis of the criteria laid out above.
9.8 The details of branch changes effected shall be notified to the students by the Registrar, within 7 days of the submission of applications.
9.9 All changes of branch shall be final and binding on the applicants. No student shall be permitted, under any circumstance, to refuse the change of branch offered.
9.10 All changes of branch made in accordance with the above rules shall be effective from the third semester of the applicants concerned. No change of branch shall be permitted after this.

10.0 Enrolment (for semesters other than the first)
10.1 Every student is required to enrol for the relevant courses before the commencement of each semester within the dates fixed for such enrolment and notified by the Registrar.
10.2 Students who do not enrol within the dates announced for the purpose may be permitted late enrolment up to the notified date on payment of a late fee.
10.3 Only those students shall be permitted to enrol who have
   • cleared all University, Departmental, Hostel and Library dues and fines (if any) of the previous semester,
   • paid all required University, Departmental and Hostel fees for the current semester, and
   • not been debarred from enrolling on any specific ground.
10.4 No student may enrol for a semester if he/she has not appeared, for whatever reason, in the end semester examinations of the previous semester.
10.5 A student who fails to obtain 50% of the credits offered in the third and subsequent semesters shall not be permitted to enrol for the next semester and shall have to re-enrol for and attend all the courses of the said semester in the following academic year. Students who due to X grade (lack of due attendance) have been debarred from exams in any semester (including first and second) will have to re-enrol for the same.

11.0 Eligibility for the Award of the Graduate Degree
11.1 A student shall be declared to be eligible for the award of the Graduate Degree for which he/she has enrolled if he/she has
   11.1.1 completed all the credit requirements for the degree with grade ‘C’ or higher grade in each of the mandatory graded courses and grade ‘P’ in all mandatory non-graded courses;
   11.1.2 satisfactorily completed all the non-credit requirements for the degree viz., Extra Academic Activities, Industry Training, Field Work, Internship Programme, etc. (if any);
   11.1.3 obtained a CGPA of 5.00 or more at the end of the semester in which he/she completes all the requirements for the degree;
   11.1.4 owes no dues to the University, School, Department, Hostels; and
   11.1.5 has no disciplinary action pending against him/her.
11.2 The award of the Graduate Degree must be recommended by the Academic Council and approved by the Board of Management of the University.

12.0 Termination from the Programme
12.1 If more than the number of years permitted for the completion of a programme have elapsed since the student was admitted, and the student has not become eligible for the award of Degree, the student shall be removed from the programme.
12.2 A student may also be required to leave the Programme on disciplinary grounds on the recommendations of the Students’ Disciplinary Committee of the concerned School.
ASSAM DON BOSCO UNIVERSITY REGULATIONS
POST GRADUATE DEGREE PROGRAMMES
SCIENCE AND TECHNOLOGY

The following are the regulations of the Assam Don Bosco University concerning the Post-Graduate Programmes leading to the award of the Master’s Degree in the disciplines of Science and Technology made subject to the provisions of its Statutes and Ordinances.

1.0 Academic Calendar
1.1 Each academic year is divided into two semesters of approximately 18 weeks duration: an Autumn Semester (July – December) and a Spring Semester (January – June). The Autumn Semester shall ordinarily begin in July for students already on the rolls and the Spring Semester shall ordinarily begin in January. However, the first semester (Autumn, for newly admitted students) may begin later depending on the completion of admission formalities.

1.2 The schedule of academic activities approved by the Academic Council for each semester, inclusive of the schedule of continuing evaluation for the semester, dates for the conduct of end-semester examinations, the schedule of publication of results, etc., shall be laid down in the Academic Calendar for the semester.

2.0 Duration of the Programme
2.1 The normal duration of the Post Graduate Programme shall be as per the table given below:

<table>
<thead>
<tr>
<th>Programme</th>
<th>Number of Semesters</th>
<th>Number of Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master of Technology (MTECH)</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Master of Computer Applications (MCA)</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Master of Science (MSc)</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

2.2 However, students who do not fulfill some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to 4 more semesters (2 years) to complete all the requirements of the degree.

2.3 Under exceptional circumstances and depending on the merit of each case, a period of 2 more semesters (1 year) may be allowed for the completion of the programme.

3.0 Course Structure
3.1 The University follows Outcome Based Education with Choice Based Credit System (CBCS) for all the Post Graduate Degree Programmes. One credit is equivalent to 15 hours of lecture/tutorial or 30 hours of practical. The courses offered for the Post Graduate Degree Programmes are divided into two baskets – Core Courses and Elective Courses.

3.2 Core Courses: Core courses are those in the curriculum, the knowledge of which is deemed essential for students who are pursuing the said Post Graduate Degree Programme.

3.2.1 A student shall be required to take all the core courses offered for a particular programme.

3.2.2 The number of credits required from core courses shall be as prescribed by the competent academic authority.

3.3. Elective Courses: These are courses in the curriculum which give the student opportunities for specialization and which cater to his/her interests and career goals. These courses may be selected by the student and/or offered by the department conducting the programme, from those listed in the curriculum according to the norms laid down by the competent academic authority.

3.3.1 The number of credits which may be acquired through elective courses shall be prescribed by the competent academic authority.

3.3.2 It shall be the prerogative of the department not to offer an elective course which has less than 5 students opting for it.

The schema of categorisation of courses into baskets is as given below:

<table>
<thead>
<tr>
<th>Core Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departmental Core (DC)</td>
</tr>
<tr>
<td>Core courses which are offered by the department conducting the programme</td>
</tr>
<tr>
<td>School Core (SC)</td>
</tr>
<tr>
<td>Core courses which are offered by a department other than the department conducting the programme, from within the same School</td>
</tr>
</tbody>
</table>
Institutional Core (IC)  
Core courses which are offered by departments of the University from Schools other than the parent School

<table>
<thead>
<tr>
<th>Elective Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departmental Elective (DE)</td>
</tr>
<tr>
<td>Elective courses which are offered by the department conducting the programme</td>
</tr>
<tr>
<td>School Elective (SE)</td>
</tr>
<tr>
<td>Elective courses which are offered by a department other than the department conducting the programme, from within the same School</td>
</tr>
<tr>
<td>Institutional Elective (IE)</td>
</tr>
<tr>
<td>Elective courses which are offered by departments of the University from Schools others than the parent School</td>
</tr>
</tbody>
</table>

*UGC Equivalent Courses* - Core Paper (DC), Ability Enhancement Compulsory Course (IC/SC), Skill Enhancement Course (IE), General Elective (IE/SE), Discipline Specific Elective (DE)

*AICTE Equivalent Courses* - Basic Science Course (IC), Engineering Science Course (IC), Open Elective Course (IC), Humanities and Social Science Courses (IC), Mandatory Course (IC), Professional Core Course (DC), Professional Elective Course (DE)

3.6 In order to qualify for a Post Graduate Degree, a student is required to complete the minimum credit requirements as prescribed by the competent academic authority.

3.7 In addition to the prescribed credit requirement, a student shall have to complete Institutional mandatory courses with Pass grade, as prescribed by the competent academic authority, from time to time, which shall be recorded in the Grade sheet but not taken into account for computing the SGPA and the CGPA.

3.8 Audit Course: Students who secure a CGPA of at least 8 at the end of the first may opt to take one audit course per semester from any Department from the second semester onwards, provided the course teacher permits the auditing of the course. This shall be done under the guidance of the Departmental Faculty Advisor/mentor. The student is free to participate in the evaluation process for such courses. However, an attendance of 75% is necessary for obtaining a P grade for such courses. When auditing courses offered by other departments, it shall be the responsibility of the student to attend such courses without missing courses of one’s own department and semester.

3.9 In addition, students may also opt for additional elective courses in consultation with their mentors. Students are required to participate in the evaluation process of such courses. The grades obtained for such courses shall be recorded in the grade sheet, but not taken into account for computing SGPA and CGPA.

3.10 It shall be the prerogative of the department to not offer an elective course which has less than 5 students opting for it.

3.11 The medium of instruction shall be English and examinations and project reports shall be in English.

3.12 The course structure and syllabi of the Post Graduate Degree Programmes shall be approved by the Academic Council of the University. Departmental Boards of Studies (DBOS) shall discuss and recommend the syllabi of all the courses offered by the department from time to time before forwarding the same to the School Board of Studies (SBOS). The SBOS shall consider the proposals from the departments and make recommendations to the Academic Council for consideration and approval.

3.13 The curriculum may include industry training and/or fieldwork for a specified time. This is to be satisfactorily completed before a student is declared eligible for the degree. There shall be credit allocation for such industrial training or fieldwork. Normally these activities shall be arranged during convenient semester breaks as shall be determined by the School Board of Studies.

3.14 Faculty Advisor/Mentor: A faculty advisor/mentor (and a co-mentor to perform the duties of a mentor during the absence of the mentor) shall be assigned for groups of students. Faculty advisors/mentors shall help their mentees to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them.

4.0 Admission

4.1 All admissions to the Post Graduate Degree Programmes of the University shall be on the basis of merit. There may, however, be provision for direct admission for a limited number of NRI/FN students.

4.2 Eligibility Criteria

4.2.1 To be considered for admission to a Post Graduate Degree Programme a candidate should have passed a Bachelor’s Degree (or equivalent) programme of a recognised university securing grades/marks as specified in the table below.

4.2.2 Admission will be on the basis of the performance of the candidate at the graduate level, the Post Graduate Entrance Test conducted by the university and/or a personal interview. Candidates for MTECH who have a valid
GATE score may be exempted from the entrance test.

<table>
<thead>
<tr>
<th>Programme</th>
<th>Grade / Marks requirement from qualifying examinations</th>
<th>Entrance Examinations / Personal Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTECH</td>
<td>Completed a Bachelor’s Degree programme in the appropriate stream of technology from a recognised university successfully with a minimum CGPA of 6.5 (or equivalent). The Academic Council may establish other eligibility criteria for M Tech in a particular discipline.</td>
<td>Post Graduate Entrance Test of Assam Don Bosco University</td>
</tr>
<tr>
<td>MCA</td>
<td>Completed a Bachelor’s Degree programme in any stream of a recognised university successfully with a minimum of 50% marks in the aggregate. In addition, the candidate must have passed Mathematics or equivalent at the higher secondary level or above.</td>
<td>Post Graduate Entrance Test of Assam Don Bosco University</td>
</tr>
<tr>
<td>MSc</td>
<td>Completed a Bachelor’s Degree programme in Science of a recognised university successfully with a minimum aggregate, specified by the competent academic body.</td>
<td>Satisfactory performance in the Personal Interview</td>
</tr>
</tbody>
</table>

4.3 Reservation of seats for the programme shall be as per the guidelines laid out in the Statutes of the University.

4.4 Admissions shall ordinarily close after a specified period from the date of commencement of the first semester, through a notification. However, in exceptional cases, admission of a candidate after the last date may be recommended to the University with justification, by the School / Departments concerned. Under such an event, this period shall not exceed four weeks from the date of commencement of the first semester.

4.4.1 The attendance of such students shall be computed from the date of admission.

4.4.2 Such students may be offered the opportunity of taking part in in-semester assessment modules which may have already been completed.

4.5 All candidates shall be required to satisfy the norms prescribed by the University for medical fitness prior to admission.

4.6 Candidates may be required to furnish a certificate of good conduct from the institution last attended.

4.7 Bridge Courses: The Departments shall make provision for Bridge Courses to facilitate admission of students from varied backgrounds to a programme of their choice.

4.8 Value-added Courses: Each department shall offer value-added courses, which are optional. Certificates will be awarded to those who successfully complete the course.

5.0 University Registration

5.1 Candidates shall have to register as bona-fide students with the University as per the University regulations within a period specified by the University, by a formal application routed through the Director of the School concerned.

6.0 Attendance

6.1 To be permitted to appear for the end-semester examination of a particular course, a student is required to have a minimum attendance of 75% for that course.

6.2 Deficiency in attendance up to 10% may be condoned by the Director of the School in the case of leave taken for medical and other grievous reasons, which are supported by valid medical certificates and other requisite documents.

6.3 Some students, due to exceptional situations like their own serious sickness and hospitalization or death of members of inner family circle (restricted to only father, mother, siblings), may have attendance below 65%. Such students may be given bonus attendance percentage for a particular course based on his/her attendance for that course during the remaining days of the current semester, as given in the following table:

<table>
<thead>
<tr>
<th>Attendance during the remaining days of the current semester</th>
<th>Bonus percentage available in the current semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>95% or more</td>
<td>5</td>
</tr>
<tr>
<td>90% or more but less than 95%</td>
<td>4</td>
</tr>
<tr>
<td>85% or more but less than 90%</td>
<td>3</td>
</tr>
<tr>
<td>80% or more but less than 85%</td>
<td>2</td>
</tr>
<tr>
<td>75% or more but less than 80%</td>
<td>1</td>
</tr>
</tbody>
</table>

They shall be permitted to appear for the end-semester examination of the course if, on the strength of this bonus attendance
percentage, they obtain 65% attendance for that course.

6.4 If the sum of the credits of the courses for which a student is unable to appear at the end- semester examinations exceeds 50% of the total credits allotted for the semester, he/she shall not be permitted to appear for the entire end-semester examinations in view of clause 9.5 of these Regulations.

6.5 The School may propose to set aside a certain portion of the in-semester assessment marks for attendance. The number of marks and modalities of their allotment shall be made known to the students at the beginning of each semester.

6.6 Leave

6.6.1 Any absence from classes should be with prior sanctioned leave. The application for leave shall be submitted to the office of the Director of the concerned School on prescribed forms, through proper channels, stating fully the reasons for the leave requested along with supporting documents.

6.6.2 In case of emergency such as sickness, bereavement or any other unavoidable reason for which prior application could not be made, the parent or guardian must promptly inform the office of the Director of the concerned School.

6.6.3 If the period of absence is likely to exceed 10 days, a prior application for grant of leave shall have to be submitted through the Director of the concerned School to the Registrar of the University with supporting documents in each case; the decision to grant leave shall be taken by the Registrar on the recommendation of the Director of the concerned School.

6.6.4 The Registrar may, on receipt of an application, also decide whether the student be asked to withdraw from the programme for that particular semester because of long absence.

6.7 It shall be the responsibility of the student to intimate the concerned teachers regarding his/her absence before availing the leave.

7.0 Grading System

7.1 Three types of courses are offered in the Post Graduate programmes:

- **Graded courses**: For the majority of the courses, students shall be assessed and given grades.
- **Pass/No-Pass courses**: There are some courses for which the students are expected to obtain a P grade to be eligible for the degree.
- **Audit Courses**: A third category of courses are audit courses. These are optional. However, students who opt for these courses must have the required attendance to obtain a P grade in the course.

7.2 Based on the performance of a student, each student is awarded a final letter grade in each graded course at the end of the semester and the letter grade is converted into a grade point. The correspondence between percentage marks, letter grades and grade points is given in the table below:

<table>
<thead>
<tr>
<th>Marks [x] obtained (%)</th>
<th>Grade</th>
<th>Description</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 ≤ x ≤ 100</td>
<td>O</td>
<td>Outstanding</td>
<td>10</td>
</tr>
<tr>
<td>80 ≤ x &lt; 90</td>
<td>E</td>
<td>Excellent</td>
<td>9</td>
</tr>
<tr>
<td>70 ≤ x &lt; 80</td>
<td>A+</td>
<td>Very Good</td>
<td>8</td>
</tr>
<tr>
<td>60 ≤ x &lt; 70</td>
<td>A</td>
<td>Good</td>
<td>7</td>
</tr>
<tr>
<td>50 ≤ x &lt; 60</td>
<td>B</td>
<td>Average</td>
<td>6</td>
</tr>
<tr>
<td>40 ≤ x &lt; 50</td>
<td>C</td>
<td>Below Average</td>
<td>5</td>
</tr>
<tr>
<td>x &lt; 40</td>
<td>F</td>
<td>Failed</td>
<td>0</td>
</tr>
</tbody>
</table>

In addition, a student may be assigned the grades ‘P’ and ‘NP’ for pass marks and non- passing marks respectively, for Pass/No-pass courses, or the grade ‘X’ (not permitted).

7.2.1 A student shall be assigned the letter grade ‘X’ for a course if he/she is not permitted to appear for the end semester examination of that course due to lack of requisite attendance.

7.2.2 A letter grade ‘F’, ‘NP’ or ‘X’ in any course implies failure in that course.

7.2.3 A student is considered to have completed a course successfully and earned the credits if she/he secures a letter grade other than ‘F’, ‘NP’, or ‘X’.

7.3 At the end of each semester, the following measures of the performance of a student in the semester and in the programme up to that semester shall be computed and made known to the student together with the grades obtained by the student in each course:

7.3.1 The Semester Grade Point Average (SGPA): From the grades obtained by a student in the courses of a semester, the
SGPA shall be calculated using the following formula:

\[ SGPA = \frac{\sum_{i=1}^{n} GP_i \times NC_i}{\sum_{i=1}^{n} NC_i} \]

Where  
- \( GP_i \) = Grade points earned in the \( i^{th} \) course
- \( NC_i \) = Number of credits for the \( i^{th} \) course
- \( n \) = the number of courses in the semester

7.3.2 The Cumulative Grade Point Average (CGPA): From the SGPA obtained by a student in the completed semesters, the CGPA shall be calculated using the following formula:

\[ CGPA = \frac{\sum_{i=1}^{n} SGP_i \times NSC_i}{\sum_{i=1}^{n} NSC_i} \]

Where  
- \( SGP_i \) = Semester Grade point of the \( i^{th} \) semester
- \( NSC_i \) = Number of credits for the \( i^{th} \) semester
- \( n \) = the number of semesters completed

7.3.3 The CGPA may be converted into a percentage by multiplying CGPA by 10.

7.4 Both the SGPA and CGPA shall be rounded off to the second place of decimal and recorded as such. Whenever these CGPA are to be used for official purposes, only the rounded off values shall be used.

7.5 There are academic and non-academic requirements for the Graduate programmes where a student shall be awarded the ‘P’ and ‘NP’ grades. Non-credit courses such as Extra Academic Programmes belong to this category. No grade points are associated with these grades and these courses are not taken into account in the calculation of the SGPA or CGPA. However, the award of the degree is subject to obtaining a ‘P’ grade in all such courses.

7.6 In the case of an audit course, the letters “AU” shall be written alongside the course name in the Grade Sheet. A student is not required to register again for passing failed audit courses.

8.0 Assessment of Performance

8.1 A student’s performance is evaluated through a continuous system of evaluation comprising tests, quizzes, assignments, seminars, minor projects, major projects and end-semester examinations.

8.2 Theory Courses: Theory courses shall have two components of evaluation – in-semester assessment of 40% weightage and an end-semester examination having 60% weightage.

8.2.1 The modalities of the conduct of in-semester assessment and weightages attached to its various components shall be as published by the School/Department at the beginning of each semester.

8.3 Lab Courses: Lab courses (Laboratory, Drawing, Workshop, etc.) shall be evaluated on the basis of attendance, assessment of tasks assigned and end-semester test/viva voce. The weightage assigned for these components of the evaluation is given in the following table:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of Tasks Assigned</td>
<td>40</td>
</tr>
<tr>
<td>End-semester test / Viva voce</td>
<td>60</td>
</tr>
</tbody>
</table>

8.3.1 The modalities of the conduct of evaluation under the heading “Assessment of tasks assigned”, its components and the weightages attached to its various components shall be published by the department concerned at the beginning of each semester.

8.3.2 The evaluation of the end-semester test for a lab course may be done on the basis of criteria and weightage to be specified in the question paper, among which are included

- Organisation of the program/experiment
- Coding, freedom from logical and syntactical errors, and accuracy of the result obtained / conduct of the experiment assigned and accuracy of the result
- Extent of completion
- A comprehensive viva-voce which examines the overall grasp of the subject

8.4 End-Semester examinations

8.4.1 End-semeter examinations for the theory courses, generally of three hours’ duration, shall be conducted by the
University. The Director of the concerned school shall make the arrangements necessary for holding the examinations.

8.4.2 In the end-semester examinations, a student shall be examined on the entire syllabus of the courses.

8.4.3 A student shall not obtain a pass grade for a course without appearing for the end-semester examination in that course.

8.5 Research Seminar

8.5.1 During the course of the Post Graduate programme students may be required to conduct research seminars on a regular basis. The purpose of these research seminars is to encourage the students to conduct literature survey on the recent trends and developments in a chosen area of the discipline.

8.5.2 The literature survey conducted in preparation for these seminars may lead the students to the development of a project model to be executed during the final semesters of the programme.

8.5.3 The Research Seminars shall be evaluated on the basis of a presentation, a report and a viva voce examination.

8.6 The Major Project / Research Project / Dissertation

8.6.1 Students of the Post Graduate Programme shall undertake a Major Project / Research Project / Dissertation during the course of their Post Graduate studies. The Major Project / Research Project / Dissertation (to be referred to as Major Project henceforth) is normally conducted in two phases during the last two semesters of the programme.

8.6.2 The Major Project may be a software project, a research oriented project or research work which leads to a dissertation, as may be relevant to the discipline in which the work is undertaken. If it is a research oriented work, it should expose the students to the current state of research in a chosen area of the discipline and lead to new developments in the area.

8.6.3 The Major Project is to be undertaken individually in the campus or outside as may be specified by the department.

8.6.4 Each department shall constitute a Departmental Project Evaluation Committee (DPEC) consisting of the Director of the School (Chairperson), Head of the Department (Vice Chairperson), Project Co-ordinator and two senior teachers from the department, with the Project Co-ordinator as the convenor. The DPEC shall co-ordinate the conduct and assessment of the project.

8.6.4.1 The DPEC will notify the schedule and modalities for the following stages in the implementation of the project.

- Submission of the topic of the project.
- Notification for assignment of project supervisors.
- Submission of the synopsis
- Schedule for the seminar presentation of synopsis.
- Schedule for Progress Seminars, submission of progress reports and viva voce examination.
- Date for the submission of the project report and a brief summary.
- Dates for the end semester evaluation of the project.

8.6.5 The DPEC may ask a student to resubmit a synopsis if the same does not get its approval.

8.6.6 The project supervisor may be from outside the department or university. Such a supervisor should be approved by the DPEC and jointly supervise a project with a faculty member of the department.

8.6.7 The minimum qualification of a project supervisor shall be laid down by the DPEC in consultation with the Director of the School and authorities of the University.

8.6.8 The Chairperson of the DPEC will submit to the Controller of Examinations a panel of at least three names of external examiners at least three weeks before the end semester examination. The Controller of Examinations will appoint the external examiner(s) from this panel.

8.6.9 Each student shall submit to the DPEC four bound, printed copies of the project report, prepared according to the prescribed format made available, by the due date. The student will submit also three copies of a brief summary of the project that will be forwarded to the concerned examiners.

8.6.10 The DPEC will make the arrangements necessary to conduct the end semester evaluation in consultation with the examiners appointed by the University, during the dates notified.

8.6.11 The project will be evaluated through in-semester and end-semester assessments of equal weightage. The in-semester assessment will be done by the DPEC and the project supervisor. The end-semester assessment will be done by the external examiner(s), the project supervisor and a member of the DPEC appointed by it for the purpose. The weightages attached to their respective evaluations shall be 60:20:20.

8.6.12 The DPEC will forward the in-semester assessment marks to the Controller of Examinations by the date
8.6.13 Given below are the suggested components of Internal assessment and respective marks assigned:
- Synopsis: 15 marks
- Seminar presentation of the synopsis: 15 marks
- Project implementation: 40 marks
- Pre-submission presentation: 15 marks
- Pre-submission viva voce: 15 marks

8.6.14 Given below are the suggested components of External assessment and respective marks assigned:
- Project implementation: 40 marks
- Seminar presentation: 25 marks
- Viva voce examination: 20 marks
- Project documentation: 15 marks

8.6.15 Publication of papers and registering of patents are encouraged during the Post Graduate programme. Papers published or patents obtained may be awarded extra weightage during the evaluation of the project.

8.6.16 Those who obtain an ‘F’ grade for the major project will be required to re-enrol for it in the subsequent semester and pay the prescribed fees.

8.7 The Director will forward the marks obtained in the in-semester evaluation to the Controller of Examinations within the prescribed time as may be notified.

8.8 All evaluated work in a subject except the end semester answer scripts will be returned to the students promptly.

8.9 Eligibility for appearing in the end-semester examinations: A student shall be permitted to appear for the end-semester examinations, provided that
- A student has not been debarred from appearing in the end semester examinations as disciplinary action for serious breach of conduct.
- He/she has satisfactory attendance during the semester according to the norms laid out in section 6 of these regulations.
- He/she has paid the prescribed fees or any other dues of the university within the date specified.

8.10 Registration for end-semester Examinations
8.10.1 The University shall, through a notification, invite applications from students to register for the end-semester examinations.
8.10.2 Students who have registered with the University (vide clause 5) and those who have applied for such registration may apply to appear for the end-semester examinations of the university, in response to the notification issued by the University, provided that they fulfil the eligibility norms as laid down in clause 8.9.
8.10.3 All eligible candidates shall be issued an admit card for the relevant examination and for specified courses. A student who does not have a valid admit card may not be permitted to write the end-semester examinations.
8.10.4 A student who secures an ‘F’ or ‘X’ grade in any course in a semester may register for the end-semester examination for that course in a subsequent semester when that course is offered again, within the maximum period of time allotted for the completion of the programme. The in-semester assessment marks obtained by him/her in the last semester in which the said course was attended by him/her shall be retained.
8.10.5 Similarly, in case of an ‘NP’ grade in Extra Academic Programmes the student shall have to re-register for it in the appropriate semester of the next academic session.
8.10.6 When a student re-registers for the end semester examination of a course, in accordance with clause 8.10.4 above, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.11 Conduct of Examinations: The University shall conduct the end-semester examinations in accordance with the applicable regulations on such dates as are set down in the Academic Calendar or as notified.

8.12 Declaration of Results: The University shall declare the results of a semester and make available to students their grade sheets within the time-frame prescribed by the relevant regulations of the university and specified in the academic calendar.

8.13 The University may withhold the results of a student for any or all of the following reasons
- he/she has not paid his/her dues
- there is a disciplinary action pending against him/her
- he/she has not completed the formalities for University Registration according to the requirement of section 5 of
8.14 Re-examining of answer scripts

8.14.1 If a student feels that the grade awarded to him/her in a course is not correct, he/she may apply to the University for the re-examining of his/her answer script.

8.14.2 Re-examining of scripts may be of two different categories – scrutiny and re-evaluation.

8.14.3 Scrutiny: The activities under this category shall ordinarily be confined to checking

• correctness of the total marks awarded and its conversion into appropriate letter grades
• whether any part/whole of a question has been left unevaluated inadvertently
• correctness of transcription of marks on the tabulation sheet and the gradesheet issued in respect of the course under scrutiny.

8.14.4 Re-evaluation: Re-evaluation of the answer script by independent experts in the concerned subject(s).

8.14.5 Application for re-examining of answer scripts

• A student may apply for scrutiny or re-evaluation for one or more courses of the just-concluded end-semester examinations within seven calendar days from the date of publication of its results in the application form prescribed for this purpose.
• He/she shall pay the prescribed fee to the University as notified.
• A student applying for scrutiny/re-evaluation shall expressly state on the application form whether the application made is for Scrutiny or for Re-evaluation. In each case, the student may also request to see his/her answer script.
• All applications for scrutiny/re-evaluation must be routed through the Director of the concerned School.

8.14.6 If in the process of re-examining, the grade obtained in a course changes, the better of the two grades shall be assigned to the course. If there is a change, the new grade shall be recorded and a new grade sheet shall be issued to the student.

8.14.7 Without prejudice to any of the clauses of section 8.14, a student who has been found to have used unfair means during an examination shall not be eligible to apply for scrutiny or re-evaluation of answer scripts.

8.15 Repeat Examination: The University shall conduct repeat examination for those with F grade at a different time slot, as set down in the Academic Calendar or as notified. Such students should register for these examinations.

8.16 Improvement Examination

8.16.1 After the completion of the entire programme of study, a student may be allowed the provision of improvement examinations. These are to be availed of only once each in the Autumn and Spring semesters that immediately follow the completion of the programme, and within the maximum number of years permissible for a programme.

8.16.2 A student who has taken migration from the University shall not be eligible to appear for Improvement Examination.

8.16.3 A student may not choose more than the number of courses specified in the table below for improvement examinations.

<table>
<thead>
<tr>
<th>Programme</th>
<th>Number of Courses for Improvement Examinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Autumn Semester</td>
</tr>
<tr>
<td>MCA</td>
<td>3</td>
</tr>
<tr>
<td>MSc</td>
<td>3</td>
</tr>
<tr>
<td>MTECH</td>
<td>2</td>
</tr>
</tbody>
</table>

8.16.4 After the improvement examination, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.16.5 If the student improves his/her grades through the improvement examination, new grade sheets and comprehensive transcripts shall be issued to the student.

8.17 Special Examination

8.17.1 The University shall conduct Special Examinations to benefit the following categories of students:

8.17.1.1 Students who, on the completion of the final semester, have some ‘F’ graded courses in the two final semesters, but no ‘F’ or ‘X’ graded courses in any of the previous semesters

8.17.1.2 Students who have only one ‘F’ graded course in a semester other than the two final semesters and do not have ‘F’ or ‘X’ graded courses in the two final semesters.

8.17.2 The Special Examinations shall ordinarily be conducted each year within a month of the declaration of the results of
the Spring Semester.

8.17.3 Students who fail to secure 50% of the credits offered in the final semester shall not be eligible to appear for the special examinations. Such students will be governed by the provisions of clause 9.5 of these regulations. However, this restriction shall not apply in the case of students who are unable to appear in the end semester examinations due to exceptional situations like their own serious illness and hospitalisation or death of members of inner family circle (restricted to only father, mother, siblings).

8.17.4 Students who have 'X' graded courses only in the last two semesters may be offered the opportunity for participating in a Tutorial Programme which may be conducted during the semester break immediately following the end-semester examinations of the final semester and students who earn 85% attendance for the programme shall be permitted to appear for the Special Examinations. Separate fees shall be charged for the Tutorial Programme.

8.17.5 Students who do not obtain pass grades in any course at the special examinations shall have to apply in the prescribed format and appear for the end-semester examination of these courses when they are scheduled by the University during subsequent relevant end-semester examinations.

9.0 Enrolment (for semesters other than the first)
9.1 Every student is required to enrol for the relevant courses before the commencement of each semester within the dates fixed for such enrolment and notified by the Registrar.
9.2 Students who do not enrol within the dates announced for the purpose may be permitted late enrolment up to the notified date on payment of a late fee.
9.3 Only those students shall be permitted to enrol who have
   ● cleared all University, Departmental, Hostel and Library dues and fines (if any) of the previous semester,
   ● paid all required University, Departmental and Hostel fees for the current semester, and
   ● not been debarred from enrolling on any specific ground.
9.4 No student may enrol for a semester if he/she has not appeared, for whatever reason, in the end semester examinations of the previous semester.
9.5 A student who fails to obtain 50% of the credits offered in the third and subsequent semesters shall not be permitted to enrol for the next semester and shall have to re-enrol for and attend all the courses of the said semester in the following academic year. Students who due to X grade (lack of due attendance) have been debarred from exams in any semester (including first and second) will have to re-enrol for the same.

10.0 Eligibility for the Award of the Post Graduate Degree
10.1 A student shall be declared to be eligible for the award of the Post Graduate Degree for which he/she has enrolled if he/she has
   10.1.1 completed all the credit requirements for the degree with grade ‘C’ or higher grade in each of the mandatory graded courses and grade ‘P’ in all mandatory non-graded courses.
   10.1.2 satisfactorily completed all the non-credit requirements for the degree viz., Extra Academic Activities, Industry Training, field work, internship programme, etc. (if any);
   10.1.3 obtained a CGPA of 5.00 or more at the end of the semester in which he/she completes all the requirements for the degree;
   10.1.4 owes no dues to the University, School, Department, Hostels; and
   10.1.5 has no disciplinary action pending against him/her.
10.2 The award of the Post Graduate Degree must be recommended by the Academic Council and approved by the Board of Management of the University.

11.0 Termination from the Programme
11.1 If more than the number of years permitted for the completion of a programme have elapsed since the student was admitted, and the student has not become eligible for the award of Degree, the student shall be removed from the programme.
11.2 A student may also be required to leave the Programme on disciplinary grounds on the recommendations of the Students’ Disciplinary Committee of the concerned School.
ASSAM DON BOSCO UNIVERSITY REGULATIONS

POST GRADUATE DEGREE PROGRAMMES

HUMANITIES AND SOCIAL SCIENCES & COMMERCE AND MANAGEMENT

The following are the regulations of the Assam Don Bosco University concerning the Post-Graduate Programmes leading to the award of the Master’s Degree in the disciplines of Humanities and Social Sciences & Commerce and Management made subject to the provisions of its Statutes and Ordinances:

The Master’s Degree Programmes of Assam Don Bosco University consist of theory and practicum components, taught and learned through a combination of lectures, field work/field visit and research projects.

1.0 Academic Calendar

1.1 Each academic year is divided into two semesters of approximately 18 weeks duration: an Autumn Semester (July – December) and a Spring Semester (January – June). The Autumn Semester shall ordinarily begin in July for students already on the rolls and the Spring Semester shall ordinarily begin in January. However, the first semester (Autumn, for newly admitted students) may begin later depending on the completion of admission formalities.

1.2 The schedule of academic activities approved by the Academic Council for each semester, inclusive of the schedule of continuing evaluation for the semester, dates for end-semester examinations, the schedule of publication of results, etc., shall be laid down in the Academic Calendar for the semester.

2.0 Duration of the Programme

2.1 The normal duration of the Post Graduate Programme in the disciplines of Humanities and Social Sciences & Commerce and Management shall be 4 semesters (2 years).

2.2 However, students who do not fulfil some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to 4 more semesters (2 years) to complete all the requirements of the degree.

2.3 Under exceptional circumstances and depending on the merit of each case, a period of 2 more semesters (1 year) may be allowed for the completion of the programme.

3.0 Course Structure

3.1 The choice based credit system shall be followed for the Masters Degree Programmes. Credits are allotted to the various courses depending on the number of hours of lecture/practicum/Field work assigned to them using the following general pattern:

3.1.1 Lecture: One hour per cycle/week is assigned 1 credit.

3.1.2 Practicum/fieldwork: Two hours per cycle/week is assigned 1 credit.

3.2 The courses are divided into two baskets – core courses and elective courses. (Core courses will include “Core Courses” and “Ability Enhancement Courses” mentioned in CBCS guidelines. Elective Courses will include “Discipline Specific Electives”, “Generic Electives”, optional “Dissertation or Project”, and “Skill Enhancement Courses”)

3.3 Core Courses: Core courses are those in the curriculum, the knowledge of which is deemed essential for students who are pursuing the programme.

3.3.1 A student shall be required to take all the core courses offered for a particular programme.

3.3.2 The number of credits required from core courses shall be as prescribed by the competent academic authority.

3.4 Elective Courses: These are courses in the curriculum which give the student opportunities for specialisation and which cater to his/her interests and career goals. These courses may selected by the student and/or offered by the department conducting the programme, from those listed in the curriculum according to the norms laid down by the competent academic authority.

3.4.1 The number of credits which may be acquired through elective courses shall be prescribed by the Board of studies pertaining to the programme.

3.5 These categories of courses may further be subdivided into departmental, school or institutional, depending on the department which offers the course. The schema of categorisation of courses into baskets is as given below:

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departmental Core (DC)</td>
<td>Core courses which are offered by the department which conducts the programme</td>
</tr>
<tr>
<td>School Core (SC)</td>
<td>Core courses which are offered by a department other than the department which conducts the programme, from within the same School</td>
</tr>
</tbody>
</table>
Institutional Core (IC) | Core courses which are offered by departments of the University from Schools other than the parent School

**Elective Courses**

Departmental Elective (DE) | Elective courses which are offered by the department which conducts the programme

School Elective (SE) | Elective courses which are offered by a department other than the department which conducts the programme, from within the same School

Institutional Elective (IE) | Elective courses which are offered by departments of the University from Schools other than the parent School

*UGC Equivalent Courses* - Core Paper (DC), Ability Enhancement Compulsory Course (IC/ SC), Skill Enhancement Course (IE), General Elective (IE/SE), Discipline Specific Elective (DE)

*AICTE Equivalent Courses* - Basic Science Course (IC), Engineering Science Course (IC), Open Elective Course (IC), Humanities and Social Science Courses (IC), Mandatory Course (IC), Professional Core Course (DC), Professional Elective Course (DE)

3.6 In order to qualify for a Master's Degree, a student is required to complete the credit requirement as prescribed in the curriculum.

3.7 In addition to the prescribed credit requirement, a student shall have to complete the requirements of Extra Academic Programmes (EAP) as may be prescribed by the Department. Students shall be awarded P/NP grades for the EAP, which shall be recorded in the Gradesheet, but not taken into account for computing the SGPA and the CGPA.

3.8 Students who secure a CGPA of at least 7.5 at the end of the 2nd semester may opt to take one audit course per semester from any Department from the 3rd semester onwards, provided the course teacher permits the auditing of the course. This shall be done under the guidance of the Departmental Faculty Advisor/mentor. The student is free to participate in the evaluation process for such courses. However, an attendance of 75% percentage is necessary for obtaining a P grade for such courses. When auditing courses offered by other departments, it shall be the responsibility of the student to attend such courses without missing courses of one’s own department and semester.

3.9 In addition, students may also opt for additional elective courses in consultation with their mentors. Students are required to participate in the evaluation process of such courses. The grades obtained for such courses shall be recorded in the gradesheet, but not taken into account for computing SGPA and CGPA.

3.10 It shall be the prerogative of the department to not offer an elective course which has less than 5 students opting for it.

3.11 The medium of instruction shall be English and examinations and project reports shall be in English.

3.12 The course structure and syllabi of the Post Graduate Degree Programmes shall be approved by the Academic Council of the University. Departmental Boards of Studies (DBOS) shall discuss and recommend the syllabi of all the courses offered by the department from time to time before forwarding the same to the School Board of Studies (SBOS). The SBOS shall consider the proposals from the departments and make recommendations to the Academic Council for consideration and approval.

3.13 The curriculum may include fieldwork / institutional visits / internship for a specified time. These are to be satisfactorily completed before a student is declared eligible for the degree. There shall be credit allocation for such activities. These activities may be arranged during the semester or during convenient semester breaks as shall be determined by the School Board of Studies.

3.14 Faculty Advisor/Mentor: A faculty advisor/mentor shall be assigned for groups of students. Faculty advisors/mentors shall help their mentees to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them.

**PROGRAMME SPECIFIC CURRICULAR ASPECTS**

4.0 MASTER OF SOCIAL WORK (MSW)

4.1 Area of Concentration: The third and fourth semesters shall have courses from a chosen Area of Concentration (AoC) from among those offered by the department. The AoC is to be opted for at the end of the second semester and will be confirmed by the department depending on the availability of seats and the aptitude and ability of the student. An AoC will be offered by the department only if a minimum of ten students opt for it. The fieldwork and research project of the third and fourth semesters will be based on the AoC.

4.2 Concurrent and Continuous Fieldwork
Fieldwork shall be an essential part of the course structure in all the semesters of the programme. The field work practice in the first semester shall consist of orientation visits, sessions for skills training and placement. In the first year, the focus of the field work shall be the community and in the second year the focus shall be based on the specialisation chosen by the students. In the first semester, students shall be placed in communities, NGOs, service organizations and government agencies working with communities, and in those settings where they can be exposed to the community and community issues. The students get a close feel of the community and community settings, understand the dynamics and issues in the community and become aware of the sensitivities of people while working with them. They also get a firsthand experience of the programmes and projects implemented in the communities by NGOs and government agencies and the impact that these have on the community. They shall also interact with the personnel from organisations and the community members to understand the tension between tradition and change that the communities in the region are likely to experience, and how it is handled. They shall, with the help of the organisation and the field work supervisor, identify an issue and work on it following the principles of community organization. The students are expected to be creative and innovative in assisting the agency and community in whatever way possible.

The field work practice in the second semester will consist of lab sessions for skills training and placement. The focus will be on the practice of social case work and Group works. The students shall be placed in NGOs, and government service organizations and government agencies working with individuals and families, and in those settings where they can be exposed to issues related to individuals and groups.

4.2.1 Normally a student shall spend fifteen hours over two days per week in field work. However, keeping in mind the peculiar situation of transport and communications in the region and the expenses involved, the field work practice may be arranged in other convenient ways as the institution deems fit.
4.2.2 The student is required to submit the report on the field work and the field work diary to the field work supervisor, before the commencement of classes on the first day of class following the field work days. The supervisor shall conduct regular field work conferences.
4.2.3 A student is expected to have 100 percent attendance in field work. Any shortage shall be compensated by him/her.
4.2.4 At the end of the semester the student shall submit a summary report of the field work for the semester and a viva voce examination shall be conducted.
4.2.5 The field work practice in the Third and Fourth Semesters shall focus upon the Area of Concentration chosen by the students. The students shall be placed in the field for twenty five days of consecutive field work. The field work settings shall be communities, NGOs, service organizations, hospitals, clinics and governmental agencies. Those students who are specializing in Community Development will either be placed in an urban or rural community setting that is identified by the Department. Students who are specializing in Medical and Psychiatric Social Work will be exposed to either a Medical or a Psychiatric setting.

4.3 Rural Camp

Students shall organise and participate in a rural camp during the first / second semester. The duration of the rural camp shall generally be ten days excluding days of travel.
4.3.1 The objectives of the rural camp are:
   • To apply the acquired skills of group work and community organisation in communities.
   • To understand and assess the problems faced by the rural population.
   • To involve oneself positively in the communities to help to remove some of these problems.
4.3.2 At the end of the camp each student shall submit a written report to the department in a specified format. Performance at the Rural Camp shall be considered for the evaluation of the Field Work during the second semester.
4.3.3 The Rural Camp shall be credited along with the fieldwork of the semester along with which it can be conveniently coupled.

4.4 Study Tour

During the programme the students shall undertake a study tour along with the assigned faculty members to a place approved by the department. The places are to be so chosen as to be of educational benefit to students. During the tour, the focus shall be on visiting and interacting with as many NGOs/ state/national/international organisations involved in developmental work as possible. A report of the learning outcomes shall be submitted to the department at the end of the tour. The Study Tour shall be a Pass/No Pass course.

4.5 Block Placement

After the examinations at the end of the fourth semester, the students shall be placed with an NGO or Agency for a period of not less than one month for practical experience and application of their skills. While the Block Fieldwork is not credited, it is mandatory for the completion of the MSW programme. The student shall contact an agency of his/her choice and get the choice of agency approved by the department. Students shall endeavour to choose an agency that is...
primarily in tune with their AoC and which has credentials in the concerned field. At the end of every week the student shall send a brief report to the supervisor and at the end of the Block Field Work period a summary report shall be submitted. The summary report shall contain a short description of the Agency, the social service skills applied in his/her work and the student’s learning outcomes. The report shall be submitted in a format prescribed by the department and shall be submitted together with a certificate from the agency confirming his/her field work, in a prescribed format.

4.6 Research Project Work
Every student shall undertake a research project work which has bearing on his/her AoC and present a written thesis on the research work under the supervision and guidance of a faculty member. The preliminary work may begin at the end of the second semester. The students are expected to complete the data collection before the fourth semester. The thesis is to be submitted to the department before the date notified. The student shall write a dissertation of the research thesis and appear for a viva voce examination on the research done. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

4.7 Assignments
Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

5.0 MASTER OF SCIENCE (MSC) PSYCHOLOGY

5.1 Field Work
Students shall take part in field work during the first three semesters in mental health agencies, medical institutions, educational institutions etc., under the supervision of professional counsellors and psychologists, where the student of psychological counselling can get a first-hand experience of the application of the learning derived from the classroom. The field work shall be credited and shall be evaluated using norms laid down by the department.

5.2 Study Tour
During the programme the students shall undertake a study tour, along with the faculty members, to a place approved by the department. The places are to be so chosen as to be of educational benefit to students. During the tour, the focus shall be to visit and interact with NGOs, hospitals, state/national/international organisations involved in psychological counselling. A report of the learning outcomes shall be submitted to the department at the end of the tour followed by a presentation. The Study Tour shall be a P/NP course.

5.3 Summer Internship
Students are required to undergo a summer internship of two weeks' during the semester break between the second and third semesters. It is a P/NP course and shall be recorded in the third semester. The Summer Internship gives students an opportunity to apply the theories and principles that they have learnt in class room courses to the “real world” of social service agencies, medical institutions, the criminal justice system, business, and industry. During the internship, students can explore career interests, develop professional skills, learn how community organizations work and expand their clinical and interpersonal skills. The summer internship enriches the students’ academic experience while making a valuable contribution to the community and utilizing the vacation optimally.

5.4 Supervised Internship
Each student shall perform a supervised internship for a period of 90 days (spread across semester three and four with 45days in each semester) in two organisations which offers counselling help to clients. The supervised internship is a credited course and the report for each internship shall be submitted by the students at the end of each semester followed by a presentation on the same. It shall be the prerogative of the department to propose the number of institutions where a student is expected to perform supervised internship. Supervision shall be provided for by the university in collaboration with the organisation where the student performs the internship. Evaluation of the internship shall be based on the documentation, reports from the organisation, report of the supervisor and the presentation and the viva voce examination of the student at the end of the period of Internship.

5.5 Research Project Work
A research project shall be undertaken during the course of the third and the fourth semesters. The topic of the research shall be so chosen that it will be possible for the student to pursue and complete the research work in the institution/hospital where the student is placed for the supervised internship. The preliminary work may begin at the end of the second semester. The students are expected to complete the data collection before the fourth semester. The thesis is to be submitted to the department before the date notified. The student shall write a dissertation of the research thesis and appear for a viva voce examination on the research done. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/ Institute at the beginning of the
5.6 Assignments
Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A Group assignment shall be accompanied by a common presentation.

6.0 MASTER OF ARTS (MA) EDUCATION

6.1 Specialisations
The Master’s Degree Programme in Education offers a number of specialisations, of which a student shall be required to choose a specialisation after the completion of the first semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

6.2 Educational Seminar
During the course of the programme, students are expected to present a series of seminars which will address fundamental intellectual, conceptual and practical issues in current educational philosophy and application. They may also deal with other relevant topics which may be suggested by the department. Students shall be assisted through guest lectures, discussions, field work in education related institutions and active engagement with faculty members. During these interactions students shall be provided with an opportunity to explore how best to bring new interdisciplinary scholarship, technology and critical thinking into the development of the chosen seminar area. They shall also consider alternative pedagogic strategies, teaching techniques and technologies. Students shall prepare and present a final paper based on these seminars. Students shall be evaluated on the basis of the seminars and the final paper.

6.3 Assignments
Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

6.4 Research Project Work
Every student shall undertake a research project work which has bearing on his/her field of specialisation and present a written thesis on the research work under the supervision and guidance of a faculty member. The Research Project shall be undertaken individually, in two phases during the third and fourth semesters. Students are expected to make presentations to the department at different stages of the research work. The student shall write a dissertation of the research thesis, submit it to the department and appear for a viva voce examination at times to be notified by the department. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

6.5 School Visits
The students of the Masters Programme in Education shall be engaged in regular school visits with the purpose of understanding and evaluating the process of teaching, learning and evaluation as well as the exigencies of administration of the school.

6.6 Internship
During the final semester of the programme, a student is required to undergo an internship for a period of one month. The internship provides an opportunity for students to experience the ground reality and connect it with the theoretical and methodological perspectives the student has studied and interiorized. During the internship the student will be monitored and guided by his/her supervisor and faculty members. The student will be required to maintain a journal and at the end of the period of internship, submit a written report and to make a presentation of his/her experiences and learnings at the internship. The student will be required also to submit a report from the head of the institution regarding his/her performance there.

The evaluation of the student shall be based on the level of his/her engagement during the internship in addition to his/her ability to communicate this engagement in the journal, the report and the presentation. The journal and the report are to be submitted within a month of the completion of the internship. The department shall specify the criteria for evaluating the journal, the report and the presentation.

6.7 Journaling
During the 1st semester, students shall maintain a reflective journal, to develop within them a reflection that can be described as an inner dialogue, using visible thinking routine (Harvard), as a critical structure for guiding their journal writing. Journaling has to be done six days a week. At the end, the student will be awarded grade/marks after assessing their learning.

7.0 MASTER OF ARTS (MA) MASS COMMUNICATION
7.1 Specialisations
The Master’s Degree Programme in Mass Communication offers a number of specialisations, of which a student shall be required to choose a specialisation after the completion of the first semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

7.2 Media House Visits
During the course of the programme, students shall be required to visit a variety of Media Houses in small groups constituted by the department. The purpose of these Media House Visits shall be to gain exposure to the best practices among the day-to-day activities of the media house. A report of the visit is to be submitted in the format specified within two days of the visit. The Media House visit shall be a graded course and grades shall be awarded on the basis of the written reports of the media house visits.

7.3 Research Project Work
Every student shall undertake a research project work which has a bearing on his/her field of specialisation and present a written thesis on the research work under the supervision and guidance of a faculty member. The Research Project shall be undertaken individually, in two phases during the course of two semesters as shall be laid down in the course structure of the programme. Students are expected to make presentations to the department at different stages of the research work. The student shall write a dissertation of the research thesis, submit it to the department and appear for a viva voce examination at times to be notified by the department. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

7.4 Assignments
Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

7.5 Internship
All students shall undergo an internship involving media related activities of four weeks’ duration. The purpose of the internship is to give the students an opportunity to have a hands-on field experience to effectively put into practice the theoretical and practical learning from the programme in an area of interest. Students may undergo their internship in a media house of their choice. The student shall be required to discuss the choice of media house with the department and obtain its consent. Before going for the internship, a Letter of Consent from the concerned media house, in the prescribed format, shall be submitted by the student to the Department. After returning from the internship each student shall have to submit a detailed report in a prescribed format. Each student shall also make a presentation of the internship experience and learning in the Department and submit a certificate of successful completion of the internship from the designated authority of the concerned media house. The schedule of the conduct, report submission and evaluation of the internship shall be as notified by the Department. The components of evaluation of the Internship and their weightages shall be as notified by the department at the beginning of the semester.

7.6 Final Project
As a Final Project the students are required to create a Social Awareness and Community Development oriented multimedia project which shall culminate in a Media Event. The purpose of the final project is to showcase all the skills that the students have acquired during the course of the programme as well as demonstrate their Media and Event Management, and Media Entrepreneurship abilities and at the same time use these skills for the service and upliftment of the community. The Final Project shall essentially be a group project and the number of groups shall be specified by the department. The groups shall perform their activities under the guidance of faculty members who shall be assigned to guide each group. The last dates for the submission of the project proposal and the conduct of the event shall be notified by the Department well in advance. The components of evaluation of the Final Project and their weightages shall be as notified by the department at the beginning of the semester.

8.0 MASTER OF ARTS (MA) ENGLISH

8.1 Specialisations
The Master’s Degree Programme in English offers a number of specialisations, of which a student shall be required to choose a specialisation after the completion of the second semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

8.2 Educational Seminar
During the course of the programme, students are expected to present a series of seminars related to English literature. They may also deal with other relevant topics which may be suggested by the department. Students shall prepare and present a final paper based on these seminars. Students shall be evaluated on the basis of the seminars and the final paper.

8.3 Assignments
Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

8.4 Dissertation
Students will be required to write a dissertation in the 4th semester.
9.0 MASTER OF COMMERCE (MCOM)

9.1 Specialisations
The Master's Degree Programme in Commerce offers a number of specialisations, of which a student shall be required to choose a specialisation after the completion of the second semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

9.2 Project Work/Dissertation
The Master's Degree Programme in Commerce will require students to do Project work in the 3rd and 4th semesters. The mode and components of evaluation of the project work and the weightages attached to them shall be published by the department at the beginning of the semester.

9.3 Assignments
Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

10.0 Admission
10.1 All admissions to the Post Graduate Degree Programmes of the University shall be on the basis of merit. There may, however, be provision for direct admission for a limited number of NRI/FN students.

10.2 Eligibility Criteria
10.2.1. To be considered for admission to a Post Graduate Degree Programme a candidate should have passed a Bachelor's Degree (or equivalent) programme of a recognised university securing 50% of the grades/marks.
10.2.2. Admission will be on the basis of the academic records of the candidate, and taking into consideration his/her performance in any or all of the following:
   • Written test
   • Group Discussion
   • Personal Interview

10.3 Candidates whose results for the qualifying examination are not yet declared may be provisionally admitted provided she/he submits proof of fulfilment of the eligibility criteria by 31 October of the year of provisional admission.

10.4 Bridge Courses: The Departments shall make provision for Bridge Courses to facilitate admission of students from varied backgrounds to a programme of their choice.

10.5 Value-added Courses: Each department shall offer value-added courses, which are optional. Certificates will be awarded to those who successfully complete the course.

11.0 University Registration
11.1 Candidates shall have to register as bona-fide students with the University as per the University regulations within a period specified by the University, by a formal application routed through the Director.

12.0 Attendance
12.1 To be permitted to appear for the end-semester examination of a particular course, a student is required to have a minimum attendance of 75% for that course.
12.2 Deficiency in attendance up to 10% may be condoned by the Director in the case of leave taken for medical and other grievous reasons, which are supported by valid medical certificates and other requisite documents.
12.3 Some students, due to exceptional situations like their own serious sickness and hospitalization or death of members of inner family circle, may have attendance below 65%. Such students may be given bonus attendance percentage for a particular course based on his/her attendance for that course during the remaining days of the current semester, as given in the following table:

<table>
<thead>
<tr>
<th>Attendance during the remaining days of the current semester</th>
<th>Bonus percentage available in the current semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>95% or more</td>
<td>5</td>
</tr>
<tr>
<td>90% or more but less than 95%</td>
<td>4</td>
</tr>
<tr>
<td>85% or more but less than 90%</td>
<td>3</td>
</tr>
<tr>
<td>80% or more but less than 85%</td>
<td>2</td>
</tr>
<tr>
<td>75% or more but less than 80%</td>
<td>1</td>
</tr>
</tbody>
</table>

They shall be permitted to appear for the end-semester examination of the course if on the strength of this bonus attendance percentage, they obtain 65% attendance for that course.

12.4 If the sum of the credits of the courses for which a student is unable to appear at the end-semester examinations
exceeds 50% of the total credits allotted for the semester, he/she shall not be permitted to appear for the entire end-
semester examinations in view of clause 13.5 of these Regulations.

12.5 The School may decide to set aside a certain portion of the in-semester assessment marks for attendance. The number of
marks and modalities of their allotment shall be made known to the students at the beginning of each semester.

12.6 Leave

12.6.1 Any absence from classes should be with prior sanctioned leave. The application for leave shall be submitted to
the Office of the Director of the School on prescribed forms, through the Head of the Department, stating fully the
reasons for the leave requested along with supporting documents.

12.6.2 In case of emergency such as sickness, bereavement or any other unavoidable reason for which prior
application could not be made, the parent or guardian must inform the office of the Director promptly.

12.6.3 If the period of absence is likely to exceed 10 days, a prior application for grant of leave shall have to be submitted
through the Director to the Registrar with supporting documents in each case; the decision to grant leave shall be
taken by the Registrar on the recommendation of the Director.

12.6.4 The Registrar may, on receipt of an application, also decide whether the student be asked to withdraw from the
programme for that particular semester because of long absence.

12.6.5 It shall be the responsibility of the student to intimate the concerned teachers regarding his/her absence before
availing of the leave.

13.0 Grading System

13.1 Based on the performance of a student, each student is awarded a final letter grade in each graded course at the end of
the semester and the letter grade is converted into a grade point. The correspondence between percentage marks, letter
grades and grade points is given in the table below:

<table>
<thead>
<tr>
<th>Marks (x) obtained (%)</th>
<th>Grade</th>
<th>Description</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 ≤ x ≤ 100</td>
<td>O</td>
<td>Outstanding</td>
<td>10</td>
</tr>
<tr>
<td>80 ≤ x &lt; 90</td>
<td>E</td>
<td>Excellent</td>
<td>9</td>
</tr>
<tr>
<td>70 ≤ x &lt; 80</td>
<td>A+</td>
<td>Very Good</td>
<td>8</td>
</tr>
<tr>
<td>60 ≤ x &lt; 70</td>
<td>A</td>
<td>Good</td>
<td>7</td>
</tr>
<tr>
<td>50 ≤ x &lt; 60</td>
<td>B</td>
<td>Average</td>
<td>6</td>
</tr>
<tr>
<td>40 ≤ x &lt; 50</td>
<td>C</td>
<td>Below Average</td>
<td>5</td>
</tr>
<tr>
<td>x &lt; 40</td>
<td>F</td>
<td>Failed</td>
<td>0</td>
</tr>
</tbody>
</table>

In addition, a student may be assigned the grades ‘P’ and ‘NP’ for pass marks and non-passing marks respectively, for
Pass/No-pass courses, or the grade ‘X’ (not permitted).

13.1.1 A student shall be assigned the letter grade ‘X’ for a course if he/she is not permitted to appear for the end
semester examination of that course due to lack of requisite attendance.

13.1.2 A letter grade ‘F’, ‘NP’ or ‘X’ in any course implies a failure in that course.

13.1.3 A student is considered to have completed a course successfully and earned the credits if she/he secures a letter
grade other than ‘F’, ‘NP’, or ‘X’.

13.2 At the end of each semester, the following measures of the performance of a student in the semester and in the
programme up to that semester shall be computed and made known to the student together with the grades obtained by
the student in each course:

13.2.1 The Semester Grade Point Average (SGPA): From the grades obtained by a student in the courses of a semester,
the SGPA shall be calculated using the following formula:

\[ SGPA = \frac{\sum_{i=1}^{n} GP_i \times NC_i}{\sum_{i=1}^{n} NC_i} \]

Where \( GP_i \) = Grade points earned in the \( i^{th} \) course
\( NC_i \) = Number of credits for the \( i^{th} \) course
\( n \) = the number of courses in the semester

13.2.2 The Cumulative Grade Point Average (CGPA): From the SGPAs obtained by a student in the completed semesters,
the CGPA shall be calculated using the following formula:

\[ CGPA = \frac{\sum_{i=1}^{n} SGP_i \times NSC_i}{\sum_{i=1}^{n} NSC_i} \]
Where \(SGP_i\) = Semester Grade point of the \(i^{th}\) semester  
\(NSC_i\) = Number of credits for the \(i^{th}\) semester 
\(n\) = the number of semesters completed  

13.2.3 The CGPA may be converted into a percentage by multiplying CGPA by 10.

13.3 Both the SGPA and CGPA will be rounded off to the second place of decimal and recorded as such. Whenever these CGPA are to be used for official purposes, only the rounded off values will be used.

13.4 There are academic and non-academic requirements for the programme where a student will be awarded the ‘P’ and ‘NP’ grades. All non-credit courses (such as Study Tour and Extra Academic Activities) belong to this category. No grade points are associated with these grades and these courses are not taken into account in the calculation of the SGPA or CGPA. However, the award of the degree is subject to obtaining a ‘P’ grade in all such courses.

14.0 Assessment of Performance

14.1 A student’s performance is evaluated through a continuous system of evaluation comprising tests, quizzes, assignments, seminars, projects, research work, concurrent and block field work performance and end-semester examinations.

14.2 Theory Courses: Theory courses will have two components of evaluation – in-semester assessment of 40% weightage and an end-semester examination having 60% weightage.

14.2.1 The modalities of conduct of in-semester evaluation, its components and the weightages attached to its various components shall be published by the department concerned at the beginning of each semester.

14.3 Practicum/Field Work/Lab: These courses shall be evaluated on the basis of attendance, performance of tasks assigned and an end semester test/viva voce examination. The weightage assigned to these components of the evaluation is given in the following table:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>10</td>
</tr>
<tr>
<td>Performance of tasks assigned</td>
<td>30</td>
</tr>
<tr>
<td>end-semester test / viva voce examination</td>
<td>60</td>
</tr>
</tbody>
</table>

14.4 End-Semester examinations

14.4.1 End-semester examinations, generally of three hours’ duration, shall be conducted by the University for the theory courses. However, the Director of the Institute shall make the arrangements necessary for holding the examinations.

14.4.2 In the end-semester examinations, a student shall be examined on the entire syllabus of the courses.

14.4.3 A student shall not obtain a pass grade for a course without appearing for the end-semester examination in that course.

14.5 The evaluation of performance in Co-curricular Activities will be done by the authorities conducting them and they will communicate the grades to the Director who will forward them to the Controller of Examinations of the University.

14.6 The Director will forward the marks obtained in the in-semester evaluation to the Controller of Examinations within the prescribed time as may be notified.

14.7 All evaluated work in a subject except the end semester answer scripts will be returned to the students promptly. They should be collected back after the students have examined them, and preserved for a period of one semester.

14.8 Eligibility for appearing in the end-semester examinations: A student will be permitted to appear for the end-semester examinations, provided that

14.8.1 A student has not been debarred from appearing in the end semester examinations as disciplinary action for serious breach of conduct.

14.8.2 He/she has satisfactory attendance during the semester according to the norms laid out in section 9 of these regulations.

14.8.3 He/she has paid the prescribed fees or any other dues of the university, institute and department within the date specified.

14.9 Registration for end-semester Examinations

14.9.1 The University shall, through a notification, invite applications from students to register for the end-semester examinations.

14.9.2 Students who have registered with the University and those who have applied for such registration may apply to appear for the end-semester examinations of the university, in response to the notification issued by the University, provided that they fulfil the eligibility norms as laid down in clause 14.8.

14.9.3 All eligible candidates shall be issued an admit card for the relevant examination and for the specified courses. A student who does not have a valid admit card may not be permitted to write the end-semester examinations.

14.9.4 A student who secures an ‘F’ or ‘X’ grade in any course in a semester may register for the end-semester examination for that course in a subsequent semester when that course is offered again, within the maximum
14.10 Conduct of Examinations: The University shall conduct the end-semester examinations in accordance with the applicable regulations on such dates as are set down in the Academic Calendar or as notified.

14.11 Declaration of Results: The University shall declare the results of a semester and make available to the students their grade sheets within the time-frame prescribed by the relevant regulations of the university and specified in the academic calendar.

14.12 Re-examining of answer scripts

14.12.1 If a student feels that the grade awarded to him/her in a course is not correct, he/she may apply to the University for the re-examining of his/her answer script.

14.12.2 Re-examining of scripts may be of two different categories – scrutiny and re-evaluation.

14.12.3 Scrutiny: The activities under this category shall ordinarily be confined to checking
- correctness of the total marks awarded and its conversion into appropriate letter grades
- whether any part/whole of a question has been left unevaluated inadvertently
- correctness of transcription of marks on the tabulation sheet and the grade sheet issued in respect of the course under scrutiny.

14.12.4 e-evaluation: Re-evaluation of the answer script by independent experts in the concerned subject(s).

14.12.5 Application for re-examining of answer scripts
- A student may apply for scrutiny or re-evaluation for one or more courses of the just-concluded end-semester examinations within seven calendar days from the date of publication of its results in the application form prescribed for this purpose.
- He/she shall pay the prescribed fee to the University as notified.
- A student applying for scrutiny/re-evaluation shall expressly state on the application form whether the application made is for Scrutiny or for Re-evaluation. In each case, the student may also request to see his/her answer script.
- All applications for scrutiny/re-evaluation must be routed through the Director of the Institute.

14.12.6 If in the process of re-examining, the grade obtained in a course changes, the better of the two grades shall be assigned to the course. If there is a change, the new grade shall be recorded and a new grade sheet shall be issued to the student.

14.12.7 Without prejudice to any of the clauses of section 14.12, a student who has been found to have used unfair means during an examination shall not be eligible to apply for scrutiny or re-evaluation of answer scripts.

14.12 Repeat Examination: The University shall conduct repeat examinations for those with F grade at a different time slot, as set down in the Academic Calendar or as notified. Such students should register for these examinations.

14.14 Improvement Examination

14.14.1 After the completion of the entire programme of study, a student may be allowed the provision of improvement examinations. These are to be availed of only once each in the Autumn and Spring semesters that immediately follow the completion of the programme, and within the maximum number of years permissible for the programme.

14.14.2 A student may choose no more than six courses (three in the Autumn semester and three in the Spring semester) for improvement examinations.

14.14.3 After the improvement examination, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

14.14.4 If the student improves his/her grades through the improvement examination, new grade sheets and comprehensive transcripts shall be issued to the student.

14.15 Special Examination

14.15.1 The University shall conduct Special Examinations to benefit the following categories of students:

14.15.1.1 Students who, on the completion of the final semester, have some ‘F’ graded courses in the two final semesters, but no ‘F’ or ‘X’ graded courses in any of the previous semesters
14.1.5.2 Students who have only one ‘F’ graded course in a semester other than the two final semesters and do not have ‘F’ or ‘X’ graded courses in the two final semesters.

14.1.5.3 Students who fail to secure 50% of the credits offered in the final semester shall not be eligible to appear for the special examinations. Such students shall be governed by the provisions of clause 15.5 of these regulations. However, this restriction shall not apply in the case of students who are unable to appear in the end semester examinations due to exceptional situations like their own serious illness and hospitalisation or death of members of inner family circle (restricted to only father, mother, siblings).

14.1.5.4 Students who have ‘X’ graded courses only in the last two semesters may be offered the opportunity for participating in a Tutorial Programme which may be conducted during the semester break immediately following the end-semester examinations of the final semester and students who earn 85% attendance for the programme shall be permitted to appear for the Special Examinations. Separate fees shall be charged for the Tutorial Programme.

14.1.5.5 Students who do not obtain pass grades in any course at the special examinations shall have to apply in the prescribed format and appear for the end-semester examination of these courses when they are scheduled by the University during subsequent relevant end-semester examinations.

15.0 Enrolment (for semesters other than the first)

15.1 Every student is required to enrol for the programme through the designated officer at the commencement of each semester on the days fixed for such enrolment and notified in the Academic Calendar.

15.2 Students who do not enrol on the days announced for the purpose may be permitted late enrolment up to the notified day in the Academic Calendar on payment of a late fee.

15.3 Only those students will be permitted to enrol who have cleared all University, Institute, Department, Hostel and Library dues and fines (if any) of the previous semester, paid all required University, Institute, Department and Hostel fees for the current semester, and not been debarred from enrolling on any specific ground.

15.4 No student may enrol for a semester if he/she has not appeared, for whatever reason, in the end semester examinations of the previous semester.

15.5 A student who fails to obtain 50% of the credits offered in the third and subsequent semesters shall not be permitted to enrol for the next semester and shall have to re-enrol for and attend all the courses of the said semester in the following academic year. Students who due to X grade (lack of due attendance) have been debarred from exams in any semester (including first and second) will have to re-enrol for the same.

16.0 Eligibility for the Award of Degree

16.1 A student shall be declared to be eligible for the award of the degree if he/she has completed all the credit requirements for the degree with grade ‘C’ or higher grade in each of the graded courses and grade ‘P’ in all the non-graded courses.

16.1.2 satisfactorily completed all the non-credit requirements for the degree (if any);

16.1.3 obtained a CGPA of 5.00 or more at the end of the semester in which he/she completes all the requirements for the degree;

16.1.4 owes no dues to the University, Institute, Department, Hostels; and

16.1.5 has no disciplinary action pending against him/her.

16.2 The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

17.0 Termination from the Programme

17.1 If more than the number of years permitted for the completion of a programme have elapsed since the student was admitted, and the student has not become eligible for the award of Degree, the student shall be removed from the programme.

17.2 A student may also be required to leave the Programme on disciplinary grounds on the recommendations of the Students’ Disciplinary Committee of the concerned School.
SCHEME OF IN-SEMESTER ASSESSMENT

GRADUATE DEGREE PROGRAMMES

Theory Courses
For theory courses, in-semester assessment carries 40% weightage. Different components along with the weightage of each are given in the table below:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Test (Two Class tests of one and a half hour duration)</td>
<td>20</td>
<td>Average of the two marks shall be considered</td>
</tr>
<tr>
<td>Assignment (Individual and Group)</td>
<td>10</td>
<td>Group assignments for two courses and individual assignments for the remaining courses</td>
</tr>
<tr>
<td>Non-formal evaluation</td>
<td>5</td>
<td>Based on response and interaction in class, quizzes, open book tests, etc.</td>
</tr>
<tr>
<td>Attendance</td>
<td>5</td>
<td>For norms regarding attendance cfr. clause 6 of the Regulations for Undergraduate Programmes</td>
</tr>
</tbody>
</table>

There shall be no re-test for In-semester assessment under any circumstance. The original marks of all the In-semester assessment components shall be retained for all further repeat examinations.

Attendance
Marks for attendance will be given according to the following scheme:

<table>
<thead>
<tr>
<th>Attendance Percent (x)</th>
<th>Marks Allotted</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 &lt;= x &lt; 80</td>
<td>2</td>
</tr>
<tr>
<td>80 &lt;= x &lt; 90</td>
<td>3</td>
</tr>
<tr>
<td>90 &lt;= x &lt; 95</td>
<td>4</td>
</tr>
<tr>
<td>95 &lt;= x 100</td>
<td>5</td>
</tr>
</tbody>
</table>

EVALUATION OF LABORATORY COURSES, DRAWING AND WORKSHOP
All Laboratory courses are evaluated on the basis of attendance, performance of tasks assigned and end semester test/viva voce examination. The distribution of marks within these components will be specified by individual departments along the lines of the break-up given below:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>10</td>
</tr>
<tr>
<td>assessment of tasks assigned</td>
<td>30</td>
</tr>
<tr>
<td>End Semester Test and/or Viva-Voce Examination</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

In-Semester Evaluation of Minor and Mini Projects
The guidelines for the conduct and evaluation of Minor and Mini Projects shall be laid down by the Department. The components of evaluation and allotment of marks may be as follows:

<table>
<thead>
<tr>
<th>In Semester Evaluation</th>
<th>Marks</th>
<th>End Semester Evaluation (weightage 40)</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synopsis</td>
<td>10</td>
<td>Project Implementation</td>
<td>16</td>
</tr>
<tr>
<td>Seminar presentation of synopsis (Analysis and Design)</td>
<td>15</td>
<td>Seminar Presentation</td>
<td>8</td>
</tr>
<tr>
<td>Progress Seminar (Implementation)</td>
<td>15</td>
<td>Viva Voce Examination</td>
<td>16</td>
</tr>
<tr>
<td>Project Documentation</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attendance</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td></td>
<td>40</td>
</tr>
</tbody>
</table>
In-Semester Evaluation of BTECH Major Project Phase I and Phase II
The in-semester evaluation of Major Project Phase I and Phase II shall have 60% weightage. The modality and conduct of the in-semester evaluation of the Major Project Phase I, and their weightages shall be declared by the DPEC of each department at the beginning of the semester. The following aspects are to be assessed, among others:
Synopsis presentation Progress seminars Progress reports Weekly activity reports

In-Semester BCOM Project Evaluation
The scheme of in-semester evaluation and the modalities along with the weightages will be specified by the department at the beginning of the semester.
SCHEME OF IN-SEMESTER EVALUATION

POST GRADUATE DEGREE PROGRAMMES

MCA, MSW, MSC (Psychology), MA English, MA Education, MCOM

Theory Courses
The different components of the scheme of in-semester for the theory courses are given in the table below:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Test (Two class tests of equal weightage)</td>
<td>20</td>
</tr>
<tr>
<td>Assignments, Group Presentations/Seminar</td>
<td>10</td>
</tr>
<tr>
<td>Non-formal evaluation</td>
<td>5</td>
</tr>
<tr>
<td>Attendance</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
</tr>
</tbody>
</table>

Non-formal Evaluation
Non-formal evaluation may be done using a combination of quizzes, unannounced tests, open book tests, library work reports, class room interaction and participation, etc. The scheme of non-formal evaluation shall be announced by every teacher in the beginning of the semester.

Attendance
Marks for attendance will be given according to the following scheme:

<table>
<thead>
<tr>
<th>Attendance Percent (x)</th>
<th>Marks Allotted</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 &lt;= x &lt; 80</td>
<td>2</td>
</tr>
<tr>
<td>80 &lt;= x &lt; 90</td>
<td>3</td>
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<tr>
<td>90 &lt;= x &lt; 95</td>
<td>4</td>
</tr>
<tr>
<td>95 &lt;= x 100</td>
<td>5</td>
</tr>
</tbody>
</table>

NB: There shall be no re-test for in-semester Assessment under any circumstance. The original marks of all the in-semester Assessment components shall be retained for all further repeat examinations.

MCA Minor Project
The guidelines for the conduct and evaluation of the MCA Minor Project shall be laid down by the Department. The components of evaluation and allotment of marks will be as follows:

<table>
<thead>
<tr>
<th>In Semester Evaluation</th>
<th>Marks</th>
<th>End Semester Evaluation (Weightage 40)</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synopsis</td>
<td>10</td>
<td>Project Implementation</td>
<td>16</td>
</tr>
<tr>
<td>Seminar presentation of synopsis (Analysis and Design)</td>
<td>15</td>
<td>Seminar Presentation</td>
<td>8</td>
</tr>
<tr>
<td>Progress Seminar (Implementation)</td>
<td>15</td>
<td>Viva Voce Examination</td>
<td>16</td>
</tr>
<tr>
<td>Project Documentation</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attendance</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td></td>
<td>40</td>
</tr>
</tbody>
</table>

In-Semester Evaluation of MCA Major Project
The in-semester evaluation of the MCA Major Project shall have 60% weightage. The Internal Evaluation of the Major project will be done through two seminar sessions:

Synopsis : 20
Seminar Presentation of Synopsis (Analysis and Design) : 30
Progress Seminar (Implementation) : 30
Project Documentation : 20

External Evaluation of all Major projects will follow the guidelines laid down in the Regulations.
MSW, MSc Psychology Field Work
The components of evaluation and their weightages for the concurrent/continuous fieldwork are as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Work Diary</td>
<td>10</td>
</tr>
<tr>
<td>Agency Evaluation</td>
<td>15</td>
</tr>
<tr>
<td>Faculty Evaluation</td>
<td>20</td>
</tr>
<tr>
<td>Attendance</td>
<td>5</td>
</tr>
<tr>
<td>Viva Voce Examination</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Practicum
Field Report : 15
Presentation : 15
Administration of tests : 10
Faculty Evaluation : 10
Viva Voce Examination : 50

MSW, MSc Psychology Research Project

**Phase I**
- Literature Survey Presentation : 40
- Synopsis Presentation : 60

**Phase II**
- Examination of Thesis : 50
- Presentation and Viva Voce Exam : 50

MTECH, MSC (Physics, Chemistry, Mathematics, Biochemistry, Biotechnology, Microbiology, Botany, Zoology)
Theory Courses

For theory courses, in-semester assessment carries 40% weightage. Different components along with the weightage of each are given in the table below:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Test (Two Class tests of one and a half hour duration)</td>
<td>20</td>
<td>Average of the two marks shall be considered</td>
</tr>
<tr>
<td>Assignments</td>
<td>15</td>
<td>Written Assignments/Seminar on course Topics/Technical Paper Review</td>
</tr>
<tr>
<td>Non-formal evaluation</td>
<td>5</td>
<td>Based on response and interaction in class, quizzes, open book tests, etc.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td></td>
</tr>
</tbody>
</table>

There shall be no re-test for In-semester assessment under any circumstance. The original marks of all the In-semester assessment components shall be retained for all further repeat examinations.

In-Semester Evaluation of Project (Phase I) / Research Project (Phase I) / Dissertation (Phase I)
The in-semester evaluation of Project Phase I / Research Project (Phase I) / Dissertation (Phase I) shall have 60% weightage. It shall be evaluated in the following seminar sessions having equal weightage:

**Seminar 1: Presentation of the synopsis**
- Synopsis : 30%
- Seminar presentation of the synopsis : 50%
- Viva voce examination : 20%
Seminar 2: Progress Seminar
Progress report : 30%
Progress seminar : 50%
Viva voce Examination : 20%

In-Semester Evaluation of Project (Phase II) / Research Project (Phase II) / Dissertation (Phase II)
The in-semester evaluation of Project Phase II / Research Project (Phase II) / Dissertation (Phase II) shall have 60% weightage. The in-semester evaluation will be done through two seminar sessions having equal weightage. Each seminar will be evaluated using the following components.

Progress Report : 30
Progress Seminar : 50
Viva Voce Examination : 20

External Evaluation of the project / Research Project / Dissertation shall follow the guidelines laid down in the Regulations.
RULES, PROCEDURES AND BEHAVIOURAL GUIDELINES

1. Dress Code and Identity Card
1.1 The dress code of the University consists of shirt/top (of the prescribed colour and material), trousers (of the prescribed colour and material), shoes (black) and socks (dark grey), a belt (black/dark brown, if required) and a tie (blue, with diagonal stripes). Students are required to come to the University following this dress code. The tie will be required to be worn only on formal occasions. An apron (of the prescribed colour) is to be worn in the Chemistry Lab and during Workshop Practice. During winter, students may wear only a blazer and/or a sweater (full sleeve or sleeveless) of the prescribed colour and material.
1.2 The Student Identity Card is to be brought to the University every day and is to be produced whenever asked for. Entry to the University campus shall be only on production of the Identity Card. The Identity Card is also the Library Card.
1.3 All students should wear the ID card around the neck from entry in the morning to exit in the evening.

2. Morning Assembly
2.1 The morning assembly is a daily programme in the university on all class days during which all members, i.e., students, faculty, staff and management meet together. The assembly starts at the prescribed time. During the assembly, important announcements are made and a thought or insight is shared. The assembly is concluded with an invocation to God to bless the activities of the day. Note that any announcement made at the morning assembly is considered as being equivalent to notifying the same in the notice boards. All students should reach the assembly venue before prescribed time. Immediately after assembly all should proceed to the classroom to start class. Any change in procedures will be notified by the concerned School at the beginning of the Semester.
2.2 One of the following prayers may be used to conclude the Morning Assembly:

   **The Our Father**
   Our Father, who art in heaven,
   Hallowed be thy name, Thy kingdom come, Thy will be done on earth as it is in heaven.
   Give us this day, our daily bread
   And forgive us our trespasses
   As we forgive those who trespass against us.
   But deliver us from all evil, Amen.

   Or

   **Prayer for Peace**
   Lord, make me an instrument of your peace,
   where there is hatred, let me sow love;
   where there is injury, pardon;
   where there is doubt, faith;
   where there is despair, hope;
   where there is darkness, light;
   where there is sadness, joy;
   O Divine Master, grant that I may not so much seek to be consoled as to console;
   to be understood as to understand;
   to be loved as to love.
   For it is in giving that we receive;
   it is in pardoning that we are pardoned;
   and it is in dying that we are born to eternal life. Amen

3. Punctuality in Attending Classes
3.1 All are expected to be at their respective assembly venues five minutes before assembly time.
3.2 Normally no student shall leave the University before all the classes are over. In case of an emergency, a student may leave with proper written permission from the HOD of the concerned department.
3.3 While all students are encouraged to have their lunch in the University Canteens, students are permitted to take lunch outside the University.

4. Make-up Classes, Leave of Absence and Earned Attendance
4.1 If any student misses any laboratory class due to illness or other grievous problems, he/she is required to meet the concerned teacher for completing the experiments as soon as possible. Such make-up attendance will be taken into consideration at the end of the semester if attendance is less than 75%. At most two make-up attendances may thus be earned by any student.
4.2 Any student who is required to be engaged in a University activity or a pre-planned training and placement activity during class hours, may apply for the grant of an ‘earned attendance’ from the concerned HODs in the prescribed form available at the Reception. Such applications must be forwarded by the Activity In-Charge. For club related activities, Faculty Advisor of the concerned club will be the Activity In-Charge. In all other cases, Faculty In-Charge or Assistant Faculty In-Charge of Student Affairs will be the Activity In-Charge. Filled up forms shall be submitted preferably before or in case of emergency, immediately after the activity for which earned attendance is to granted.

4.3 Any student going to participate in any activity or competition outside the University must apply to the Faculty In-Charge of student Affairs using the prescribed form which must be forwarded by the Assistant Faculty In-Charge of Student Affairs in consultation with respective Club Advisers. On return, these students must report back to the Assistant Faculty In-Charge of Student Affairs for recording the outcome.

4.4 Any student who is not able to attend classes due to medical or other grievous reasons are required to apply for leave in the prescribed form along with valid medical certificates and other requisite documents, to the Faculty In-charge, students’ affairs within seven days of joining back. Such applications must be signed by a parent of the student and forwarded by the mentor of the concerned student and the HOD of the concerned department. Only these students will be considered for condonement of deficiency in attendance.

5. Discipline
5.1 Personal, academic and professional integrity, honesty and discipline, a sense of responsibility and a high degree of maturity is expected of all students inside and outside the campus. Integrity calls for being honest in examinations and assignments, avoiding plagiarism and misrepresentation of facts.

5.2 Indulging in acts of violence, riotous or disorderly behaviour directed towards fellow students, faculty members or other employees of the institution/hostel in the campus or outside is considered to be a serious breach of discipline and will attract penalty.

5.3 Respect for Common Facilities: Care and respect for common facilities and utilities are an essential component of social responsibility. Any willful damage to University property must be made good by the persons concerned. Further, maintaining cleanliness of the classrooms and the entire campus is everyone’s responsibility.

5.4 Substance Abuse: Chewing of tobacco, betel nut and the likes, smoking and the use of other addictive substances and alcoholic drinks are strictly prohibited. These should not be brought into or used within the campus of the University. Violation of this norm will lead to stern action.

5.5 Use of Cell Phones: Cell phones may be used in the University lawns, canteens and other open areas. However, the use of cell phones in classrooms and labs are strictly prohibited except when used for teaching/learning purposes with the explicit permission of the teacher concerned. The cell phone of anyone found violating this rule shall be confiscated and his/ her SIM card shall be taken away and retained in the University office for 7 days. If a person violates the norm for a second time, his/her mobile will be confiscated and retained in the University office till the end of the semester.

5.6 Use of Internet: The entire campus is wi-fi enabled and the students may use the Internet freely for educational purposes. Students may also use the Computing Centre for browsing the Net. However, the use of Internet to access unauthorized and objectionable websites is strictly prohibited.

5.7 All cases of indiscipline will be brought before the Students’ Disciplinary Committee and the decisions made by the Committee for dealing with such cases shall be final.

6. Class Tests and Examinations
6.1 The conduct of examinations will be governed by the norms of the University.

6.2 The Student Identity Card shall be the Admit Card for the class tests

6.3 During class tests, all students are expected to enter the venue of the class test 15 minutes before the scheduled time of commencement. However, no one will be permitted into the examination hall after 15 minutes of the commencement of the class test and No one will be allowed to leave the examination hall until an hour has elapsed from the commencement of the class test.

6.4 No one is to leave the hall during examination for any purpose, except in case of an emergency.

6.5 Malpractices during class tests and examinations will not be tolerated and will attract stern action.

7. Ragging
Ragging and eve-teasing are activities which violate the dignity of a person and they will be met with zero tolerance. Anti-ragging norms have been given to each student at the time of admission and all students and parents have signed the anti-ragging affidavit. Any case of ragging and eve-teasing must be reported to the anti-ragging squad. All cases of violation of anti-ragging norms will be taken up by the anti-ragging Committee and punished according to the norms.

8. Grievance Redressal
The University has constituted a Grievance Redressal Cell to redress any genuine grievance students may have. Any student having a genuine grievance may make a representation to the Grievance Redressal Cell through his/her mentor. The representation should be accompanied by all relevant documents in support of the genuineness of the grievance.
9. School Association
9.1 The School Association is an association of the representatives of the various stake holders of the School – students, staff, faculty and management. It is the responsibility of the School Association to take charge of organizing most of the co-curricular activities such as the annual festivals, quizzes, debates, competitions and social events.
9.2 A male and a female student are elected by the students of each class as “class representatives” to represent them in the School Association. Class representatives are expected to be outstanding students who are academically competent and having qualities of leadership.

10. Participation in University Activities
10.1 In order to provide opportunities for the holistic development of the human person, a large number of co-curricular and extra-curricular activities are designed and implemented under the banner of the University Association and student clubs. Some of the most important activities are D'VERVE & BOSCOSIADE (intra-University sports and cultural festival during University Week), PRAJYUKTTAM (the inter-University technical festival). All students are expected to take part actively in such activities to showcase their talents, to develop leadership qualities and to gain the experience of working in groups.
10.2 Training and Placement Activities: The training and Placement Cell of DBCET has been incorporated with the objective of minimizing the gap between industry and academia and giving the students training and exposure so that they can capitalize on every opportunity for placement. It is the prime responsibility of the cell to look after all matters concerning ‘Training to enhance employability’ and ‘guiding students for placement’. In the first two semesters, students are trained for communication skills development under the department of Humanities and Social Sciences, and personal development programmes under the department of campus ministry. From the third semester onwards, in every semester, students are given systematic training in aptitude tests, communication skills, group discussion, etc. They are also made to undergo mock HR and Technical Interviews. These activities of the training and placement cell find a place in the curriculum as Extra Academic Programmes (EAP) and all students are required to get a P grade for these activities by taking an active part in these activities regularly.

Other departments of the University offer customised services in training and placement of their students.

11. Free Time
Some hours without class may be available for some students during the day. Students are expected to use such ‘free time’ for visiting the library, meeting teachers and mentors, self-study, carrying out lab or project related activities, etc.

12. Faculty Performance Feedback
In order to improve the teaching and learning process in the University, students will be required to give feedback about the performance of their teachers from time-to-time. All students are expected to participate in the online feedback sessions concerning their teachers with sincerity and responsibility.

13. Mentoring
All students are assigned mentors from among the faculty members for their guidance. Directors of Schools in collaboration with the Heads of Departments will take care of assigning mentors. Mentors shall help the students to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them. Although students should meet their mentors on a regular basis to get timely help, specific days have been set aside in the calendar for meeting mentors to ensure proper documentation of achievements, activities, shortcomings and problems faced by the students. Every student must meet the mentor during these days.

14. Interaction Meet with Parents
The University organises interaction meetings with parents once a year in which the parents are invited to interact with teachers and management to appraise themselves about the performance of their ward and also to offer their suggestions for the betterment of the institution. It is the responsibility of the students too to invite their parents to come and participate in the event and make the event meaningful.
SCHOOL OF FUNDAMENTAL AND APPLIED SCIENCES
## SCHOOL OF FUNDAMENTAL AND APPLIED SCIENCES

### DEPARTMENT OF CHEMISTRY

**BACHELOR OF SCIENCE - HONOURS IN CHEMISTRY**

*Wherever there is a practical there will be no tutorial and Vice versa*

### SEMESTER I

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<th>Course Name</th>
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## COURSE STRUCTURE

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Generic Elective Course 3 (Theory/ Theory-Tutorial) | 4-0-0/5-1-0 |

Generic Elective Course 3 (Lab) | 0-0-2 |

Value added course | CHPC6137 | Petroleum Chemistry | NC | 149 |

### Total Credits | 26 |

#### SEMESTER IV

| Core Course 8 (Theory) | CHCC0139 | Inorganic Chemistry III: Coordination chemistry | 3-1-0 | 118 |
| Core Course 9 (Theory) | CHHC0140 | Organic Chemistry III: Heterocyclic Chemistry | 3-1-0 | 118 |
| Core Course 10 (Theory) | CHEL0141 | Physical Chemistry IV: Electrochemistry | 3-1-0 | 120 |
| Core Course 8 (Lab) | CHCC6129 | Inorganic Chemistry III: Coordination chemistry Lab | 0-0-2 | 146 |
| Core Course 9 (Lab) | CHHC6130 | Organic Chemistry III: Heterocyclic Chemistry Lab | 0-0-2 | 146 |
| Core Course 10 (Lab) | CHEL6131 | Physical Chemistry IV: Electrochemistry Lab | 0-0-2 | 147 |

Skill Enhancement Course 2 (Elective) | 2 |

| CHPY0116 | Pesticide Chemistry | 1-0-1 | 97 |
| CHFC0117 | Fuel Chemistry | 1-0-1 | 97 |
| CHIP0118 | Intellectual Property Rights | 2-0-0 | 98 |
| CHAB0142 | Analytical Clinical Biochemistry | 1-0-1 | 120 |
| CHGM0143 | Green Methods in Chemistry | 2-0-0 | 121 |
| CHPC0144 | Pharmaceutical Chemistry | 1-0-1 | 122 |

Generic Elective Course 4 (Theory/ Theory-Tutorial) | 4-0-0/5-1-0 |

Generic Elective Course 4 (Lab) | 0-0-2 |

Value added course | CHPA6138 | Pharmaceutical Chemistry and its applications | NC | 150 |

### Total Credits | 26 |

#### SEMESTER V

| Core Course 11 (Theory) | CHBM0121 | Organic Chemistry IV: Biomolecules | 4-0-0 | 101 |
| Core Course 12 (Theory) | CHQS0122 | Physical Chemistry V: Quantum Chemistry and Spectroscopy | 4-0-0 | 102 |
| Core Course 11 (Lab) | CHBM6115 | Organic Chemistry IV: Biomolecules Lab | 0-0-2 | 136 |
| Core Course 12 (Lab) | CHQS6116 | Physical Chemistry V: Quantum Chemistry and Spectroscopy Lab | 0-0-2 | 136 |

Discipline Specific Elective 1 (Theory) | 2 |

| CHAC0123 | Application of Computers in Chemistry | 4-0-0 | 103 |
| CHAM0124 | Analytical Methods in Chemistry | 4-0-0 | 104 |
| CHNS0125 | Novel Inorganic Solids | 4-0-0 | 105 |
| CHP0126 | Polymer Chemistry | 4-0-0 | 106 |
| CHMD0145 | Molecular Modelling & Drug Design | 4-0-0 | 122 |

Discipline Specific Elective 1 (Lab) | 2 |

| CHAC6117 | Applications of computers in Chemistry Lab | 0-0-2 | 137 |
| CHAM6118 | Analytical Methods in Chemistry Lab | 0-0-2 | 138 |

Discipline Specific Elective 2 (Lab) | 2 |

| CHNS6119 | Novel Inorganic Solids Lab | 0-0-2 | 138 |
| CHP0120 | Polymer Chemistry Lab | 0-0-2 | 139 |
| CHMD6132 | Molecular Modelling & Drug Design Lab | 0-0-2 | 147 |

Value added course | CHPC6137 | Petroleum chemistry | NC | 149 |

### Total Credits | 24 |

#### SEMESTER VI

| Core Course 13 (Theory) | CHOC0127 | Inorganic Chemistry IV: Organometallic Chemistry | 4-0-0 | 107 |

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## MASTER OF SCIENCE IN CHEMISTRY – MSc Chemistry

### SEMESTER I

<table>
<thead>
<tr>
<th>Type of Course/Category</th>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits L-T-P</th>
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**Total Credits** 24

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**Total Credits** 19

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**Total Credits: 24**

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**Total Credits: 21**

**Total Programme Credits: 86**

### DEPARTMENT OF MATHEMATICS

**BACHELOR OF SCIENCE - HONOURS IN MATHEMATICS**

*Wherever there is a practical there will be no tutorial and Vice versa*

#### SEMESTER I

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**Total Credits: 20**

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**Total Credits**: 24

#### SEMESTER VI

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**Optional Dissertation or Project Work in place of one Discipline Elective (DSE) Course**

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**Total Credits**: 24

**Total Programme Credits**: 140

### MASTER OF SCIENCE IN MATHEMATICS – MSc Mathematics

#### SEMESTER I

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**Total Credits**: 20

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### Total Credits

**Total Credits**: 20

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**Total Credits**: 20

## SEMESTER IV

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### DEPARTMENT OF PHYSICS

**BACHELOR OF SCIENCE - HONOURS IN PHYSICS**

*Wherever there is a practical there will be no tutorial and vice versa*

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| DE                                           | MAPD0065                                                   Plasma Dynamics                                           |
| Specialization III: Computational            |                                                                                                           |
| DE                                           | MADN0054                                                   Design and Algorithms Analysis                            |
| DE                                           | MAML0064                                                   Machine Learning                                          |
| DE                                           | MAFE0053                                                   Finite Elements Methods                                   |
| DE                                           | MAIC0055                                                   Introduction to Cryptography                              |
| Project DC                                   | MARP6003                                                   Research Project                                         |
| Value Added Course                           | MAMR0153                                                   Statistical Methods & Software in Research                |
| Value Added Course                           | MACS6005                                                   Computational Mathematics with SAGEMATH                   |
| **Total Credits**                            | 20                                                          |

**Total Programme Credits**: 80

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*ADBU| Regulations and Syllabus|2022-23*
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ADBU| Regulations and Syllabus|2022-23|54
### MASTER OF SCIENCE IN PHYSICS - MSc Physics

| Semester I |
|---|---|---|
| **Type of Course/Category** | **Course Code** | **Course Name** | **Credits** | **Page** |
| Theory/DC | PSCM0020 | Classical Mechanics | 4 | 224 |
| Theory/DC | PSQM0021 | Quantum Mechanics I | 4 | 224 |
| Theory/DC | PSMP0055 | Mathematical Physics-I | 4 | 242 |
| Theory/DC | PSEL0049 | Electronics I | 4 | 237 |
| Theory/DC | PSPL6009 | Physics Laboratory I | 4 | 272 |
| Mandatory | PSPS0200 | Physics and Service Learning |  | 271 |
| Value Added Course | PSCP6120 | Computational Physics using PYTHON | 2-0-0 | 292 |
| **Total Credits** | | | 20 | |

<p>| Semester II |
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| Theory/DC | PSQM0024 | Quantum Mechanics II | 4 | 225 |
| Theory/DC | PSMP0056 | Mathematical Physics -II | 4 | 242 |</p>
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SCHOOL OF FUNDAMENTAL AND APPLIED SCIENCES

DETAILED SYLLABUS
DEPARTMENT OF CHEMISTRY

VISION:
To produce competent chemistry graduates through dedicated teaching in classrooms, through labs and research, who can contribute meaningfully to society while fulfilling their ambitions in academia, research or industry.

MISSION:
The objective of the department is to provide dedicated guidance and support to students to equip them with a sound understanding of the fundamentals of chemistry
• to enable them to explore the diverse and hitherto unexplored resources of the north-eastern region
• to make significant contributions to fundamental and socially relevant research in the frontiers of chemistry
• to help them generate their ideas and provide them the knowhow to convert them into reality

PROGRAM OUTCOMES – BSC PROGRAMME
PO 1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more other disciplines that form a part of an undergraduate programme of study.
PO 2: Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives. Critically evaluate practices, policies and theories by following scientific approach to knowledge development.
PO 3: Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; communicate with others using appropriate media; confidently share one’s views and express herself/himself; demonstrate the ability to listen carefully; and present complex information in a clear and concise manner to different groups.
PO 4: Social Interaction: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group and act together as a group or a team in the interests of a common cause. Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO 5: Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO 6: Moral and Ethical Awareness: Ability to embrace moral/ethical values in conducting one’s life, possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
PO 7: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
PO 8: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes. Critical sensibility to lived experiences, with self-awareness and reflexivity of both and society.
PO 9: Information and Digital Literacy: Capability to use ICT in a variety of learning situations. Demonstrate ability to access, evaluate and use a variety of relevant information sources; and use appropriate software for analysis of data.
PO 10: Research related skills: A sense of inquiry and capability for asking relevant/appropriate questions, problematizing, synthesizing and articulating; Ability to recognize cause and affect relationships, define problems, formulate hypotheses, interpret and draw conclusions from data, ability to plan, execute and report the results of an experiment or investigation. Ability to apply one’s learning to real life situations.

PROGRAM SPECIFIC OUTCOMES- BSC CHEMISTRY (HONOURS)
PSO 1: Scientific Problem solving skill: Sound knowledge of fundamentals which can develop the problem solving skills using chemical principles.
PSO 2: Analytical skills: Develop analytical skills such as synthesizing, separating, characterizing chemical compounds and chemical reaction with the help of sophisticated instruments.
PSO 3: Skills related to employability: Develop deep knowledge in some applied areas of chemistry such as pesticides chemistry, pharmaceutical chemistry etc. which helps in employability.
PSO 4: Learning on life processes: Develop basic understanding of the role of chemistry in natural products as well as biological system.
### COURSES OFFERED IN BSC CHEMISTRY (HONOURS)

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**PROGRAM OUTCOMES – MSC PROGRAMME**

PO 1: Critical Thinking: Inculcate critical thinking to carry out scientific investigation objectively. Formulate coherent
arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

Critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.

PO 2: Knowledge Skill: Equip the student with skills to analyze problems, formulate an hypothesis, evaluate and validate results, and draw reasonable conclusions thereof. Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge.

PO 3: Scientific Communication Skills: Imbibe effective scientific and / or technical communication in both oral and writing. Ability to show the importance of the subject as a precursor to various scientific developments since the beginning of the civilization.

PO 4: Ethics: Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in the subject concerned. Ability to identify unethical behavior such as fabrication, falsification or misrepresentation of data and adoptive objective, unbiased and truthful actions in all aspects.

PO 5: Enlightened Citizenship: Create awareness to become an enlightened citizen with commitment to deliver one’s responsibilities within the scope of bestowed rights and privileges.

PO 6: Analytical Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.

PO 7: Multicultural Competence: Development of a set of competencies in order to enhance and promote the growth of multicultural sensitivity within universities. Integrating multicultural awareness such as race, gender, physical ability, age, income and other social variables, and by creating an environment that is “welcoming for all students”.

PO 8: Lifelong Learning: Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning throughout life, through self-paced and self-directed learning aimed at personal development, and adapting to changing academic demands of work place through knowledge/ skill development/reskilling.

PO 9: Leadership Qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination in a smooth and efficient way.

PO 10: Research Skills: Prepare students for pursuing research or careers in industry in concerned subject and allied fields. Capability to use appropriate software to solve various problems and to apply programming concepts of C++ and Mathematica/ Matlab to various scientific investigations, problem solving and interpretation.

PROGRAMME SPECIFIC OUTCOMES FOR MSC CHEMISTRY

PSO 1: Scientific Problem solving skills: Deep knowledge of the topic which can develop the problem solving skills using chemical principles.

PSO 2: Analytical skills: Develop analytical skills such as synthesizing, separating, characterizing chemical compounds and chemical reaction with the help of sophisticated instruments.

PSO 3: Research skills: Develop research skills through dissertation/Project work in different fields of chemistry such as organic, nanoscience, analytical, physical etc.

PSO 4: Learning skills on life processes: Acquire advanced level of knowledge in natural products as well as biological system from the chemistry point of view.

COURSES OFFERED IN MSC CHEMISTRY

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### Value Added Course

#### MSC Chemistry - Mapping of Courses to PO/PSO

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THEORY COURSES

CHE50002: Environmental Studies
(2-0-0)

Course Outcomes
1. Recall the multidisciplinary nature of environmental studies. (Remembering)
2. Explain ecological processes of natural resources. (Understanding)
3. Categorize different types of natural resources. (Analysing)
4. Evaluate the global scale of environmental pollution. (Evaluating)

Module I: The Multidisciplinary Nature of Environmental Studies (3 lectures)
Definition, scope and importance, need for public awareness.

Module II: Natural Resources (3 lectures)
a. Different types of natural resources and associated problems - forest resources, water resources, mineral resources, food resources, energy resources, land resources.
b. Conservation of natural resources.

Module III: Ecosystems (4 lectures)
a. Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energyflow in the ecosystem, food chains, food webs.
b. Structure of following ecosystems - forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems.

Module IV: Biodiversity and Its Conservation (4 lectures)
Types of biodiversity – genetic, species and ecosystem, value of biodiversity, global biodiversity, India as a mega-diversity nation, threats to biodiversity, conservation of biodiversity - in-situ and ex-situ conservation.

Module V: Environmental Pollution (6 lectures)
a. Definition, causes, effects and control measures of - air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards and e-pollution.
b. Solid waste management.
c. Disaster management.

Module VI: Social Issues and the Environment (6 lectures)
a. From unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, climate change, global warming, acid rain, ozone layer depletion.
b. Environment protection act.
c. Introduction to environmental impact assessment.

Module VII: Human Population and the Environment (4 lectures)
Population growth and sex ratio; Population explosion - family welfare programme; Environment and human health; HIV/AIDS; Role of information technology in environment and human health.

Suggested Readings
2. Fundamentals of Environmental Studies, S. Somvanshi and R. Dhupper, S.K. Kataria and Sons Publisher.

Mapping of COs to Syllabus

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CHIC0003: Fundamentals of Inorganic Chemistry
(4-0-0)

Course Outcomes
1. Recall the fundamental concepts associated with hard and soft acids and bases. (Remembering)
Course Outcomes

2. Explain the general characteristics and applications of coordination compounds. (Understanding)
3. Make use of the electronic spectra to understand the electronic transition in coordination complexes. (Applying)
4. Analyse the Metal-ligand bonding in transition metal complexes. (Analysing)
5. Explain the Magnetic properties of transition metal complexes. (Evaluating)
6. Design complexes of transition metal and predict their electronic and magnetic properties. (Creating)

Module I: Concepts of Acids and bases (10 lectures)
Hard and soft acid-base concept, non-aqueous solvents, redox chemistry.

Module II: Transition Metal Chemistry (8 lectures)
Descriptive chemistry of transition metals including lanthanides and actinides, coordination chemistry - coordination number and geometry, isomerism, thermodynamic stability - successive and overall stability constants, Irving-William series, chelate and macrocyclic effects.

Module III: Bonding in Inorganic and Coordination Compounds (20 lectures)
VBTS (hybridization), CFT and their limitations, ligand field theory, d-orbital wave functions, d-orbital splitting in octahedral, square planar, square pyramidal, trigonal bipyramidal, and tetrahedral complexes; Jahn-Teller distortion, CFSE for d1 to d10 systems, pairing energy, low-spin and high-spin complexes and molecular orbital (MO) theory of selected octahedral, tetrahedral complexes and other geometries, Walsh Diagram.

Module IV: Electronic Spectra of Transition Metal Complexes (12 lectures)
d-d transition, charge transfer transition, color, intensity and origin of spectra, interpretation, term symbols and splitting of terms different geometries, selection rules for electronic transitions, correlation, Tanabe-Sugano and Orgel diagrams, calculation of Dq, B and C, nephelauxetic ratio.

Module V: Magnetic Properties of Transition Metal Complexes (10 lectures)
Magnetic properties of free ions, types of magnetic behavior: dia-, para-, ferro- and antiferro-magnetism, temperature independent paramagnetism, magnetic susceptibility - Van Vleck equation, experimental measurement, magnetic moment - orbital contribution, quenching of contribution, effect of spin orbit coupling, spin crossover, temperature dependence of magnetic susceptibility, exchange coupling effects, magnetic properties of second and third transition series and lanthanides.

Suggested Readings
2. Ligand Field theory and its Applications, B. N. Figgis and M. A. Hitchman, Wiley India.

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CHOC0004: Fundamentals of Organic Chemistry
(4-0-0)

Course Outcomes
DEPARTMENT OF CHEMISTRY

1. Recall various concepts associated with the kinetics of organic reaction mechanisms. (Remembering)
2. Explain the generation and application of different reaction intermediates in organic synthesis. (Understanding)
3. Analyse Point group of organic molecules and their connection with optical activity. (Analysing)
4. Determine the absolute or relative configuration of chiral organic molecules and design asymmetric synthesis. (Evaluating)
5. Predict the stereochemistry of the product of different reactions. (Creating)

Module I: Kinetics and Energetics of Reaction Mechanism (15 lectures)
Transition state theory of reaction rates - kinetics and thermodynamics of activation, reaction profiles for multistep reactions, Hammond postulate, Curtin-Hammett Principle, kinetic and thermodynamic control, Linear free energy relationships (LFER), Hammond equation - substituent and reaction constants, the Taft treatment of polar and steric effects in aliphatic compounds, kinetic isotope effects in organic reactions, effects of conformation on reactivity, stereoelectronic effects, neighbouring group participation, anomeric effect.

Module II: Reaction Mechanisms and Intermediates (Structure and Reactivity) - I (15 lectures)
a. Carbanions: enolates and enamines, kinetic and thermodynamic enolates, lithium and boron enolates in Aldol and Michael reactions, alkylation and acylation of enolates, name reactions under carbanion chemistry - Claisen, Dieckmann, Knoevenagel, Stobbe, Darzen, Acyloan condensations, Shapiro reaction, Julia olefination, Brookrearrangement, Sakurai reaction, Henry reaction, Kulinkovich reaction, Nef reaction, Baylis-Hillman reaction.
b. Ylids: Chemistry of phosphorous and sulfur ylids - Wittig and related reactions, Peterson olefination.
c. Carbocations: structure and stability of carbocations, classical and non-classical carbocations, neighbouring group participation and rearrangements including Wagner-Meerwein, pinacol-pinacolone, semi-pinacol rearrangement, C-C bond formation involving carbocations, oxymercuration, halolactonisation, Tishchenko reaction, Ritter reaction, Prins reaction.

Module III: Reaction Mechanisms and Intermediates (Structure and Reactivity) – II (15 lectures)
a. Carbenes and Nitrenes: Structure of carbenes, generation of carbenes, addition and insertion reactions, rearrangement reactions of carbenes such as Wolff rearrangement, generation and reactions of ylids by carbene decomposition (existence of O and N based ylids), Structure of nitrile, generation and reactions of nitrile and related electron deficient nitrogen intermediates, Curtius, Hoffmann, Schmidt, Beckmann rearrangement, structure and reactivity of benzynes.
b. Radicals: Generation of radical intermediates and its addition to alkenes, alkynes (inter &intramolecular) for C-C bond formation and Baldwin’s rules, name reactions involving radical intermediates such as Barton deoxygenation and decarboxylation, Mc Murry coupling.

Module IV: Stereochemistry (15 lectures)
a. Classification of organic molecules into different Point Groups, R and S, and E and Z nomenclature in C, N, S, P containing compounds, concept of absolute and relative configuration, chirality in molecules devoid of chiral centres - allenes, spiranes and biphenyls.
c. Dynamic stereochemistry, stereoselective synthesis, classification of stereoselective synthesis, diastereoselective, enantioselective and double stereo-differentiating reactions, nucleophilic addition to aldehyde and acyclic ketones, Prelog’s rule, nucleophilic addition to cyclic ketones.
d. Enantioselective synthesis, use of chiral reagent, chiral catalyst and chiral auxiliary, stereospecific and stereoselective reactions.

Suggested Readings
2. Steroelectronic Effects, A. J. Kirby, OUP.

Mapping of COs to Syllabus

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CHPC0005: Fundamentals of Physical Chemistry  
(4-0-0)

Course Outcomes
1. Explain the laws of thermodynamics. (Understanding)
2. Explain the methods to determine the properties of polymers. (Understanding)
3. Explain the various terms involved in data analysis. (Understanding)
4. Apply the laws of thermodynamics and kinetics of polymerization to solve problems. (Applying)
5. Distinguish between different types of systems, polymers and various statistical parameters. (Analysing).
6. Calculate the sizes of polymer molecules and analyses the results of different chemical experiments from the statistical point of view. (Evaluating)

Module I: Equilibrium and Non-Equilibrium Thermodynamics (22 lectures)

a. Laws of thermodynamics, state and path functions and their applications, Maxwell’s relations, spontaneity and equilibria, Le Chatelier principle.
c. Phase equilibrium - thermodynamic criteria of phase equilibrium, Gibbs phase rule and its application to three component systems - triangular plots - water-acetic acid-chloroform system and ammonium chloride-ammonium sulphate-water system.
d. Non-equilibrium thermodynamics - forced flows and entropy of production, coupled flows and phenomenological relations, Onsager reciprocal relations, thermodynamic effects-Seebeck, Peltier and Thomson effects.

Module II: Statistical Thermodynamics (22 lectures)

a. Statistical mechanics of systems independent particles - Maxwell Boltzmann distribution, entropy and probability, calculation of thermodynamic properties for independent particles, molecular partition functions, evaluation of translational, rotational and vibrational and nuclear partition functions.
b. Thermodynamic properties of monatomic and diatomic gases (Suckur Tetrode equation), calculation of partition functions, thermodynamic function, principles of equipartition, heat capacities (Einstein model and Debye modification), residual entropy, equilibrium constant.

Module III: Polymer Chemistry (8 lectures)

Molecular weight of polymers, determination of molecular weight, kinetics of polymerization reaction, copolymerization, average dimension of polymer molecules, size exclusion chromatography.

Module IV: Sampling and Data Analysis (8 lectures)

Sampling of solid, liquid and gaseous samples, mean and standard deviation, absolute and relative errors, linear regression, covariance and correlation coefficient.

Suggested Readings
2. Physical chemistry, I. R. Levine, Mcgraw Hill Education.
4. Physical Chemistry, R. S. Berry, S. A. Rice and J. Ross, Oxford University Press.
5. Statistical Mechanics, D. A. McQuarrie, University Science Books, California.

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**CHIR0007: Advanced Inorganic Chemistry I**

(4-0-0)

**Course Outcomes**
1. Recall the concepts of organometallic chemistry. (Remembering)
2. Illustrate the photochemistry of different inorganic compounds. (Understanding)
3. Select the inorganic compounds for their suitable analytical and industrial use. (Applying)
4. Analyse the structure, bonding and synthesis of some inorganic compounds. (Analysing)
5. Explain the bonding in solid-state chemistry. (Evaluating)
6. Discuss the mechanism of Inorganic reactions. (Creating)

**Module I: Descriptive Inorganic Chemistry (20 lectures)**
- b. Silanes, silicon halides, silicates, silicones, silanols, zeolites, germanium, tin and lead organyls, silenes, germanes, stannenes, phosphorous halides, phosphazenes, sulphur halides, structural features and reactivity of S-N heterocycles.
- c. Synthesis and reactivity of organo-lithium, beryllium and magnesium compounds, calixarines, cryptands and crown ethers in complexation chemistry.
- d. Preparation and reactivity of aluminium organyls, carbalumination, hydro alumination, chemistry of Ga (I) and In (I), reduction of Al, Ga and In organyls, Metal organic framework structures (MOFs).

**Module II: Introduction to Solid State Chemistry (10 lectures)**
Structure of simple solids – metals, alloys and compounds; common structure types; synthesis of solid state compounds - ceramic method, microwave synthesis, sol-gel, precursor method, hydrothermal synthesis, CVD and intercalation; characterization of solids, bonding in solids – free-electron and molecular orbital theory; bands in solid state compounds, properties of solids – optical, magnetic and electrical properties of solids.

**Module III: Organometallic Chemistry (15 lectures)**
- a. Valence electron count (16/18 electron rules), synthesis, structure, bonding and reactivity of mono and polynuclear metal carbonyls, substituted metal carbonyls, vibrational spectra of metal carbonyls, metal-metal bonding.
- b. Types of M-C bonds, synthesis and reactivity of metal alkyls, carbenes, alkenes, alkyne s and arene complexes, metalloenes and bent metalloenes, isolobal analogy.

**Module IV: Mechanism of Inorganic Reactions (10 lectures)**
Substitution in octahedral and square planar complexes, lability, trans-effect, conjugate base mechanism, racemisation, electron transfer reactions - inertia and lability, inner sphere and outer sphere mechanism, Marcus theory, solid state reactions – topotactic and epitactic mechanisms.

**Module V: Inorganic Photochemistry (5 lectures)**
Photosubstitution and photoredox reactions of chromium, cobalt and ruthenium compounds, Ligand field and charge transfer state (Thexi and DOSENCO states), cis-trans isomerization, photocatalysis and solar energy conservation by ruthenium complexes.

**Suggested Readings**

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CHOG0008: Advanced Organic Chemistry-I

Course Outcomes
1. Recall nucleophilic and electrophilic substitution reactions and the factors related to the rate of these reactions. (Remembering)
2. Explain the stereo chemical aspects and mechanism of elimination reactions. (Understanding)
3. Apply the practical utility of metal and metal-free oxidising agents in organic synthesis. (Applying)
4. Compare various kinds of reducing agents in chemo selective and stereo selective synthesis. (Analysing)
5. Select name reactions for constructing compounds having industrial and academic importance. (Evaluating)

Module I (15 lectures)
a. Nucleophilic Substitution: $S_n1$, $S_n2$ and related mechanisms; Factors influencing reaction rates; Neighboring group participation by $\pi$- and $\sigma$-bond; Anchimeric assistance; Aromatic Nucleophilic Substitution: The $SNAr$, $S_n1$, benzyne and $SR_n1$ mechanisms. Reactivity; effect of substrate structure, leaving group and attacking nucleophile; The $S_n2$ mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinyl carbon. Aromaticity, antiaromaticity and homoaromaticity.
b. Electrophilic Substitution: Aliphatic: Bimolecular mechanisms: SE1, SE2 and SEi. The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity. Aromatic: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems.

Module II (15 lectures)
a. Elimination reactions: Mechanism and stereochemistry of different types of elimination reactions; Effects of substrate structure, attacking base, leaving group and medium; Formation of other double bonds ($C=\pi$, $C=O$) and triple bonds by elimination reactions; Mechanism and orientation in pyrolytic elimination.
b. Miscellaneous Reactions: Biginelli reaction, Passerini reaction, Nazarov cyclisation, Pd-catalyzed reactions, Vilsmeier Hack reaction, Ugi reaction, Robinson annulations, Mitsonobu reaction, Appel reaction, Favoriskii rearrangement.

Module III: Oxidation Reactions (15 lectures)
Metal and non-metal based oxidations (Cr, Mn, Al, Ag, Os, Ru, Se, DMSO, hypervalent iodine), reagents (Fremy’s salt, silver carbonate, peroxides/per-acids), Sharpless asymmetric epoxidation, Jacobsen epoxidation, Shi epoxidation, Sharpless asymmetric dihydroxylation, Baeyer-Villiger oxidation, Wacker oxidation, hydroboration-oxidation, Prevost reaction and Woodward modification.

Module IV: Reduction Reactions (15 lectures)
Catalytic hydrogenation (Pd/Pt/Rh/Ni), Wilkinson catalyst, Noyori asymmetric hydrogenation, metal based reductions using Li/Na/Ca in liquid ammonia, Sodium, Magnesium, Zinc, Titanium and Samarium (Birch, Pinacol formation, McMurry, Acyloin formation, dehalogenation and deoxygenations), Hydride transfer reagents from Group III and Group IV in reductions (NaBH$_4$/triacetoxyborohydride, L-selectride, K-selectride, Luche reduction, LiAlH$_4$, DIBAL-H, and Red-Al, Trialkylsilanes and Trialkylstannane, Meerwein-Pondorf-Verley reduction), stereo/enantioselective reductions (Chiral Boranes, Corey-Bakshi-Shibata).

Suggested Readings
7. Modern Synthetic Reaction, H. O. House, W. A. Benjamin Inc.

Mapping of COs to Syllabus
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CHAP0009: Advanced Physical Chemistry I
(4-0-0)

Course Outcomes
1. Recall the kinetics of different types of chemical reactions. (Remembering)
2. Explain the interactions of ion species with solvent molecules. (Understanding)
3. Apply the knowledge of chemical kinetics to some important types of reactions. (Applying)
4. Analyse the application of electrochemistry in different fields. (Analysing)
5. Calculate the rate of different types of chemical reactions. (Evaluating)

Module I: Chemical Kinetics (15 lectures)

Module II: Study of Fast Reactions (5 lectures)
Stopped flow technique, temperature and pressure jump methods, NMR studies in fast reactions, shock tube kinetics, relaxation kinetics, Linearized rate equation, relaxation time in single step fast reactions, determination of relaxation time.

Module III: Molecular Reaction Dynamics (15 lectures)
Collisions of real molecules- trajectory calculations, Laser techniques, reactions in molecular beam, reaction dynamics, estimation of activation energy and calculation of potential energy surface- the transition state theory (TST) of bimolecular gaseous reactions, statistical and thermodynamic formulations. Comparison between TST and hard sphere collision theory, theory of unimolecular reactions- Lindemann theory and its limitations, kinetics of reactions in solution-diffusion controlled and chemically controlled reactions, TST of reactions in solution- Bronsted and Bjerrum equation, effect of ionic strength, kinetic salt effect.

Module IV: Electrochemistry - I (10 lectures)
a. Ion-solvent interaction- the Born model, Thermodynamic parameters of ion solvent interactions- structural treatment, the ion-dipole model-its modifications, ion-quadrupole and ion-induced dipole interactions.
b. Primary solution- determination of hydration number, compressibility method and viscosity-mobility method, Debye-Huckel theory of ion-ion interactions, derivation, validity and limitations, extended Debye-Huckel-Onsager equation, random walk model of ionic Diffusion-Einstein Smoluchowski reaction.

Module V: Electrochemistry – II (15 lectures)
a. Theories of Electrical Interface: Electrocapillary phenomena - Lippmann equation, electron transfer at interfaces, polarizable, non-polarizable and non-polarisable interfaces, Butler-Volmer equation, Tafel plot.
b. Electro-analytical Techniques: Potential step methods, potential sweep methods, Polarography and Pulsevoltammetry, controlled current techniques, techniques based on impedance.
c. Systems for Electro-Chemical Energy Storage and Conversion: Types of Batteries, Lead- acid batteries, Nickel-cadmium batteries and Li-ion batteries, electrical double layer capacitor, pseudo-capacitor, fuel cells.

Suggested Readings
2. Physical chemistry, I. R. Levine, Mcgraw Hill Education.

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DEPARTMENT OF CHEMISTRY
CHGC0011: An Introduction to Environmental and Green Chemistry

Course Outcomes
1. Recall the basic concepts of green chemistry. (Remembering)
2. Explain the principles of green chemistry, green reaction conditions, renewable sources of energy etc. (Understanding)
3. Apply the concept of green chemistry in the applied research field. (Applying)
4. Analyse and solve the problems related to the environment. (Analysing)
5. Identify the causes of environmental degradation and find solutions for its protection. (Applying)

Module I: Environmental pollution (15 lectures)
Chemistry and environmental pollution: Chemical hazards, chemical disasters, Water pollution, air pollution and soil pollution; agricultural pollution, pollution by plastics; environmental biochemistry, toxicological chemistry, e-pollution and nuclear hazard. Environmental analysis: Analysis of water and wastewater, solid-wastes and air pollution.

Module II: Environmental protection (10 lectures)
Environmental protection: pollution prevention, green chemistry, biodegradation, water and wastewater purification – removal of arsenic, iron, fluoride, etc.; air purification, waste minimization, industrial and municipal waste treatment and soil remediation.

Module III: Principles and concepts of Green Chemistry (10 lectures)
Green chemistry: Principles of green chemistry, development of green chemistry; atom economy reactions – rearrangement reactions, addition reactions; atom uneconomic reactions– sublimation, elimination; toxicity measures, need of green chemistry in day-to-day life.

Module IV: Emerging Green Technology and alternative energy sources (10 lectures)
Design for energy efficiency, photochemical reactions – advantages, disadvantages; microwave technology in chemistry - microwave heating, microwave assisted reactions, ultrasound assisted reactions, reactions in organic liquids, reactions in aqueous media, electrochemical synthesis- examples. Supercritical solvents, ionic liquids, green catalyst, auto-exhaust catalyst and clean technology. Real world examples.

Suggested Readings
4. Green Chemistry: An Introductory Text, M. Lancaster, RSC.
6. M. C. Cann and M. E. Connelly, Real World Cases in Green Chemistry, ACS.

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CHAI0012: Advanced Inorganic Chemistry II
(4-0-0)

Course Outcomes
1. Recall the concepts of analytical techniques used in inorganic analysis. (Remembering)
2. Illustrate the role of metal ions in the function of biological macromolecules. (Understanding)
3. Apply the special Analytical Techniques for the characterization of inorganic compounds. (Applying)
4. Analyse the principles and application of Nuclear and Radiochemistry. (Analysing)
5. Explain the nature of supramolecular interactions. (Evaluating)
6. Develop a fundamental knowledge of nanomaterials. (Creating)

Module I: Special Analytical Techniques (25 lectures)
a. Principles and applications of Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDS/EDX),

b. Principles and applications of atomic absorption spectroscopy, atomic emission spectroscopy, Infrared and Raman Spectroscopy, Magnetic Resonance Spectroscopy- Electron Spin Resonance (ESR) of $d^4$ and $d^5$ transition metal ions in cubic and tetragonal ligand fields, applications of $^{31}$P, $^{19}$F, $^{119}$Sn and $^{195}$Pt nuclear magnetic resonance (NMR) spectroscopy.

Module II: Bioinorganic Chemistry (15 lectures)
Role of metal ions in biology and their toxic effects; Iron management in biological systems— siderophores, ferritin and transferrin; Dioxygen storage and transport – structure of myoglobin and haemoglobin, cooperativity of $O_2$ binding in haemoglobin, Bohr effect and Hill coefficients; Electron transfer proteins (structure and function) - Fe-S proteins, cytochromes and plastocyanines; Structure of nitrogenase and its role in di-nitrogen fixation; Structure and function of vitamin B$_{12}$ and mechanism of 1,2-shift reaction; Inorganic therapeutics - chelate therapy, metal based drugs.

Module III: Introduction to Supramolecular Chemistry (5 lectures)
Supramolecular chemistry: Definition, supramolecular host-guest compounds, macrocyclic effect, nature of supramolecular interactions.

Module IV: Introduction to Nanomaterials (5 lectures)
Fabrication of nanomaterials – top-down and bottom-up approaches; solution-based synthesis of nanoparticles; other methods of nanomaterial synthesis – brief overview. Carbon fullerenes and nanotubes. Applications of nanoparticles.

Module V: Nuclear and Radiochemistry (10 lectures)
Radioactive decay and equilibrium. Mass defect and binding energy, packing fraction, stability of nucleus, neutron-proton ratio, Artificial radioactivity. Nuclear reactions; Q value, cross sections, types of reactions, Chemical effects of nuclear transformations; fission and fusion, fission products and fission yields. Radioactive techniques; nuclear reactors, separation of isotopes; tracer technique, neutron activation analysis, counting techniques such as G.M. ionization and proportional counter. Application of radio-isotopes in agriculture, medicine and industry. Radiocarbon dating.

Suggested Readings
8. Supramolecular chemistry, J. W. Steed and J. L. Atwood, John Wiley
12. Perspectives in Supramolecular Chemistry and Molecular Recognition, G. R. Desiraju, Wiley.

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CHAO00013: Advanced Organic Chemistry-II
(4-0-0)

Course Outcomes
1. Recall the principles of organic photochemistry, pericyclic reactions. (Remembering)
2. Explain the theories related to pericyclic reactions. (Understanding)
3. Apply the knowledge of different reactions in research and industrial field. (Applying)
4. Analyse the problems related to photochemistry and synthetic strategy. (Analysing)
5. Demonstrate different theories in pericyclic reaction and photochemistry to check the feasibility of chemical reactions. (Understanding)

Module I: Organic Photochemistry (15 lectures)

a. Introduction to organic photochemical-photophysical processes, chemiluminescence, photosensitization.


Module II: Pericyclic Reactions (15 lectures)

Main features of pericyclic reactions; Woodward-Hoffman rules, correlation diagram and FMO approaches; Electrocyclic reactions – conrotatory and disrotatory motions for 4n and 4n+2systems; Cycloadditions – antarafacial and suprafacial additions, [2+2] and [4+2] reactions (hv and Δ), 1,3-dipolar cycloadditions and chelotropic reactions; Sigmatropic[i,j] shifts of C-H and C-C bonds; Sommelet-Hauser, Claisen, thio-Claisen, Cope and aza-Cope rearrangements.

Module III: Introduction to Heterocyclic chemistry (15 lectures)

Nomenclature of heterocyclic compounds. Structure, reactivity, synthesis and reactions Pyridine, quinoline, Isoquinoline, Indole, Benzofuran, Benzothiophene, pyrazole, Imidazole, oxazole, Isoxazole, Thiazole, Isothiazole, pyridazine, pyrimidine and pyrazine.

Module IV: Synthetic Strategies (15 lectures)

Synths and synthetic equivalents, disconnection approach, functional group inter-conversions, importance of order of events in organic synthesis, one group and two group C-X disconnections, chemo selectivity, reversal of polarity, cyclisation reactions, amine synthesis.

One group C-C disconnections – alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.

Two group C-C disconnections – Diels-Alder reaction, 1,3-difunctionalised compounds, α, β-unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael addition and Robinsonannelation. Principle of protection of alcohol, amine, carbonyl and carboxyl groups; Common protecting groups.

Suggested Readings

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CHAP0014: Advanced Physical Chemistry II
(4-0-0)

Course Outcomes
1. Recall the basic structure and properties of solids. (Remembering)
2. Explain the electrical properties in terms of semiconductor, superconductor etc. (Understanding)
3. Interpret the results of problems related to adsorption processes and electro kinetic phenomena of surfaces.(Applying)
4. Analyse the process of surface adsorption and types of different catalysed reactions. (Analysing)
5. Apply the properties of solids to interpret the conducting behaviour of different types of materials. (Applying)

Module I: Solid state (18 lectures)

Module II: Surface Chemistry (22 lectures)

b. Reverse micelle and its application, solubilization, microemulsion.

Module III: Catalysis and Photochemistry (20 lectures)


Suggested Readings

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CHSP0015: Special Topics in Biochemistry
(3-0-0)

Course Outcomes
1. Recall the characteristic, properties of carbohydrates. (Remembering)
2. Explain the synthesis and biosynthesis of different biomolecules. (Understanding)
3. Distinguish between the physical, chemical and biochemical properties of amino acids, proteins, peptides, enzymes etc. (Analysing)
4. Explain the chemistry of nucleic acids. (Understanding)
5. Explain the importance of vitamins for a living being. (Understanding)

Module I: Carbohydrates (9 lectures)
Characteristics and properties of carbohydrates – nomenclature and stereochemistry of monosaccharides, typical carbohydrates, sweetening agents; chemistry of monosaccharides – cyclic structures, Haworth and conformational representations, oxidation, determination of ring size, structure of correlations, synthesis, glycosides; Oligosaccharides and Polysaccharides – sucrose and other oligosaccharides, starch, cellulose and other polysaccharides.

Module II: Lipids (9 lectures)

a. Glycerol derivatives- fats and oils, fatty acid biosynthesis, phospholipids, glycolipids, properties of lipid aggregates, micelles, bilayers, liposomes and biological membranes.
b. Steroids – structural characteristics, synthesis and biosynthesis, steroid hormones; prostaglandins – structural characteristics, synthesis and biosynthesis.
c. Pheromones – structure and origin, synthesis.

Module III: Nucleosides, Nucleotides and Nucleic acids (9 lectures)

a. Nucleosides and Nucleotides: The structure of nucleosides, chemistry of nucleosides, nucleotides; sunlight, carbohydrates and energy – photosynthesis, glycolysis and metabolic energy.
b. Nucleic acids: Structure and function of DNA, RNA (m-RNA, t-RNA, r-RNA), an overview of gene expression (replication, transcription and translation), genetic code (origin, Wobble hypothesis and other features), genetic errors, carcinogenesis
and recombinant DNA technology.

**Module IV: Amino acids, Peptides and Proteins (9 lectures)**

a. Amino Acids – structural characteristics, acid-base properties, synthesis.
b. Peptides – amino acid analysis, terminal group analysis, the amino acid sequence, synthesis; Proteins, enzymes and biosynthesis – the alpha-helix, other secondary and tertiary structural characteristics, enzymes; protein synthesis.

**Module V: Vitamins (9 lectures)**

Vitamins: Classification; occurrence; chemistry of Vitamins – structure elucidation and synthesis; biochemical functions; deficiency syndromes.

**Suggested Readings**


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**CHRM0017: Research Methodology for Chemistry**

(3-0-0)

**Course Outcomes**

1. Explain the different methods of scientific Research. (Understanding)
2. Explain how to use e-resources for research. (Understanding)
3. Explain the analysis and presentation of data. (Understanding)
4. Apply the knowledge of chemical safety and handle chemicals safely in the lab. (Applying)
5. Construct a proposal for project funding. (Creating)

**Mode of Assessment:**

Modules I-II will be assessed based on a written examination (2 credits) while Module III will be assessed on the basis of a seminar (1-credit).

**Module I: Methods of Scientific Research and Chemical Safety (15 lectures)**

a. Print resources, digital resources, information technology and library resources, reporting practical and project work, writing literature surveys and reviews, organizing a poster display, giving an oral presentation, writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publication of scientific work; writing ethics – avoiding plagiarism.
b. Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals, overview of chemical regulations in India.

**Module II: Data Analysis (15 lectures)**

The Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments.


**Module III: Project Proposal Writing (Seminar Module) (15 lectures)**

In this module, students will be reviewing scientific articles, writing reports on the papers they have read and finally prepare a
research proposal.

**Suggested Readings**

4. Quantitative chemical analysis, D. C. Harris, Freeman.
5. How to use Excel in analytical chemistry and in general scientific data analysis, R. de Levie, Cambridge Univ. Press.
7. OSU safety manual 1.01.

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**CHMC0018: Materials Chemistry**

(3-0-0)

**Course Outcomes**

1. Recall the knowledge of the basic structure of materials. (Remembering).
2. Explain how molecular structure affects the properties of materials. (Understanding)
3. Explain the properties of different materials based on their structures. (Applying)
4. Analyse the application of different types of materials in a different field. (Analysing).
5. Predict and control material properties. (Creating)

**Module I: Solid state ionic conductors (11 lectures)**

Structure, physico-chemical principles, applications of Ferrous alloys, Fe-C phase transformations in ferrous alloys, non-ferrous alloys, properties and applications of ferrous and non-ferrous alloys, magnetic alloy, metallic glass, ceramics, nano-materials and optical materials.

**Module II: Polymers materials and inorganic Polymers (12 lectures)**

a. Molecular shape, structure and configuration, crystallinity, stress-strain behaviour, thermal behaviour, polymer types and their applications, conducting and ferro-electric properties.

b. Polysiloxanes, polysilanes, polyphosphazenes, polymeric sulphur - synthesis, structure, properties and applications, coordination polymers and organometallic polymers.

**Module III: Liquid crystals and high-temperature superconductors (High-Tc or HTS) materials (12 lectures)**

Nematic, smectic, cholesteric - properties and applications, high Tc materials, defect perovskites, high Tc superconductivity in cuprates, 1-2-3 and 2-1-4 materials, anisotropy, temperature dependence of electrical resistance, optical phonon modes, superconducting state, heat capacity, coherence length, elastic constants, position lifetimes, micro-wave absorption pairing and multi gap structure in high Tc materials, applications of high Tc materials.

**Module IV: Organic solids and molecular devices (10 lectures)**

a. Conducting organics, organic superconductors, magnetism in organic materials, fullerenes, doped fullerenes as superconductors.


**Suggested Readings**


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CHCC0019: Computational Chemistry  
(3-0-0)

Course Outcomes
1. Recall the programming and some numerical methods in Chemistry. (Remembering)
2. Explain the molecular mechanics methods. (Understanding)
3. Apply QM/MM methods in organic, inorganic and organometallic systems. (Applying)
4. Explain the quantum mechanical methods. (Understanding)

Module I: Programming and some numerical methods in chemistry (10 lectures)
Introduction to Linux/UNIX and shell scripts; programming in C/python; Least squares fit; root finding; numerical differentiation; integration and solution of ODE; matrix multiplication, inversion and diagonalization; interpolation; pattern recognition techniques and molecular graphics.

Module II: Molecular Mechanics (MM) Methods (10 lectures)
Basic geometrical description of molecules; force field energy, force field parameterization, differences between force fields, computational considerations, validation of force fields, advantages and limitations of force field methods, transition structure modelling, hybrid force field – electronic structure methods.

Module III: Electronic structure (or Quantum Mechanical, QM) Methods (15 lectures)
Many electron systems, Hartree-Fock method, basis sets, electron correlation and its treatment, basics of density functional theory, DFT based reactivity descriptors. Introduction to popular softwares (like Gaussian, Dmol, GAMESS). Applications to simple molecular systems. Monte Carlo and molecular dynamics simulations.

Module IV: Combined QM/MM methods (10 lectures)
Implications of the choice of QM and MM methods; Application of QM/MM methods in organic, inorganic and organometallic systems including bio-organic and bio-inorganic molecules. Quantitative structure activity relation (QSAR): Early approaches, topological indices, fragmental models; quantum mechanical descriptors.

Suggested Readings
4. Introduction to computational chemistry, F. Jensen, John Wiley and Sons Press.

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CHFC0020: Food Chemistry  
(3-0-0)

Course Outcomes
1. Recall the relationship between food, nutrition and health. (Remembering)
2. Explain the nutritional needs during the life cycle and nutritional deficiency and their prevention. (Understanding)
3. Apply the knowledge of food chemistry for entrepreneurial development. (Applying)
4. Explain the sources, functions of major nutritional constituents. (Analysing).
5. Outline the changes in nutrition during cooking, ripening, storage of different categories of food. (understanding)
6. Explain nutritional perspectives of diets. (understanding)

**Module I: Basic idea of food and nutrients (2 lectures)**
Relationship between food, nutrition and health; functions of food: physiological and social.

**Module II: Major nutritional constituents (12 lectures)**
Functions, sources, deficiency/excess diseases of the following major nutrients: (a) Carbohydrates; (b) Amino acids and proteins; (c) Lipids, sterols, metabolite; (d) Mineral; (e) Vitamins: A, D, E, K.

**Module III: Different categories of food (7 lectures)**
Selection, nutritional contribution and changes during Cooking/Ripening/storage of the following categories of food: (a) Cereals; (b) Pulses; (c) Fruits and vegetables; (d) Milk and milk products; (e) Egg, meat, poultry and fish; (f) Fats and oils.

**Module IV: Nutritional needs during life cycle (6 lectures)**

**Module V: Prevention and management of deficiencies (6 lectures)**
Causes, symptoms, treatments and prevention of the following: Protein-Energy malnutrition among children; Vitamin A deficiency; Iron deficiency; Fluorosis: Over nutrition, obesity, coronary heart diseases, Diabetes (Type I & II); Diet, Nutrition and cancer.

**Module VI: Dietary goals & guidelines (10 lectures)**
National Perspectives; nutritional perspectives of vegetarian diets; Social Health Issues – Smoking, Alcoholism, Drug Addiction, AIDS and AIDS Control Programs; Food Preservation & Food Additives & Colorants.

**Module VII: Entrepreneurship Development (2 lectures)**
Scope of food based items for Entrepreneur Development in North East India & Identification of Resources; Development of a Project Plan.

**Suggested Readings**
3. Handbook of Food and Nutrition, M. Swaminathan, BAPPCO.
5. Food Science, Nutrition and Food Safety, S. Sari, A. Malhotra, Pearson India Ltd.

**Mapping of COs to Syllabus**

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**CHIC0021: Industrial Chemistry**

(3-0-0)

**Course Outcomes**
1. Recall the origin, importance of elastomers. (Remembering)
2. Recall the classification, limitations of synthetic fibers. (Remembering)
3. Illustrate the classification and utility of fertilizers and pesticides. (Understanding)
4. Compare and Analyse different chemical reactions and procedures adopted in different industries. (Analysing)
5. Evaluate the challenges existing in the tea and sugar industries and suggest ways to overcome them. (Evaluating)
6. Explain the classes, manufacturing of different paints. (Understanding)

**Module I: Elastomers (7.5 lectures)**
Rubbers: origin, importance, types of rubber, natural rubber, gutta-percha, guayle rubber, balata. Refining of crude rubber, drawbacks of natural rubber, vulcanization, technique of vulcanization. Synthetic rubber, poly butadiene, buna –S or SBR
rubber, neoprene, nitrile rubber, butyl rubber, silicone rubber, & poly urethane.

**Module II: Synthetic Fibres (5 lectures)**
Introduction, natural and artificial fibres characteristics and limitations. Study of following synthetic fibres- Rayon (nitro cellulose) cupra ammonium rayon, acetate rayon, nylon 66, nylon-6, terylene (Dacron) Teflon & Saran.

**Module III: Fertilizers and Pesticides (10 lectures)**
1. Fertilizers: Plants nutrients, need for fertilizers, qualities of fertilizers, NPK ratio, classification of fertilizers, straight and mixed fertilizers. Nitrogenous fertilizers, manufacture of ammonium nitrate, urea, ammonium sulphate, phosphate fertilizers manufacture of triple phosphate and super phosphate, potassium fertilizers.

**Module IV: Sugar and Fermentation Industries (10 lectures)**
1. Sugar: Importance of sugar industry, manufacture of raw and refined sugar with flow sheet, estimation of sugar (physical and chemical methods).
2. Fermentation: Definition of fermentation, importance of various fermentation industries, basic requirements for fermentation, steps in fermentation process. Manufacture of alcohol from molasses, distillation, coffee still, preparation of absolute alcohol, various useful fractions and their uses, proof spirit, denatured spirit.

**Module V: Tea Industry (7.5 lectures)**
Chemical composition - an overview, Polyphenols in tea- Mechanism of theaflavin formation, biochemistry of tea - Biosynthesis of caffeine, Cinnamate, Flavonoids, Chemical properties of tea- Polyphenols as Antioxidants.

**Module VI: Paints (5 lectures)**
Introduction, classification of paints, constituents of paints, qualities of good paint, emulsion paints, paint removers, varnishes enamels, lacquers, thinners in brief.

**Suggested Readings**
1. Industrial Chemistry, B. K. Sharma, Goel Publishing House Meerut, India.

**Mapping of COs to Syllabus**

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**CHMD0022: Medicinal Chemistry**
(3-0-0)

**Course Outcomes**
1. Recall the definition of drugs and pro drugs and history of drug development. (Remembering)
2. Explain the mechanisms and theoretical aspects of drug action. (Understanding)
3. Explain the properties and synthetic methods of antibiotics, antiviral, antimalarials etc. (Understanding)
4. Explain the classes of neurotransmitters, drugs affecting cholinergic and adrenergic pathways. (Understanding)
5. Recall about antihistamines, anti-inflammatory drugs, analgesics, anticancer gene therapy etc. (Remembering)

**Module I: Introduction and History of Drug Development (5 lectures)**
Definition of drug and prodrugs; need of drugs; germ theory of diseases; history of sulpha drugs and their mode of action; antibacterial agents.

**Module II: Mechanisms and Theoretical aspects of drug action, drug discovery, design and delivery (10 lectures)**
Receptors – two-state model of receptor theory, drug-receptor interaction and Clark’s Occupancy Theory; physiological response; drug agonist and antagonist – classification; Need of quantification of drug action; definition of chemotherapeutic index and therapeutic index; factors affecting bioactivity of drugs; pharmacokinetics and pharmacodynamics; QSAR; Lead
compounds in drug discovery; importance of SAR and molecular modification; importance of combinatorial library and molecular modelling in drug discovery; drug delivery – controlled drug delivery methods.

**Module III: Antibiotics, Antivirals and Antimalarials (15 lectures)**

a. General introduction to antibiotics – their sources and classification; causes and concerns of bacterial resistance to antibiotics; definition and need of broad Spectrum Antibiotics. Mechanism of action of lactam antibiotics, non-lactam antibiotics and quinolones.


c. Antimalarials – classification of human malaria and plasmodia responsible for human malaria; discovery of quinine and its structure-activity-relationship (SAR), importance of quinine as a lead to the discovery of low cost antimalarials, artemisinin and its derivatives – their SAR and importance in dealing with chloroquine resistant malaria, mode of action.

**Module IV: Neurotransmitters (5 lectures)**

Classes of neurotransmitters, drugs affecting cholinergic and adrenergic pathways.

**Module V: Miscellaneous topics (10 lectures)**

Antihistamines, anti-inflammatory drugs, analgesics, anticancer and antihypertensive drugs, gene therapy, anti-sense and anti-gene strategies and drug resistance.

**Suggested Readings**

3. Introduction to Medicinal Chemistry, A. Gringauz, Wiley India Pvt Ltd.

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**CHRC0023: Recent Advances in Catalysis**

**Course Outcomes**

1. Recall the kinetics of heterogeneous catalysis. (Remembering)
2. Explain the preparation and characterization of industrial catalysts. (Understanding)
3. Explain the synthesis and properties of Zeolite and clays. (Understanding).
4. Explain the environmental catalyst and role of catalyst in the petroleum industry. (Understanding)

**Module I: Kinetics of heterogeneous catalysis (10 lectures)**

Adsorption and catalysis, mechanism of heterogeneous catalysis, kinetics of heterogeneous catalytic reactions, volcano principle, shape and size selectivity of catalysts, characterization of catalysts and their surfaces, methods of surface analysis, surface area, pore size, void fraction, particle size, mechanical strength, surface chemical composition, surface acidity and reactivity.

**Module II: Preparation and characterization of industrial catalysts (8 lectures)**

Catalyst design methods, catalyst support and preparation of industrial catalyst, supported and unsupported metal catalysts, bimetallic catalysts, Electron microscopy, XPS and PES, ESCA, IR and magnetic resonance spectroscopy, temperature programmed desorption (TPD), and DTA and TGA.

**Module III: Zeolite and clays (15 lectures)**

a. Synthesis of some selected important zeolites, modification of zeolites, ion exchange, metals supported on zeolites, dealumination and desilication of zeolites, shape selective catalysis in zeolites.

b. Properties of pillared clays, use of coordination and organometallic compounds as pillaring, pillaring of acid activated clays, mesoporous materials, ordered mesoporous materials, synthesis of silica molecular sieve materials, characterization of mesoporous molecular sieves, catalytic properties of mesoporous materials, catalytic applications of zeolite, clays and mesoporous materials.

**Module IV: Catalysis in petroleum industry and environmental catalysts (12 lectures)**

Design of catalytic reactors, promotion and promoters, catalytic processes in petroleum industry, reforming, cracking and
hydrotreating, hydrogenation, hydrodesulphurization, Fischer-Tropsch process, Catalytic deactivation and reactivation, control of pollution from automobile exhaust, catalytic converters, abatement of nitrogen oxides and odours, cleaning of industrial effluents.

Suggested Readings

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CHBC0024: Biophysical Chemistry
(3-0-0)

Course Outcomes
1. Recall the fundamentals of biological macromolecules. (Remembering)
2. Explain the molecular modelling and conformational analysis of biological macromolecules. (Understanding)
3. Explain different methods for analysis and separation of biomolecules. (Understanding)
4. Explain different techniques for the structural determination of biomolecules. (Understanding)
5. Explain different optical methods in biological systems. (Understanding)

Module I: Fundamentals of biological macromolecules (5 lectures)
Chemical bonds in biological systems; properties of water; thermodynamic principles in biological systems; properties and classification of amino acids; protein structure and function; properties of nucleosides and nucleotides; composition of nucleic acids; structure of nucleic acids.

Module II: Molecular modelling and conformational analysis (10 lectures)
Complexities in modelling macromolecular structure; polypeptide chain geometries and internal rotation angles; Ramachandran plots; Molecular mechanics; stabilizing interactions in biomolecules; simulating macromolecular structure; energy minimization; molecular dynamics.

Module III: Methods for analysis and separation of biomolecules (10 lectures)
General principles, chromatography; analytical centrifugation – basic principles, sedimentation velocity, sedimentation equilibrium, density gradient sedimentation – isopycnic and rate- zonal centrifugation; electrophoresis, isoelectric focusing; capillary electrophoresis, MALDI-TOF, calorimetry – introduction, isothermal titration calorimetry, differential scanning calorimetry.

Module IV: Structural determinations: Physical Methods (10 lectures)
Ultracentrifugation and other hydrodynamic techniques; light scattering – fundamental concepts, scattering from a number of small particles, Rayleigh scattering, scattering from particles that are not small compared to the wavelength of radiation, dynamic light scattering, low angle X-ray scattering, neutron scattering, Raman scattering.

Module V: Optical Methods and Applications (10 lectures)
Optical techniques in biological systems – refraction, evanescent waves and plasmons-surface plasmon resonance; absorption spectroscopy, fluorescence spectroscopy, linear and circular dichroism, single and multidimensional NMR spectroscopy.

Suggested Readings
3. Biophysical Chemistry the Royal Society of Chemistry, A. Cooper, UK.

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CHHC0025: Heterocyclic Chemistry
(3-0-0)

Course Outcomes
1. Recall the systematic nomenclature of heterocyclic compounds. (Remembering)
2. Explain the synthesis and properties of azoles and condensed five-membered rings. (Understanding)
3. Explain the synthesis and properties of three and four-membered heterocyclic compounds. (Understanding)
4. Explain the importance and chemistry of natural heterocyclic compounds. (Understanding)
5. Explain synthesis and properties of Diazines, bicyclic heterocycles & seven-membered heterocycles. (Understanding)

Module I: Introduction & Small Ring Heterocycles (10 lectures)
Hantzsch-Widman nomenclature for monocyclic, fused and bridged heterocycles; General approaches to heterocyclic synthesis; Aliphatic and aromatic heterocycles; Basicity and aromaticity of heterocycles. Syntheses of aziranes, oxiranes &thiranes; Ring openings and heteroatom extrusion; Synthesis & reactions of azetidines, oxetanes & thietanes; Strain.

Module II: Azoles and condensed five membered Rings (15 lectures)
Physical and chemical properties; Synthesis of pyrazole, isothiazole and isoxazole; Synthesis of imidazoles, thiazoles & oxazoles; Nucleophilic and electrophilic substitutions; Ring cleavages; Benzofused analogues. Synthesis of indole, benzofuran and benzo-thiophene; Nucleophilic, electrophilic and radical substitutions; Addition reactions; Indole rings in biology.

Module III: Diazines, bicyclic heterocycles & seven membered heterocycles (10 lectures)
Physical & chemical properties and synthesis of pyridazines, pyrimidines, pyrazines; Nucleophilic and electrophilic substitutions.
Synthesis of quinolines, isoquinolines, benzofused diazines, acridines, phenothiazines, carbazoles and pteridines; Substitution reactions.
Synthesis & reactions of azaepines, oxepines, thiepines & diazepines.

Module IV: Natural heterocycles (10 lectures)
a. Porphyrins: Classification and synthesis of porphin rings.
b. Nucleic Acids: Primary, secondary and tertiary structure of DNA; DNA replication and heredity; Structure and function of mRNA, tRNA and rRNA.
c. Proteins: Acid-base properties of amino acids; polypeptides; primary, secondary, tertiary and quaternary protein structures; classification of proteins on basis of structure and biological function; Merrifield peptide synthesis.

Suggested Readings

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CHNP0026: Natural Products Chemistry

Course Outcomes
1. Recall the chemistry of medicinal compounds of natural origin. (Remembering)
2. Explain the role of co-enzyme during Bio-synthesis of natural products. (Understanding)
Module I: Natural Products and their Biosynthetic Pathways (15 lectures)
General classification of natural products, sources and their isolation, characterisation and biosynthesis of common plant products; Extraction and Separation of Natural Products Biosynthesis pathways for natural products using co-enzymes and enzymes, general biogenesis and synthesis of cis-jasmon, methyl jasmonate, prostaglandins, exaltone and muscone.

Module II: Terpenoids and Alkaloids (15 lectures)
Terpenes and the Isoprene Rule; General biosyntheses of mono- and sesquiterpenes, trans-chrysanthemic acid, cyclo-pentatetraene lactones; Synthesis of α-venetinone and total synthesis of β-eudesmol; Synthesis of hirsutene, abietic acid, cis juvenile hormone, trans annular cyclisation of caryophyllene; Synthesis of caryophyllene and isocaryophyllene; Rearrangements of santonic acid and thujsopene; Synthesis and rearrangement of longifolene; Structure, synthesis and biosynthesis of common alkaloids: reticuline, yohimbine and tylotropine.

Module III: Steroids (15 lectures)
Nomenclature of steroids and synthesis of squalene; Lanosterol and caretonoids; Synthesis of equeulins; Estrogens and total synthesis of non-aromatic steroids (progesterones); Corticosteroids; Degradation of diosgenin to progesterone and its synthesis; Miscellaneous transformations of steroid molecules.

Suggested Readings

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CHOC0027: Organometallic Chemistry
(3-0-0)

Course Outcomes
1. Recall the fundamentals of organometallic compounds and their reactions. (Remembering)
2. Explain the physical techniques required for the characterization of Organometallic compounds. (Understanding)
3. Explain the synthesis and application of the main group organometallic compounds. (Understanding)
4. Analyse the function of transition metal-based organometallic compounds. (Analysing)
5. Evaluate potential applications of Organometallic chemistry in organic synthesis. (Evaluating)
6. Design one-pot synthesis of complex molecules using organometallic chemistry. (Creating)

Module I: Introduction to organometallic compounds and reaction mechanisms (7 lectures)
History of Organometallic Chemistry, 18 electron rule, Electronic structure, Ligand substitution, oxidative addition, reductive elimination, migratory insertion, hydride elimination, trans-metallation, nucleophile and electrophilic attack on the ligands coordinated to metals.

Module II: Physical methods in organometallic chemistry (8 lectures)
Characterization of organometallic compounds using NMR, EPR, Mossbauer, IR, Mass spectroscopy and X-ray crystallography; Isotope effect; Fluxionality of organometallic complexes.

Module III: Main group organometallic compounds (8 lectures)
Synthesis and reactions of main group organometallic compounds including organo lithium, organo magnesium, organo boron, organo aluminium, organosilicon and organotin compounds.

Module IV: d-block organometallic compounds (8 lectures)
Structure, Preparation, and Chemistry of Transition metal carbene and –carbyne complexes. N-Heterocyclic Carbene complexes; Transition metal compounds with M-H bonds (classical and non-classical metal-hydrides), Agostic interaction.
Module V: Organometallic catalysis and application of organometallic chemistry to organic synthesis (14 lectures)

Suggested Readings

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CHIP0028: Inorganic Rings, Clusters and Polymers
(3-0-0)

Course Outcomes
1. Recall the knowledge of inorganic rings, clusters and inorganic polymers with respect to their structural diversity. (Remembering)
2. Illustrate different theories to predict the structure of metal clusters. (Understanding)
3. Make use of isolobal analogy in the understanding of structure and bonding of heteroboranes. (Applying)
4. Analyse the concept of electron deficiency and sufficiency of Polyhedral boranes. (Analysing)
6. Discuss the synthesis, structure, bonding and applications of inorganic polymers. (Creating)

Module I: Boranes and Heteroboranes (13 lectures)
Polyhedral boranes, concept of electron deficiency and sufficiency, types and IUPAC nomenclature of polyhedral boranes. Polyhedral skeleton electron pair theory (PSEPT). W. N. Equivalent and resonance structures. Wade’s vs Lipscomb’s methods of studying higher boranes.
Heteroboranes: types and IUPAC nomenclature, structure and bonding of heteroboranes with special reference to carboranes, Metallaboranes, Metallacarboranes, metal σ and μ bonded borane/carborane clusters. Resemblance of Metallaboranes/Metallacarboranes with ferrocene and related compounds. Applications of Metallaboranes/Metallacarboranes as drug delivery system. Applications of PSEPT over heteroboranes.

Module II: Isolobility (6 lectures)
Concept of isolobility and isolobal groups with examples. Its application in the understanding of structure and bonding of heteroboranes.

Module III: Metal Clusters (11 lectures)
Metal-metal bonding, quadrupolar bond and its comparison with a C-C bond; Types of metal clusters and multiplicity of M- M bonds. Simple and condensed metal carbonyl clusters. Applications of PSEPT and Wade’s-Mingo’s and Lauhr’s rule over metal carbonyl clusters. Metal halide and metal chalcogenide clusters, polyatomic Zintl ions, Bloomington shuffle.

Module IV: Inorganic Polymers (15 lectures)

Suggested Readings

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CHQT0029: Introduction to Quantum Chemistry and Group Theory

Course Outcomes
1. Recall the postulates and principles of quantum chemistry. (Remembering)
2. Explain the Schrodinger equation. (Understanding)
3. Solve the problems related to wave functions. (Applying)
4. Distinguish one approximation method from another, one molecular point group from another. (Analysing)

Module I: Quantum Chemistry I (20 lectures)
Planck's theory, wave-particle duality, uncertainty principle, operators, eigen functions and eigen values in quantum mechanics, postulates of quantum mechanics, Schrodinger equation, free particle, particle in a box, degeneracy, harmonic oscillator, rigid rotator, the hydrogen atom, angular momentum, electron spin, spin-orbit coupling.

Module II: Quantum Chemistry II (20 lectures)
Approximate methods in quantum mechanics - the variation theorem, linear variation principle and perturbation theory (first order and non-degenerate), application of variation method and perturbation theory to the Helium atom, anti- symmetry, Slater determinant, term symbols and spectroscopic states, Huckel approximation for small pi-conjugated molecules.

Module III: Chemical Applications of Group Theory (20 lectures)
Symmetry elements and operations, equivalent symmetry elements and equivalent atoms, identification of symmetry point groups with examples, groups of very high symmetry, molecular dissymmetry and optical activity, systematic procedure for symmetry classification of molecules and illustrative examples, brief review of matrix representation of groups, reducible and irreducible representations, rules about irreducible representations as derived from great orthogonality theorem, relationship between reducible and irreducible groups, character tables.

Suggested Readings
3. Introduction to Quantum mechanics, D. J. Griffiths, Pearson Education Ltd.

Mapping of COs to Syllabus

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CHFY0030: Fundamentals of Spectroscopy
(4-0-0)

Course Outcomes
1. Recall the fundamental aspects of absorption and emission spectroscopy. (Remembering)
2. Explain the basic concepts of rotational and vibrational spectroscopy. (Understanding)
3. Illustrate basics and applications of electronic spectra. (Understanding)
4. Explain theories and applications of NMR, ESR and Mossbauer spectroscopy. (Understanding)
5. Identify unknown molecules with the help of different spectroscopic techniques. (Applying)

Module I: Interaction of light with matter (5 lectures)
Fundamental aspects of absorption and emission spectroscopy, probability of transition, oscillator strength, dipole strength, Spontaneous and stimulated emission, origin of selection rules.

**Module II: Rotational and Vibrational Spectroscopy (15 lectures)**

Degrees of freedom of molecules, rigid rotor model, rotational spectra of diatomics and polyatomics, effect of isotopic substitution and non-rigidity, selection rules and intensity distribution, Vibrational spectra of diatomics, effect of anharmonicity, Morse potential, Vibrational-rotational spectra of diatomics, P, Q, R branches, normal modes of vibration, overtones, hot bands, Raman spectroscopy – Origin, rotational and vibrational Raman spectra of diatomics.

**Module III: Electronic Spectroscopy (15 lectures)**

Electronic spectra of diatomic molecules, Frank-Condon principle, vibronic transitions, Spectra of organic compounds, \( n \rightarrow \pi^* \), \( \pi \rightarrow \pi^* \) transition, Photoelectron Spectroscopy – basic principle, photoelectron spectra of simple molecules, X-ray photoelectron spectroscopy (ESCA), Auger electron spectroscopy, Lasers – Laser action, population inversion, properties of laser radiation, examples of simple laser systems.

**Module IV: Magnetic Resonance Spectroscopy (15 lectures)**

- **Nuclear Magnetic Resonance:** Nuclear spin and nuclear spin states in magnetic field, resonance phenomenon, relaxation process, NMR line shapes and saturation, shielding and deshielding of magnetic nuclei, chemical shift, spin-spin interactions, spectra of two-spin system (A1, AB and AX cases), \( ^{13}\text{C},^{19}\text{F} \) and \( ^{31}\text{P} \) NMR spectroscopy.
- **Electron Spin Resonance:** Basic principles, factors affecting g values, hyperfine coupling, spin densities and McConnell relationship, Zero field splitting.

**Module V: Mass spectrometry and Mossbauer spectroscopy (10 lectures)**

- **Mass spectrometry:** Basic principles, ionization techniques, isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation
- **Mossbauer spectroscopy:** Principles, instrumentation and applications.

**Suggested Readings**


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**CHAP0031: Applied Spectroscopy**

(3-0-0)

**Course Outcomes**

1. Recall various principles involved in UV-Visible spectroscopy. (Remembering)
2. Explain the theories and applications of IR and mass Spectrometry. (Understanding)
3. Apply the NMR spectroscopy for structural elucidation of simple and complex molecules. (Applying)
4. Explain the role of various spectroscopic tools required for analysing the structure of unknown molecules. (Analysing)
5. Interpret the progress of organic reactions by FT-IR spectroscopy. (Evaluating)

**Module I: Ultraviolet and visible spectroscopy (10 Lectures)**

Electronic transitions, chromophores, auxochromes, red and blue shift, applications of UV spectroscopy, spectrum shifts with solvents, isolated and conjugated double bonds, woodward Fieser rules, Analytical uses of UV spectroscopy in polyenes, carbonyl compounds and aromatic systems.
Module II: IR and Mass Spectrometry (15 lectures)

a. **Infrared Spectroscopy**: Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, amines; Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acid anhydrides, lactones, lactams, conjugated carbonyl compounds); Effects of H-bonding and solvent effect on vibrational frequency, extension to various organic molecules for structural assignment.

b. **Mass Spectrometry**: Mass spectral fragmentation of organic compounds, common functional groups; molecular peak, McLafferty rearrangements, examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Module III: NMR spectroscopy (20 lectures)

a. **Nuclear Magnetic Resonance Spectroscopy**: Approximate chemical shift values of various chemically non-equivalent protons and correlation to protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic); Protons bonded to other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides, SH); Chemical exchange, effect of deuteration; complex spin-spin interaction between two, three, four and interacting nuclei (first order spectra); Complex interaction, virtual coupling, stereochemically hindered rotation, Karplus curve, variation of coupling constant with dihedral angle, nuclear magnetic double resonance, simplification of complex spectra using shift reagents, Fourier transform technique and nuclear Overhauser effect (NOE).

b. **C-13 NMR Spectroscopy**: Chemical shift (aliphatic, olefinic, alkynes, aromatic, hetero-aromatic, carbonyl carbon); Coupling constants, two-dimensional NMR spectroscopy, NOESY, DEPT and INEPT terminologies.

c. **Applications**: IR, NMR and Mass spectroscopy for structure elucidation of organic compounds.

Suggested Readings
5. Introduction to Spectroscopy, D.L. Pavia, G. M. Lampman and G. S. Kriz, Harcourt College Publisher NY.

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CHSL0100: Elements of Service Learning in Chemistry

(2-0-0)

**Course Outcomes**

a. Understanding social responsibility of higher educational institutes. (Understanding)

b. Identifying problems in the community and where students originated. (Applying)

c. Influence to get involved in the local community to gain insight into local issues. (Evaluating)

d. Adopt strong leadership skills which allow students to work well in a team. (Creating)

**Module I (10 lectures)**

Principles of Service learning; classification of service-learning models; difference between service Learning and other community experiences; historical context of University Community Partnership; service learning for an undergraduate chemistry student.

**Module II (5 lectures)**

Social responsibility of educational institutes; meaning of community university engagement (CUE), engaged teaching, and engaged research.

**Module III (15 lectures)**

Conceptualisation of the idea of service learning through practical implementations such as (any two) (i) organizing awareness programmes on scientific temper for nearby communities, (ii) participating in demonstrations of scientific experiments for school children to remove the fear of pursuing higher studies in science, (iii) imparting knowledge and guidance to school students for proper understanding of various topics of their chemistry curriculum.

**Suggested Readings**


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### CHAB0101: Inorganic Chemistry-I: Atomic Structure & Chemical Bonding

**Module I: Atomic Structure (14 lectures)**
- Bohr’s theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de-Broglie equation, Heisenberg’s Uncertainty Principle and its significance, Schrödinger’s wave equation, significance of $\psi$ and $\psi^2$. Quantum numbers and their significance.
- Paul’s Exclusion Principle, Hund’s rule of maximum multiplicity, Aufbau’s principle and its limitations, Variation of orbital energy with atomic number.

**Module II Periodicity of Elements (16 lectures)**
- $s$, $p$, $d$, $f$ block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to $s$ & $p$-block.
  - Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
  - Atomic radii (van der Waals).
  - Ionic and crystal radii.
  - Covalent radii (octahedral and tetrahedral).
  - Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
  - Electron gain enthalpy; trends of electron gain enthalpy.
  - Electronegativity, Pauling’s/ Mulliken’s/ Allred Rachow’s/ and Mulliken-Jaffé’s electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson’s electron density ratio.

**Module III Chemical Bonding (26 lectures)**
  - Covalent bond: Lewis’s structure, Valence Bond theory (Heitler-London approach).
  - Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent’s rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules $N_2$, $O_2$, $C_2$, $B_2$, $F_2$, $CO$, NO and their ions; HCl, BeF$_2$, CO$_2$, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding ($\sigma$ and $\pi$ bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan’s rules and consequences of polarization.
  - Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.
  - Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.
  - Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions,
Instantaneous dipole-induced dipole interactions.

g. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment). Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

Module IV Oxidation-Reduction (4 lectures)
Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved involumetric analysis to be carried out in class.

Suggested Readings
1. Concise Inorganic Chemistry, J.D. Lee, ELBS.

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CHSI0102: Physical Chemistry-I: States of Matter & Ionic Equilibrium
(4-0-0)

Course Outcomes
1. Recall concepts associated with the properties of three states of matter. (Remembering)
2. Explain the principles of ionic equilibria. (Understanding)
3. Apply the principles to solve problems related to ionic equilibrium. (Applying)
4. Differentiate between properties of real and ideal gases. (Analysing)
5. Learn about different crystal structure of solids. (Evaluate)

Module I: Gaseous state (18 lectures)

a. Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of \( \sigma \) from \( \eta \); variation of viscosity with temperature and pressure.

b. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, \( Z \), and its variation with pressure for different gases. Causes of deviation from ideal behaviour. Van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dielectric); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Module II: Liquid state (6 lectures)
Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity.
Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.

Module III: Solid state (16 lectures)
Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg’s law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.

Module IV: Ionic equilibria (20 lectures)

a. Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant
and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and diprotic acids (exact treatment).

b. Salt hydrolysis—calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.


d. Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

Suggested Readings
4. Physical Chemistry Elsevier, R. G. Mortimer, NOIDA, UP.

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CHBH0103: Organic Chemistry-I: Basics & Hydrocarbons
(4-0-0)

Course Outcomes
1. Recall the basic properties of different hydrocarbons. (Remembering)
2. Explain the types and mechanisms of organic reactions. (Understanding)
3. Predict the possible mechanism of organic reactions. (Applying)
4. Differentiate enantiomer, diastereomers, meso compounds, racemic mixture etc. (Analysing)
5. Determine the absolute and relative configuration of organic compounds. (Evaluating)
6. Explain the extra stability of organic compounds or synthetic intermediate using the concept of the Huckel rule for aromaticity. (Creating)

Module I: Basics of Organic Chemistry (6 lectures)

*Organic Compounds:* Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.

*Electronic Displacements:* Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbones. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Module II: Stereochemistry (18 lectures)

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis- trans and, syn-anti isomerism E/Z notations with C.I.P rules.

*Optical Isomerism:* Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centers, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Module III: Chemistry of Aliphatic Hydrocarbons (24 lectures)

a. **Carbon-Carbon sigma bonds:** Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

b. **Carbon-Carbon pi bonds:** Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions.Saytzeff and Hofmann eliminations.

c. **Reactions of alkenes:** Electrophilic additions their mechanisms (Markownikoff/AntiMarkownikoff addition), mechanism of oxymercuration-demercuration, hydroboration oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation(oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethylbenzene.
d. **Reactions of alkynes**: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

e. **Cycloalkanes and Conformational Analysis**: Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

**Module IV: Aromatic Hydrocarbons (12 lectures)**

Aromaticity: Hückel’s rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft’s alkylation/acylation with their mechanism. Directing effects of the groups.

**Suggested Readings**

3. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), I. L. Finar, Dorling Kindersley (India) Pvt. Ltd.
5. Stereochemistry Conformation and Mechanism, P. S. Kalsi, New Age International.

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**CHCT0104 Physical Chemistry-II: Chemical Thermodynamics & its applications**

(4-0-0)

**Course Outcomes**

1. Recall the laws of thermodynamics. (Remembering)
2. Explain how to derive and apply equations for different thermodynamic functions. (Understanding)
3. Calculate the change in the values of state functions accompanying a process. (Applying)
4. Derive an expression for different thermodynamic functions. (Analysing)
5. Compare and contrast ideal solutions from regular solutions. (Evaluating)
6. Apply their understanding of concepts to design and solve analytical problems. (Creating)

**Module I: Chemical Thermodynamics (36 lectures)**

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First Law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalphy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff’s equations) and pressure on enthalphy of reactions. Adiabatic flame temperature, explosion temperature.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of these law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs- Helmholtz equation; Maxwell relations; thermodynamic equation of state.

**Module II: Systems of Variable Composition (8 lectures)**

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions inmixing of ideal gases.

**Module III: Chemical Equilibrium (8 lectures)**

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of
fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants $K_p$, $K_c$ and $K_s$. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

Module IV: Solutions and Colligative Properties (8 lectures)


b. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [i] relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Suggested Readings

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CHAH0105: Atomic Structure, Bonding, General Organic Chemistry and Aliphatic Hydrocarbons

(4-0-0)

Course Outcomes
1. Learn the fundamentals of inorganic and organic chemistry. (Remembering)
2. Explain various concepts of atomic structure and chemical bonding. (Understanding)
3. Predict the structure and properties of molecules. (Applying)
4. Analyse the shape of inorganic molecules. (Analysing)
5. Evaluate the role of quantum mechanics in inorganic chemistry. (Evaluate)

Module I: Inorganic Chemistry (30 lectures)

a. Atomic Structure (14 lectures)


What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of $\psi$ and $\psi^2$. Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers $m_l$ and $m_s$. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number ($s$) and magnetic spin quantum number ($m_s$). Rules for filling electrons in various orbitals, electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

b. Chemical Bonding and Molecular Structure (16 lectures)

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability. Fajans’s rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.
Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR (H₂O, NH₃, PCl₃, SF₆, ClF₃, SF₆) and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO⁺.

Module I: Organic Chemistry (30 lectures)

a. Fundamentals of Organic Chemistry (8 lectures)

b. Stereochemistry (10 lectures)
Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis – trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C-C systems).

c. Aliphatic Hydrocarbons (12 lectures)
Functional group approach for the following reactions (preparations physical property & chemical reactions) to be studied with mechanism in context to their structure.


Alkenes: Preparation: Elimination reactions: Dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff’s rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO₄) and trans-addition (bromine), Addition of HK (Markownikoff’s and anti-Markownikoff’s addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboronation-oxidation.

Alkynes: Preparation: Acetylene from CaC₂ and conversion into higher alkyne; by dehalogenation of teta halides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides and acidity of alkyne, addition of bromine and alkaline KMnO₄, ozonolysis and oxidation with hot alk. KMnO₄. Hydration to form carbonyl compounds.

Suggested Readings
1. A new Concise Inorganic Chemistry, J. D. Lee, E L. B. S.
8. Organic Chemistry (Vol I and II), I. L. Finar, E. L. B. S.
11. Press.

Mapping of COs to Syllabus

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CHCF0106: Chemical Energetics, Equilibria and Functional Group Organic Chemistry
(4-0-0)

Course Outcomes
1. Recall theories of chemical energetics; chemical equilibria. (Remembering)
2. Explain the thermodynamics of chemical reactions. (Understanding)
3. Calculate the change in free energy accompanying a chemical reaction. (Applying)
4. Explain the mechanism of nucleophilic substitution reaction. (Analysing)
5. Compare the mechanisms of different types of organic reactions. (Evaluating).
6. Learn the methods of preparation, reactions and mechanism of some organic compounds. (Creating)

Module I: Physical Chemistry (30 lectures)

a. Chemical Energetics (10 lectures)
   Review of thermodynamics and the Laws of Thermodynamics.
   Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff’s equation.
   Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

b. Chemical Equilibrium (8 lectures)
   Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between $G$ and $G^\circ$, Le Chatelier’s principle. Relationships between $K_p$, $K_c$ and $K_x$ for reactions involving ideal gases.

c. Ionic Equilibria (12 lectures)
   Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis - calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Module II: Organic Chemistry (30 lectures)

Functional group approach for the following reactions (preparations physical properties and Chemical reactions) to be studied in context to the structure with mechanism.

a. Aromatic hydrocarbons (8 lectures)
   Preparation (benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

b. Alkyl and Aryl Halides (8 lectures)
   1. Alkyl Halides
      Preparation: from alkenes and alcohols.
      Reactions: Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions. hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson’s ether synthesis: Elimination vs substitution.
   2. Aryl Halides
      Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. Reactions (chlorobenzene): Aromatic electrophilic and nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzene Mechanism: $\text{KNH}_3$/NH$_3$ (or NaH$_2$/NH$_3$).
      Relative reactivity of alkyl, allyl, benzylic, vinyl and aryl halides towards Nucleophilic substitution reactions.

c. Alcohols, Phenols and Ethers (14 lectures)
   1. Alcohols:
      Preparation: Preparation of $1^\circ$, $2^\circ$ and $3^\circ$ alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.
      Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3), factors affecting acidity, Oppeneauer oxidation.
   2. Phenols:


e. Aldehydes and Ketones (aliphatic and aromatic):
   Preparation: from acid chlorides and from nitriles.

Suggested Readings
5. Physical Chemistry, G. M. Barrow, Tata McGraw Hill.
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CHBA0113: Basic Analytical Chemistry
(1-0-1)

Course Outcomes
1. Recall concepts of data analysis and principles of chromatography. (Remembering)
2. Explain terms associated with analytical measurements. (Understanding)
3. Determining various parameters of soil and water samples. (Applying)
4. Analyse a mixture of metal ions through paper chromatography. (Analysis)

Module I
Introduction to Analytical Chemistry and its inter disciplinary nature, concept of sampling, importance of accuracy, precision and sources of error in analytical measurements, Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators.
   a. Determination of pH of soil samples.
   b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.
   a. Determination of pH, acidity and alkalinity of a water sample.
   b. Determination of dissolved oxygen (DO) of a water sample.

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc. Paper chromatographic separation of mixture of metal ion (Ni²⁺ and Co²⁺).

Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Suggested Applications (Any one):
   a. To study the use of phenolphthalein in trap cases.
   b. To Analyse arson accelerant.
   c. To carry out analysis of gasoline.

Suggested Instrumental demonstrations:
   a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
   b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
   c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.

Suggested Readings
8. The Tools of Biochemistry, T. G. Cooper, John Wiley and Sons, N.Y.
9. Vogel’s Qualitative Inorganic Analysis, G. Svehla, Prentice Hall.
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CHCI0114: Chemoinformatics

(1-0-1)

Course Outcomes
1. Recall the principles of molecular modelling. (Remembering)
2. Explain principles of molecular modelling. (Understanding)
3. Predict properties of compounds, build models. (Applying)
4. Elucidate structure and properties, carry out the computer-assisted synthesis of drugs. (Creating)

Module I
a. **Introduction to Chemoinformatics:** History and evolution of chemoinformatics, Use of chemoinformatics, Prospects of chemoinformatics, Molecular Modelling and Structure elucidation. Representation of molecules and chemical reactions: Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Mol files and Sd files, Libraries and toolkits, Different electronic effects, Reaction classification. Searching chemical structures: Full structure search, sub-structure search, basic ideas, similarity search, three-dimensional search methods, basics of computation of physical and chemical data and structure descriptors, data visualization.
b. **Applications:** Prediction of Properties of Compounds; Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modeling Toxicity; Structure-Spectra correlations; Prediction of NMR, IR and Mass spectra; Computer Assisted Structure elucidations; Computer Assisted Synthesis Design, Introduction to drug design; Target Identification and Validation; Lead Finding and Optimization; Analysis of HTS data; Virtual Screening; Design of Combinatorial Libraries; Ligand-Based and Structure Based Drug design; Application of Chemoinformatics in Drug Design.

Exercises

Suggested Readings

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CHCP0115: Chemistry of Cosmetics and Perfumes

(1-0-1)

Course Outcomes
1. Provide introductory knowledge of cosmetics and perfumes. (Remembering)
2. Systematic study about the compositions of cosmetics and perfumes. (Understanding)
3. Application of the suitable method to prepare shampoos, enamels, face creams etc. (Applications)
4. Comparative study of natural vs synthetic sources for their preparation. (Analysing)
5. Evaluate the scope and limitations of the various methods of preparation of cosmetic or perfume. (Evaluate)
6. Design new cosmetics by modifying the proportion of basic ingredients. (Creating)

Module I:
A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Experiments
a. Preparation of talcum powder.
b. Preparation of shampoo.
c. Preparation of enamels.
d. Preparation of hair remover.
e. Preparation of face cream.
f. Preparation of nail polish and nail polish remover.

Suggested Readings
1. Industrial Chemistry, Vol-I, E. Stocchi, Ellis Horwood Ltd. UK.

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CHPY0116: Pesticide Chemistry
(1-0-1)

Course Outcomes
1. Recall the properties and synthesis of natural and synthetic pesticides. (Remembering)
2. Explain the properties of pesticides based on their structure. (Understanding)
3. Prepare pesticides such as organophosphates, phosphonates and thiophosphates. (Applying)
4. Analysing the chemical properties of pesticides. (Analysing)

Module I
General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Experiments
a. To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.
b. Preparation of simple organophosphates, phosphonates and thiophosphates.

Suggested Reading
1. Pesticides, R. Cremlyn, John Wiley.

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CHFC0117: Fuel Chemistry
(1-0-1)

Course Outcomes
1. Recall the basic concepts of energy sources. (Remembering)
2. Explain the chemistry behind the petroleum industry. (Understanding)
3. Learn methods to prepare fuel from waste, learn how to prepare clean fuels etc. (Applying)
4. Differentiate between renewable and non-renewable energy sources. (Analysing)
5. Evaluate the merits and demerits of renewable and non-renewable energy sources. (Evaluating)

Module I: Review of energy sources (renewable and non-renewable).
Classification of fuels and their calorific value.
Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses, fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical
coke, Coal gasification (hydro gasification and catalytic gasification), coal liquefaction and solvent refining.

**Module II: Petroleum and Petrochemical Industry**

a. Composition of crude petroleum, Refining and different types of petroleum products and their applications.
b. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels.
d. Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants, properties of lubricants (viscosity index, cloud point, pore point) and their determination.

**Suggested Readings**

1. Industrial Chemistry, Vol -I, E. Stocchi, Ellis Horwood Ltd. UK.

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**CHIP0118: Intellectual Property Rights**

(2-0-0)

**Course Outcomes**

1. Recall the basic concepts of intellectual property. (Remembering)
2. Explain the need for protection of intellectual property. (Understanding)
3. Develop the knowledge of different types of intellectual property. (Applying)
4. Distinguish between different types of intellectual property. (Analysing)
5. Evaluate the overall laws and procedures involved in protecting intellectual property. (Evaluating)

**Module I: Introduction to Intellectual Property**

Historical Perspective, different Types of IP, importance of protecting IP.

**Module II: Copyrights, Trade Marks, Patents**

a. Introduction, how to obtain, differences from Patents.
b. Introduction, how to obtain, Different types of marks – Collective marks, certification marks, service marks, Tradenames, etc., differences from designs.
c. Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge.
d. Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India, geographical indications.
e. Definition, rules for registration, prevention of illegal exploitation, importance to India.
f. Industrial Designs: Definition, how to obtain, features, international design registration. Layout design of integrated circuits, Circuit Boards, Integrated Chips, importance for electronic industry.

**Module III: Trade Secrets**

Introduction and Historical Perspectives, Scope of Protection, Risks involved and legal aspects of Trade Secret Protection.

**Module IV: Different International agreements**

Word Trade Organization (WTO):

a. General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement.
b. General Agreement on Trade related Services (GATS).
d. Berne Convention.
e. Budapest Treaty.

WIPO and TRIPS, IPR and Plant Breeders Rights, IPR and Biodiversity.

Suggested Readings

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CHOS0119: Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy
(4+0-0)

Course Outcomes
1. Detail study of synthesis and properties of Organometallic compounds. (Remembering)
2. Explain the role of metal ions present in biological systems. (Understanding).
3. Application of 18 the electron rule for organometallic compounds. (Applying)
4. Comparison of the reactivity of polynuclear and heteronuclear aromatic molecules. (Analysing)
5. Employing of UV-Visible and IR-Spectroscopy for structural determination. (Creating)

Module I: Inorganic Chemistry (30 lectures)
a. Chemistry of 3d metals (6 lectures)
   Oxidation states displayed by Cr, Fe, Co, Ni and Co.
   A study of the following compounds (including preparation and important properties);
   Peroxo compounds of Cr, K₂Cr₂O₇, KMnO₄, K₂[Fe(CN)]₃, K₃[Fe(CN)]₆, sodium nitroprusside, [Co(NH₃)₆]Cl₃, Na₂[Co(NO₂)₆].

b. Organometallic Compounds (12 lectures)
   Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds).
   Structures of methyl lithium, Zeise’s salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbynols of 3d metals. p-acceptor behaviour of carbon monoxide.
   Synergic effects (VB approach) - (MO diagram of CO can be referred to for synergic effect to IR frequencies).

c. Bio-Inorganic Chemistry (12 lectures)
   A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na⁺,
   K⁺ and Mg²⁺ ions: Na/K pump; Role of Mg²⁺ ions in energy production and chlorophyll. Role of iron in oxygen transport, haemoglobin, myoglobin, storage and transport of iron.

Module II: Organic Chemistry (30 lectures)
a. Structure, preparation and properties of some aromatic molecules (12 lectures)
   Structure elucidation of naphthalene, preparation and properties of naphthalene and anthracene. Properties of the following
   compounds with reference to electrophilic and nucleophilic substitution: Furan, Pyrrole, Thiophene, and Pyridine.

b. Active methylene compounds (6 lectures)
   Preparation: Claisen ester condensation. Keto-enol tautomerism. Synthetic uses of ethylacetoacetate (preparation of non-
   hetero compounds having upto 6 carbon).
   Reactions: Synthetic uses of ethylacetoacetate (preparation of non-hetero molecules having upto 6 carbon).

c. Application of Spectroscopy to Simple Organic Molecules (12 lectures)
   Application of visible, ultraviolet and infrared spectroscopy in organic molecules. Electromagnetic radiation, electronic
   transitions, λmax and εmax, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic
   spectroscopy and Woodward rules for calculating λ max of conjugated dienes and α, β – unsaturated compounds.
   Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and
   simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect
   of substitution on >C=O stretching absorptions).

Suggested Readings
3. A New Concise Inorganic Chemistry, J. D. Lee, E.L.B.S.

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CHCK0120: Chemistry of s- And p- Block Elements, States of Matter and Chemical Kinetics
(4-0-0)

Course Outcomes
1. Explanation of the properties of s - and p- block elements. (Remembering)
2. Understand the concept of an ideal gas, real gas and properties of matter. (Understanding)
3. Application of Kinetic Theory of gases and Chemical kinetics to solve problems. (Applying)
4. Extraction of metal from its ore employing various techniques. (Analysing)
5. Utility of crystallographic principles for categorizing solids into crystal systems. (Evaluating)

Module I: Inorganic Chemistry (30 lectures)
a. General Principles of Metallurgy (4 lectures)
   Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy with reference to cyanide process for silver and gold, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, van Arkel-de Boer process and Mond’s process.
b. s- and p- block Elements (26 lectures)
   Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mulliken, and Alfred-Rochow scales). Allotropy in C, S, and P.
   Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides, inert pair effect, diagonal relationship and abnormality of first member of each group.
   Compounds of s- and p-Block Elements.
   Diborane and concept of multicentre bonding, Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial and environmental chemistry.
   Hydrides of nitrogen (NH₃, N₂H₄, N₃H, NH₂OH) Oxoacids of P, S and Cl.Halides and oxohalides: PCl₅, PCl₃, SOCl₂ and SO₂Cl₂.

Module II: Physical Chemistry (30 lectures)
a. Kinetic Theory of Gases (7.5 lectures)
   Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.
   Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO₂.
   Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.
   Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation).
   Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).
b. Liquids (5 lectures)
   Surface tension and its determination using stadalrometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).
c. Solids (7.5 lectures)
Bragg’s law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

d. **Chemical Kinetics (10 lectures)**
Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

**Suggested Readings**
1. Physical Chemistry, G. M. Barrow, Tata McGraw Hill.
6. A New Concise Inorganic Chemistry, J. D. Lee, E.L.B.S.

**Mapping of COs to Syllabus**

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**CHBM0121: Organic Chemistry IV: Biomolecules**

(4-0-0)

**Course Outcomes**
1. Recall the structure and properties of the components of different biomolecules. (Remembering)
2. Explain the concept of energy in the biosystem. (Understanding)
3. Suggest the scheme for the synthesis of a peptide. (Applying)
4. Explain the roles of lipids, proteins, enzymes and nucleic acids in a living system. (Analysing)
5. Suggest mechanisms for creating a particular sequence of the protein or nucleic acid. (Creating)

**Module I: Nucleic Acids (9 lectures)**
Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides (DNA and RNA).

**Module II: Amino Acids, Peptides and Proteins (18 lectures)**


**Module III: Enzymes (6 lectures)**
Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors, specificity of enzyme action (including stereo specificity), enzyme inhibitors and their importance.

**Module IV: Lipids (8 lectures)**
Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

**Module V: Concept of Energy in Bio systems (7 lectures)**
Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism, anabolism). ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change. Agents for transfer of electrons in biological
redox systems: NAD+, FAD.
Conversion of food to energy: Outline of catabolic pathways of carbohydrate- glycolysis, fermentation, Krebs cycle. Caloric value of food, standard caloric content of food types.

Module VI: Pharmaceutical Compounds: Structure and Importance (12 lectures)
Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarial: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).

Suggested Readings

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CHQS0122: Physical Chemistry V: Quantum Chemistry and Spectroscopy
(4-0-0)

Course Outcomes
1. Remembering the postulates of quantum mechanics. (Remembering)
2. Explaining the principles of spectroscopy. (Understanding)
3. Application of quantum mechanics to chemical bonding and spectroscopy. (Applying)

Module I: Quantum Chemistry (30 lectures)
(4-0-0)

Course Outcomes
1. Remembering the postulates of quantum mechanics. (Remembering)
2. Explaining the principles of spectroscopy. (Understanding)
3. Application of quantum mechanics to chemical bonding and spectroscopy. (Applying)

Module I: Quantum Chemistry (30 lectures)
b. Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment ofH

Module II: Molecular Spectroscopy (30 lectures)
Interaction of electromagnetic radiation with molecules and various types of spectra; Born Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches. Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra,
Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. 
Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and pre dissociation, calculation of electronic transitions of polyenes using free electron model. 
Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low-resolution spectra, different scales (δ and σ), spin-spin coupling and high-resolution spectra, interpretation of PMR spectra of organic molecules. 
Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

Suggested Readings
5. Atomic & Molecular Spectroscopy, R. Kakkar, Cambridge University Press.

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CHAC0123: Application of Computers in Chemistry 
(4-0-0)

Course Outcomes
1. Recall the different components of computer hardware. (Remembering) 
2. Recall the principles of the numerical methods. (Remembering) 
3. Know how to write a program or how to use different software products. (Understanding) 
4. Write programs to solve simple chemistry problems. (Applying) 
5. Know which software to be employed for solving a chemistry problem. (Analysing)

Module I: Basic Computer system (in brief) (5 lectures)
Hardware and Software; Input devices, Storage devices, Output devices, Central Processing Unit (Control Unit and Arithmetic Logic Unit); Number system (Binary, Octal and Hexadecimal Operating System); Computer Codes (BCD and ASCII); Numeric/String constants and variables. Operating Systems (DOS, WINDOWS, and Linux); Software languages: Low level and High Level languages (Machine language, Assembly language; QBASIC, FORTRAN and C++); Software Products (Office, chemsketch, sci lab, mat lab, hyper chem etc.), internet application.

Module II: Use of Programming Language for solving problems in Chemistry (40 lectures)
Computer Programming Language- QBASIC, (for solving some of the basic and in turn complicated chemistry problems). QB4 version of QBASIC can be used.

Programing Language – QBASIC; Commands: INPUT and PRINT Commands; GOTO, IF, ELSEIF, THEN and END IF Commands; FOR and NEXT Commands; Library Functions (ABS, ASC, CHR$, EXP, INT, LOG, RND, SQR, TAB and trigonometric Functions), DIM, READ, DATA, REM, RESTORE, DEF FNR, GOSUB, RETURN, SCREEN, VIEW, WINDOW, LINE, CIRCLE. LOCATE, PSET Commands. 
Simple programs using above mentioned commands. 
QBASIC programs for Chemistry problems - Example: plotting van der Waal Isotherms (Simple Problem, available in general text books) and observe whether van der Waal gas equation is valid at temperatures lower than critical temperature where we require to solve a cubic equation and calculation of area under the curves (Complicated Problem, not available in general text books). 
Solution of quadratic equation, polynomial equations (formula, iteration and Newton – Raphson methods, binary bisection and Regula Falsi); Numerical differential, Numerical integration (Trapezoidal rule), Simultaneous equations, Matrix addition and multiplication, Statistical analysis.

Module III: Use of Software Products (15 lectures)
Computer Software like Scilab, Excel, etc. to solve some of the plotting or calculation problems. 
Basic idea of Molecular Modelling using software like chemsketch, arguslab and Accelerys J Draw etc. for geometry optimization and potential energy surface (local and global minima).

Suggested Readings
3. The Chemical Maths Book, E. Steiner, Oxford University Press.
5. Quantitative Chemical Analysis, D. C. Harris, Freeman.

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### CHAM0124: Analytical Methods in Chemistry

(4-0-0)

**Course Outcomes**
1. Define principles of different methods of analysis. (Remembering)
2. Explain different optical methods of analysis. (Understanding)
3. Identify kinds of errors in chemical analysis. (Applying)
4. Analyse the techniques of thermogravimetry to estimate ions in a mixture. (Analysing)
5. Evaluate fundamentals of electrochemistry. (Evaluating).
6. Elaborate on different techniques for the separation of mixtures. (Creating)

### Module I: Qualitative and quantitative aspects of analysis (5 lectures)
Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution of indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

### Module II: Optical methods of analysis (25 lectures)
UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument.
Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers.
Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

### Module III: Thermal methods of analysis (5 lectures)
Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

### Module IV: Electroanalytical methods (10 lectures)
Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

### Module V: Separation techniques (15 lectures)
Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation.
Technique of extraction: batch, continuous and counter current extractions.
Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.

### Suggested Readings
2. Instrumental Methods of Analysis, H. H. Willard, Wadsworth Publishing Company, Belmont, California, USA.

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**CHNS0125: Novel Inorganic Solids**

(4-0-0)

**Course Outcomes**

1. Explanation of various methods used for synthesizing inorganic solids. (Remembering)
2. Explanation about inorganic materials of technological importance. (Understanding)
3. Synthesis, application and future scope of nanomaterials in the different areas of science. (Applying)
4. Applicability of engineering materials and study of their composition variants. (Analysing)
5. Evaluate the role of matrix in composite materials and their practical importance. (Evaluating)

**Module I: Synthesis and modification of inorganic solids (10 lectures)**


**Module II: Inorganic solids of technological importance (10 lectures)**

Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments. One- dimensional metals, molecular magnets, inorganic liquid crystals.

**Module III: Nanomaterials (10 lectures)**

Overview of nanostructures and nanomaterials: classification.
Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nano architecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural nanomaterials, bio-nano composites.

**Module IV: Introduction to engineering materials for mechanical construction (10 lectures)**

Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminium and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.

**Module V: Composite materials (10 lectures)**


**Module VI: Speciality polymers (10 lectures)**


**Suggested Readings**

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**CHPC0126: Polymer Chemistry**

(4-0-0)

**Course Outcomes**

1. Recall the basic concepts of Polymers. (Remembering)
2. Understand the different processes by which polymers are formed. (Understanding)
3. Apply the methods to measure the molecular weights of polymers. (Applying)
4. Analyse polymers based on their physical, thermal, flow and mechanical properties. (Analysing)
5. Based on the properties predict possible applications or uses of the polymer. (Evaluating)

**Module I: Introduction and history of polymeric materials (4 lectures)**

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

**Module II: Functionality and its importance (8 lectures)**


**Module III: Kinetics of Polymerization (8 lectures)**

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

**Module IV: Crystallization and crystallinity (4 lectures)**

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

**Module V: Nature and structure of polymers and Molecular weight determination of polymers (10 lectures)**

Structure Property relationships. Determination of molecular weight of polymers ($M_n$, $M_w$, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

**Module VI: Glass transition temperature ($T_g$), determination of $T_g$, Polymer Solution and properties of Polymers (26 lectures)**

Free volume theory, WLF equation, Factors affecting glass transition temperature ($T_g$).

**Suggested Readings**

1. Seymour’s Polymer Chemistry, Marcel Dekker, Inc.

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CHOCO127: Inorganic Chemistry IV: Organometallic Chemistry
(4-0-0)

Course Outcomes
1. Recall principles involved in the analysis and separation of ions. (Remembering)
2. Explain the metal ion binding to biomolecules and their functions. (Understanding)
3. Apply the principles to separate a mixture of ions in the lab. (Applying)
4. List the procedures for the preparation of metal carbonyls and alkyls. (Analysing)
5. Use electron counting in assessing the reactivity and stability of organometallic compounds. (Evaluating)
6. Discuss the role of the organometallic compound in homogenous catalysed reactions. (Creating)

Module I: Theoretical Principles in Qualitative Analysis (H25 Scheme) (12 lectures)
Basic principles involved in analysis of cations and anions, solubility products, common ion effect, principles involved in separation of cations into groups and choice of group reagents, interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

Module II: Organometallic Compounds (26 lectures)
Definition and classification of organometallic compounds on the basis of bond type, Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series, structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT.n-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.
Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.
Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds.
Ferrocene: Preparation and reactions (acytlation, alkylation, metallation, Mannich Condensation). structure and aromaticity, comparison of aromaticity and reactivity with that of benzene.

Module III: Bioinorganic Chemistry (14 lectures)
Metal ions present in biological systems, classification of elements according to their action in biological system, Geochemical effect on the distribution of metals, Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals, Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine, Cisplatin as an anti-cancer drug.
Iron and its application in bio-systems, Haemoglobin, Myoglobin; Storage and transfer of iron.

Module IV: Catalysis by Organometallic Compounds (8 lectures)
Study of the following industrial processes and their mechanism:
  a. Alkene hydrogenation (Wilkinson’s Catalyst).
  b. Synthetic gasoline (Fischer Tropsch reaction).
  c. Polymerisation of ethene using Ziegler-Natta catalyst.

Suggested Readings
1. Qualitative Inorganic Analysis, A. I. Vogel, Longman.
2. Vogel’s Qualitative Inorganic Analysis, G. Svehla, Prentice Hall.

Mapping of COs to Syllabus
CHSP0128: Organic Chemistry V: Spectroscopy
(4-0-0)

Course Outcomes
1. Recall the principles of UV, IR and NMR spectroscopy. (Remembering)
2. Explain absolute configuration of carbohydrates; mutarotation. (Understanding)
3. Apply different mechanisms to the polymerization reactions. (Applying)
4. Analyse the application of different types of dyes. (Analysing)
5. Analyse unknown organic compounds with the help of different spectroscopic techniques. (Evaluating)

Module I: Organic Spectroscopy (14 lectures)
General principles introduction to absorption and emission spectroscopy.
UV Spectroscopy: Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α, β-unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers. IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.
NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR of simple compounds.
Applications of IR, UV and NMR for identification of simple organic molecules.

Module II: Carbohydrates (16 lectures)
Occurrence, classification and their biological importance.
Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani- Fischer synthesis and Ruff degradation.

Module III: Dyes (8 lectures)
Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl orange; Triphenyl methane dyes -Malachite green and Rosaniline; Phthalein Dyes – Phenolphthalein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigo; Edible Dyes with examples.

Module IV: Polymers (12 lectures)
Introduction and classification including di-block, tri-block and amphiphilic polymers; Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler- Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermo softening (PVC, polythene); Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to; Biodegradable and conducting polymers with examples.

Suggested Readings
5. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), I. L. Finar, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

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CHGC0129: Green Chemistry
(4-0-0)

Course Outcomes
1. Recall the principles, goals and limitations of green chemistry. (Remembering)
2. Understand how the principles of green chemistry apply to chemical synthesis. (Understanding)
3. Check if a chemical reaction follows or violates the principles of green chemistry. (Applying)
4. Analyse the benefits of green reactions. (Analysing)
5. Assess the overall impact on research and the environment. (Evaluating)

Module I: Introduction to Green Chemistry (4 lectures)
What is Green Chemistry? Need for Green Chemistry, goals of green chemistry, limitations/ obstacles in the pursuit of the goals of Green Chemistry.

Module II: Principles of Green Chemistry and Designing a Chemical synthesis (30 lectures)
Twelve principles of Green Chemistry with their explanations and special emphasis on the following with examples:

a. Designing a Green Synthesis using these principles; Prevention of Waste/ by-products; maximum incorporation of the materials used in the process into the final products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.

b. Prevention/ minimization of hazardous/ toxic products reducing toxicity risk = (function) hazard x exposure; waste or pollution prevention hierarchy Green solvents— super critical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solvent less processes, immobilized solvents and how to compare greenness of solvents.


d. Selection of starting materials; avoidance of unnecessary derivatization—careful use of blocking/protecting groups.

e. Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, bio catalysis, asymmetric catalysis and photo catalysis.

f. Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD —What you don’t have cannot harm you , greener alternative to Bhopal Gas Tragedy (safer route to carbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.

g. Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

Module III: Examples of Green Synthesis/ Reactions and some real-world cases (16 lectures)

a. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis).

b. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and decarboxylation reaction.

c. Ultrasound assisted reactions: sono chemical Simmons-Smith Reaction (Ultrasonic alternative to iodine).

d. Surfactants for Carbon Dioxide – replacing smog producing and ozone depleting solvents with CO₂ for precision cleaning and dry cleaning of garments.

e. Designing of Environmentally safe marine antifoulant.

f. Right fit pigment: synthetic azo-pigments to replace toxic organic and inorganic pigments.

g. An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.


i. Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting.

Module IV: Future Trends in Green Chemistry (10 lectures)
Oxidation reagents and catalysts, biomimetic, multifunctional reagents; combinatorial green chemistry; Proliferation of solvent free reactions; co crystal controlled solid state synthesis (C₃S₃); Green chemistry in sustainable development.

Suggested Readings
3. Introduction to Green Chemistry, A. S. Matlack, Marcel Dekker.

**Mapping of COs to Syllabus**

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**CHII0130: Inorganic Materials of Industrial Importance**

(4-0-0)

**Course Outcomes**

1. Remember the composition of some industrially important materials. (Remembering)
2. Understand the processes involved in the preparation of silicates materials. (Understanding)
3. Know the principle involved in the preparation and applications of fuel cells, industrial application of catalysts. (Applying)
4. Know the differences between different types of surface coatings; know how to paint formulations are made. (Analysing)

**Module I: Silicate Industries (15 lectures)**

a. *Glass*: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass, composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

b. *Ceramics*: Brief introduction to types of ceramics, superconducting and semiconducting oxides, fullerenes, carbon nanotubes and carbon fibre.

c. *Cements*: Manufacture of cement and the setting process, quick setting cements.

**Module II: Fertilizers (10 lectures)**

Different types of fertilizers (N, P and K). Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates, superphosphate of lime.

**Module III: Surface Coatings (5 lectures)**


**Module IV: Batteries (10 lectures)**

Working of the following batteries: Pb acid, Li-Battery, solid state electrolyte battery, fuel cells, solar cell and polymer cell.

**Module V: Catalysis (10 lectures)**

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, deactivation or regeneration of catalysts. Application of zeolites as catalysts.

**Module VI: Chemical explosives (10 lectures)**

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX), introduction to rocket propellants.

**Suggested Readings**

1. Industrial Chemistry, Vol I, E. Stocchi, Ellis Horwood Ltd. UK.

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CO4 | | | | | | H

CHEC0131: Industrial Chemicals and Environment
(4-0-0)

Course Outcomes
1. Recall the hazard and handling of industrial gases and Inorganic chemicals. (Remembering)
2. Discussions of preparation of ultrapure metal in metallurgy having important applications. (Understanding)
3. Preventive measures to solve a specific problem related to environmental pollution. (Applying)
4. To provide knowledge about the different sources of energy. (Analysing)
5. Identify and solve pollution-related production of energy. (Evaluating)

Module I: Industrial Gases and Inorganic Chemicals (10 lectures)
- Industrial Gases: Large scale production uses storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.
- Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

Module II: Industrial Metallurgy (4 lectures)
Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.

Module III: Environment and its segments (30 lectures)
Ecosystems, biogeochemical cycles of carbon, nitrogen and sulphur.
Air Pollution: Major regions of atmosphere, chemical and photochemical reactions in atmosphere, air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry, environmental effects of ozone, major sources of air pollution.
Pollution by SO₂, CO₂, CO, NOₓ, H₂S and other foul-smelling gases, methods of estimation of CO, NOₓ, SO₂ and control procedures.

Effects of air pollution on living organisms and vegetation, greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.
Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, sources and nature of water pollutants, techniques for measuring water pollution, impacts of water pollution on hydrological and ecosystems.

Water purification methods; Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal.

Industrial waste management, incineration of waste., water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

Module IV: Energy & Environment (10 lectures)
Sources of energy: Coal, petrol and natural gas, Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc.
Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Module V: biocatalysts (6 Lectures)
Introduction to bio catalysis: Importance in “Green Chemistry” and Chemical Industry.

Suggested Readings
1. Industrial Chemistry, Vol I, E. Stocchi, Ellis Horwood Ltd. UK.

Mapping of COs to Syllabus
### CHRM0132: Research Methodology for Chemistry

(4-0-0)

**Course Outcomes**

1. Recall resources for research literature, the purpose of a review article. (Remembering)
2. Explain methods of data analysis, explain how dc and ac circuits work. (Understanding).
3. Handle chemicals safely in the lab, dispose of chemicals the proper way. (Applying)
4. Differentiate between original research and review articles. (Analysing)
5. Select appropriate methods to analyses data. (Evaluating)
6. Develop a review paper based on original research articles. (Creating)

**Module I: Literature Survey** (20 Lectures)

- Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Subst ance Index, Author Index, Formula Index, and other indices with examples.

**Module II: Methods of Scientific Research and Writing Scientific Papers** (20 Lectures)

Reporting practical and project work. Writing literature surveys and reviews, organizing a poster display, giving an oral presentation.

Writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work, writing ethics, avoiding plagiarism.

**Module III: Chemical Safety and Ethical Handling of Chemicals** (12 Lectures)

Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation, safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric– safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals.

**Module IV: Data Analysis** (13 Lectures)

*The Investigative Approach*: Making and Recording Measurements, SI Units and their use, scientific method and design of experiments.

*Analysis and Presentation of Data*: Descriptive statistics. Choosing and using statistical tests, chemometrics, analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linearcas e, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, \( r \) and its abuse, basic aspects of multiple linear regression analysis.

**Module V: Electronics** (10 Lectures)

Basic fundamentals of electronic circuits and their components used in circuits of common instruments like spectrophotometers, typical circuits involving operational amplifiers for electrochemical instruments, elementary aspects of digital electronics.

**Suggested Readings**

2. Data analysis for chemistry D. B. Hibbert and J. J. Gooding, Oxford University Press.
4. Quantitative chemical analysis, D. C. Harris, Freeman Chapters 3-5.
5. How to use Excel in analytical chemistry and in general scientific dataanalysis. R. de, Levie, Cambridge Univ. Press 487
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CHSP0133: Inorganic Chemistry II: s - and p-block elements
(4-0-0)

Course Outcomes
1. Recall the concepts of general principles of metallurgy, the chemistry of s and p block elements. (Remembering)
2. Explain the structure, bonding, properties and uses of some important inorganic compounds. (Understanding)
3. Apply the concepts to solve simple problems on periodic properties of s-block elements. (Applying)
4. Analyse the periodic properties p block elements. (Analysing)
5. Compare the usefulness and limitations of different metallurgical processes. (Evaluating)
6. Discuss the preparation, properties, structure and uses of some compounds of p-block elements. (Creating)

Module I: General Principles of Metallurgy (6 lectures)
Chief modes of occurrence of metals based on standard electrode potentials, Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent, Electrolytic reduction, hydrometallurgy with reference to cyanide process for silver and gold, Methods of purification of metals: electrolytic process, van Arkel-de Boer process and Mond’s process, Zone refining.

Module II: Chemistry of s Block Elements (22 lectures)
a. General characteristics: melting point, flame colour, reducing nature, diagonal relationships and analogous behaviour of first member of each group.
b. Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water.
c. Common features such as ease of formation, thermal stability and solubility of the following alkali and alkaline earth metal compounds: hydrides, oxides, peroxides, super oxides, carbonates, nitrates, sulphates.
d. Complex formation tendency of s-block elements; structure of the following complexes: crown ethers and cryptates of Group I; basic beryllium acetate, beryllium nitrate, EDTA complexes of calcium and magnesium.
e. Solutions of alkali metals in liquid ammonia and their properties.

Module III: Chemistry of p-block elements (6 lectures)
Electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point, ionization enthalpy, electron gain enthalpy, electronegativity, allotropy of C, P, S; inert pair effect; diagonal relationship between B and Si and anomalous behaviour of first member of each group.

Module IV: Structure, bonding and properties: acidic/basic nature, stability, ionic/covalent nature, oxidation/reduction, hydrolysis, action of heat on the following compounds (13 lectures)
a. Hydrides: hydrides of Group 13 (only diborane), Group 14, Group 15 (EH3 where E=N, P, As, Sb, Bi), Group 16 and Group 17.
b. Oxides: oxides of phosphorus, sulphur and chlorine.
c. Oxoacids: oxoacids of phosphorus and chlorine; peroxoacids of sulphur.
d. Halides: halides of silicon and phosphorus.

Module V: Preparation, properties, structure and uses of the following compounds (13 lectures)
a. Borazine.
b. Silicates, silicons.
c. Phosphonitrile halides [(PNCl)3, where n= 3 and 4].
d. Interalog and pseudohalogen compounds.
e. Clathrate compounds of noble gases, xenon fluorides (MO treatment of XeF2).

Suggested Readings
1. Concise Inorganic Chemistry, J. D. Lee, Pearson Education.

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CHOG0134: Organic Chemistry-II: Oxygen Containing Functional Groups
(4-0-0)

Course Outcomes
1. Recall concepts of chemical reactivity of different organic compounds. (Remembering)
2. Explain the chemistry of halogenated hydrocarbons. (Understanding)
3. Solve problems of transformation of functional groups using different reactions conditions. (Applying)
4. Differentiate alcohols, phenol, ethers, epoxides. (Analysing)

Module I: Chemistry of Halogenated Hydrocarbons (16 lectures)
Alkyl halides: Methods of preparation and properties, nucleophilic substitution reactions – S_n1, S_n2 and S_n3 mechanisms with stereo chemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.
Aryl halides: Preparation (including preparation from diazonium salts) and properties, nucleophilic aromatic substitution; S_nAr, Benzene mechanism.
Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. Organometallic compounds of Mg (Grignard reagent) – Use in synthesis of organic compounds.

Module II: Alcohols, Phenols, Ethers and Epoxides (16 lectures)
Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouuaelt-Blanc Reduction; Oxidation of diols by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement.
Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe’s–Schmidt Reactions, Fries and Claisen rearrangements with mechanism.
Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAIH₄.

Module III: Carbonyl Compounds (16 lectures)
Structure, reactivity, preparation and properties; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α - substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAIH₄, NaBH₄, Meerwein-Pondorf-Verley (MPV), PDC.
Addition reactions of α, β- unsaturated carbonyl compounds: Michael addition.
Active methylene compounds: Keto-enol tautomerism, preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Module IV: Carboxylic Acids and their Derivatives (12 lectures)
General methods of preparation, physical properties and reactions of monocarboxylic acids, effect of substituents on acidic strength, typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids.
Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of acyl group, mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann- bromamide degradation and Curtius rearrangement.

Suggested Readings

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CHPC0135: Physical Chemistry-III: Phase Equilibria and Chemical Kinetics

(4-0-0)

Course outcomes
1. Recall basic concepts of chemical kinetics. (Remembering)
2. Explain concepts such as the Gibbs phase rule for non-reactive and reactive systems. (Understanding)
3. Apply the concepts of phase equilibria to systems with varying components. (Applying)
4. Analyse the kinetics of different types of chemical reactions. (Analysing)
5. Design and solve analytical problems. (Creating)

Module I: Phase Equilibria (28 lectures)
Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications.
Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions, Three component systems, water-chloroform-acetic acid system, triangular plots.
Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

Module II: Chemical Kinetics (18 lectures)
Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii)consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.
Temperature dependence of reaction rates; Arrhenius equation; activation energy, collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

Module III: Catalysis (8 lectures)
Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts, Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Module IV: Surface chemistry (6 lectures)
Physical adsorption, chemisorption, adsorption isotherms, nature of adsorbed state.

Suggested Readings
1. Physical Chemistry, A. Peter and J. de Paula, Oxford University Press.

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CHIC0136: IT Skills for Chemists
Course Outcomes
1. Recall the concepts of algebra, calculus, statistics etc. (Remembering)
2. Explain the various theorems and anecdotes related to algebra, calculus, statistics and, programming. (Understanding)
3. Apply the concepts to evaluate standard deviation, entropy change from heat capacity data etc. (Application)
4. Differentiating between analytic and numerical solutions. (Analysing)
5. Assessing the challenges and bottlenecks in programming, analytic and numerical approaches. (Evaluating)
6. Apply their understanding to write new BASIC programs. (Creating)

Module I: Mathematics
Fundamentals, mathematical functions, polynomial expressions, logarithms, the exponential function, units of a measurement, interconversion of units, constants and variables, equation of a straight line, plotting graphs.
Uncertainty in experimental techniques: Displaying uncertainties, measurements in chemistry, decimal places, significant figures, combining quantities.
Algebraic operations on real scalar variables (e.g., manipulation of van der Waals equation indifferent forms). Roots of quadratic equations analytically and iteratively (e.g. pH of a weak acid). Numerical methods of finding roots (Newton- Raphson, binary –bisection, e.g., pH of a weak acid not ignoring the ionization of water, volume of a van der Waals gas, equilibrium constant expressions).
Differential calculus: The tangent line and the derivative of a function, numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations).
Numerical integration (Trapezoidal and Simpson’s rule, e.g., entropy/enthalpy change from heat capacity data).

Module II: Computer programming
Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions, elements of the BASIC language, BASIC keywords and commands, Logical and relative operators, Strings and graphics, compiled versus interpreted languages, Debugging, simple programs using these concepts, matrix addition and multiplication, statistical analysis.
BASIC programs for curve fitting, numerical differentiation and integration (Trapezoidal rule, Simpson’s rule), finding roots (quadratic formula, iterative, Newton-Raphson method).

Module III: Introductory writing activities
Introduction to word processor and structure drawing (Chem Sketch) software. Incorporating chemical structures, chemical equations, expressions from chemistry (e.g. Maxwell-Boltzmann distribution law, Bragg’s law, van der Waals equation, etc.) into word processing documents.

Module IV: Handling numeric data
Spreadsheet software (Excel), creating a spreadsheet, entering and formatting information, basic functions and formulae, creating charts, tables and graphs. Incorporating tables and graphs into word processing documents. Simple calculations, plotting graphs using a spreadsheet (Planck’s distribution law, radial distribution curves for hydrogenic orbitals, gas kinetic theory- Maxwell-Boltzmann distribution curves as function of temperature and molecular weight), spectral data, pressure-volume curves of van der Waals gas (van der Waals isotherms), data from phase equilibria studies. Graphical solution of equations.

Module V: Numeric modelling
Simulation of pH metric titration curves. Excel functions LINEST and Least Squares. Numerical curve fitting, linear regression (rate constants from concentration time data, molar extinction coefficients from absorbance data), numerical differentiation (e.g., handling data from potentiometric and pH metric titrations, pKa of weak acid), integration (e.g., entropy/enthalpy change from heat capacity data).

Module VI: Statistical analysis
Gaussian distribution and Errors in measurements and their effect on data sets, Descriptive statistics using Excel, Statistical significance testing: The t test, The F test.

Module VII: Presentation
Presentation graphics.

Suggested Readings
3. The Chemical Maths Book, E. Steiner, Oxford University Press.

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5. Quantitative Chemical Analysis, D. C. Harris, Freeman.

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### CHCS0137: Chemical Technology & Society

(2-0-0)

**Course Outcomes**
1. Recall principles of techniques used in chemical industries. (Remembering)
2. Explain the principles of the techniques involved in distillation, separation processes. (Understanding)
3. Explore the effect of chemical technology on the environment. (Applying)
4. Analyse the pros and cons of the technology. (Analysing)
5. Outline methods for carrying out scientific experiments in ways that are least harmful to the environment. (Creating)

**Module I: Chemical Technology**

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators, scaling up operations in chemical industry, introduction to clean technology.

**Module II: Society**

Exploration of societal and technological issues from a chemical perspective, chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants); energy from natural sources (i.e.solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues, proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances like genetic engineering and the manufacture of drugs.

**Suggested Reading**

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### CHBS0138: Business Skills for Chemists

(2-0-0)

**Course Outcomes**
1. To provide idea about market demanded business plans. (Remembering)
2. Explanation of IPR, Patents etc. and to understand their value. (Understanding)
3. Application and future scope of Chemistry in current research and global economics. (Applying)
4. Analyse financial aspects of business with case studies. (Analysing)
5. Designing valuable products or procedures for the patents. (Evaluating)
6. Develop entrepreneurial skills of chemistry. (Creating)

**Module I: Business Basics**

Key business concepts: Business plans, market need, project management and routes to market.
Module II: Chemistry in Industry
Current challenges and opportunities for the chemistry-using industries, role of chemistry in India and global economies.

Module III: Making money
Financial aspects of business with case studies.

Module IV: Intellectual property
Concept of intellectual property, patents.

Suggested Reading
www.rsc.org

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CHCC0139: Inorganic Chemistry III: Coordination Chemistry
(4-0-0)

Course Outcomes
1. Recall the properties of coordination compounds and transition elements. (Remembering)
2. Interpret the properties of transition elements. (Understanding)
3. Make use of different theories of coordination compounds to explain their properties. (Applying)
4. Compare the chemistry of Lanthanides and Actinides. (Evaluating)
5. Discuss the reaction mechanisms of square planar complexes. (Creating)

Module I: Coordination Chemistry (26 lectures)
Werner’s theory, valence bond theory (inner and outer orbital complexes), electro neutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (Δv), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δv, Δt). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry, Qualitative aspect of Ligand field and MO Theory.
IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, poly nuclear complexes, Labile and inert complexes.

Module II: Transition Elements (14 lectures)
General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f (Latimer diagrams), difference between the first, second and third transition series.
Chemistry of Cr, Mn, Fe and Co in various oxidation states with special reference to the following compounds: peroxo compounds of chromium, potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite.

Module III: Lanthanoids and Actinoids (6 lectures)
Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

Module IV: Inorganic Reaction Mechanism (14 lectures)
Introduction to inorganic reaction mechanisms, substitution reactions in square planar complexes, trans-effect, theories of trans effect, thermodynamic and kinetic stability.

Suggested Readings
1. Inorganic Chemistry, K. F. Purcell and J. C. Kotz, W.B. Saunders Co.
6. Inorganic Chemistry (adapted), G. L. Miessler and D. A. Tarr, Pearson.

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CHHC0140: Organic Chemistry III: Heterocyclic Chemistry
(4-0-0)

Course Outcomes
1. Preparation and reactions of amines, nitrile, isonitrile and nitro compounds etc. (Remembering)
2. Preparation and properties of polynuclear aromatic compounds. (Understanding)
3. Synthetic route for the preparation of heterocycles and applications in the present research. (Applying)
4. Structural elucidation of polynuclear aromatic compounds, alkaloids and terpenes etc. (Analysing)
5. Total synthesis of important alkaloids. (Evaluating)
6. Development of alternative routes to manufacture natural products. (Creating)

Module I: Nitrogen Containing Functional Groups (18 lectures)
Preparation and important reactions of nitro compounds, nitriles and isonitriles.
Amines: Preparation and properties: Effect of substituent and solvent on basicity; Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann’s exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3°-amines with Hinsberg reagent and nitrous acid.
Diazonium salts: Preparation and their synthetic applications.

Module II: Polynuclear Hydrocarbons (8 lectures)
Aromaticity of polynuclear hydrocarbons, structure elucidation of naphthalene; Preparation and properties of naphthalene, phenanthrene and anthracene.

Module III: Heterocyclic Compounds (22 lectures)
Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Indole (Fischer indole synthesis and Madelung synthesis), Quinoline and isoquinoline, (Skraup synthesis, Friedlander’s synthesis, Knorr quinoline synthesis, Doebner- Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction)

Module IV: Alkaloids (6 lectures)
Natural occurrence, General structural features, Isolation and their physiological action, Hoffmann’s exhaustive methylation, Emde’s modification; Structure elucidation and synthesis of Nicotine, medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Module V: Terpenes (6 lectures)
Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral.

Suggested Readings

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CHL0141: Physical Chemistry IV: Electrochemistry
(4-0-0)

Course Outcomes
1. Recall fundamental concepts of electrochemistry. (Remembering)
2. Explain principles associated with Faraday's laws of electrolysis. (Understanding)
3. Application of theories of conductance measurements. (Applying)
4. Distinguish between different types of electrochemical cells, electrodes. (Analyzing)
5. Measurements of dipole moment and molecular polarizabilities. (Evaluating)

Module I: Conductance (20 lectures)

Module II: Electrochemistry (28 lectures)
Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry.
Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb2O3 electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

Module III: Electrical & Magnetic Properties of Atoms and Molecules (12 lectures)
Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities and their measurements, diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation.

Suggested Readings
5. Physical Chemistry, T. Engel and P. Reid Prentice-Hall.

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CHAB0142: Analytical Clinical Biochemistry
(1-0-1)

Course Outcomes
1. Recall properties of biological molecules. (Remembering)
2. Explain the classification of lipids, nucleic acids etc, their biological importance. (Understanding)
3. Identify and characterize carbohydrates, determine their iodine number etc. (Applying)
4. Relate the cause of diseases to deficiency or mutations of biomolecules. (Analyzing)
5. Develop protocols for studying biomolecules. (Creating)
Module I: Basic understanding of the structures, properties and functions of carbohydrates, lipids and proteins
Review of concepts studied in the core course: Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle.
Isolation and characterization of polysaccharides, Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins: α-helix and β- pleated sheets, Isolation, characterization, denaturation of proteins. Enzymes: Nomenclature, Characteristics (mention of Ribozymes), Classification; Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in “Green Chemistry” and Chemical Industry.
Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications, Lipoproteins, properties, functions and biochemical functions of steroid hormones, biochemistry of peptide hormones.
Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, introduction to Gene therapy.
Enzymes: Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition.

Module II: Biochemistry of disease: A diagnostic approach by blood/ urine analysis
Urine: Collection and preservation of samples, formation of urine, composition and estimation of constituents of normal and pathological urine.

Experiments
a. Identification and estimation of the following:
b. Carbohydrates – qualitative and quantitative.
c. Lipids – qualitative.
d. Determination of the iodine number of oil.
e. Determination of the saponification number of oil.
f. Determination of cholesterol using Liebermann- Burchard reaction.
g. Proteins – qualitative.
h. Isolation of protein.
i. Determination of protein by the Biuret reaction.
j. Determination of nucleic acids

Suggested Readings
1. Tool of Biochemistry, T. G. Cooper.
3. Varley’s Practical Clinical Biochemistry, A. H. Gowenlock,
8. Laboratory Handbook of Chromatographic Method, O. Mikes, and R. A. Chalmers,

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CHGM0143: Green Methods in Chemistry
(1.0.1)

Course Outcomes
1. Recall the different causes of environmental pollution. (Remembering)
2. Learn the twelve principles of Green Chemistry to solve environmental issues. (Understanding)
3. Apply their knowledge of green chemistry in the applied research field. (Applying)
4. Analyse some real-world cases in Green Chemistry. (Analysing)
5. Identify the causes of environmental degradation and find solutions for its protection. (Creating)

Module I: Tools of Green chemistry, Twelve principles of Green Chemistry, with examples.
The following Real-world Cases in Green Chemistry should be discussed:

a. A green synthesis of ibuprofen which creates less waste and fewer byproducts (Atom economy).

b. Surfactants for Carbon Dioxide – replacing smog producing and ozone depleting solvents with CO₂ for precisioncleaning and dry cleaning of garments.

c. Environmentally safe antifoulant.

d. CO₂ as an environmentally friendly blowing agent for the polystyrene foam sheet packaging market.

e. Using a catalyst to improve the delignifying (bleaching) activity of hydrogen peroxide.

f. A new generation of environmentally advanced preservative: getting the chromium and arsenic out of pressure treated wood.

g. Right fit pigment: synthetic azo pigments to replace toxic organic and inorganic pigments.

h. Development of a fully recyclable carpet: cradle to cradle carpeting.

Suggested Readings

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CHPC0144: Pharmaceutical Chemistry

(1-0-1)

Course outcomes
1. Recall methodology of drug design and development. (Remembering)
2. Explain the theory behind the synthesis of a host of drugs. (Understanding)
3. Apply the principles for the preparation of a few selected drugs in the laboratory. (Application)
4. Know optimal preparation methods for different classes of drugs. (Analysing)
5. Compare aerobic and anaerobic fermentation processes. (Evaluation)

Module I: Drugs & Pharmaceuticalcs

Drug discovery, design and development, basic retrosynthetic approach, synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, ibuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Module II: Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Experiments
a. Preparation of Aspirin and its analysis.

b. Preparation of magnesium bisilicate (Antacid).

Suggested Readings
1. Introduction to Medicinal Chemistry, G. L. Patrick, Oxford University Press, UK.

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CHMD0145: Molecular Modelling & Drug Design
(4-0-0)

Course outcomes
1. Recall the concepts of molecular modelling. (Remembering).
2. Explain the concepts of molecular modelling and their significance. (Understanding).
3. Apply the concepts to evaluate and construct a comparative model to deduce the structure of proteins. (Application)
4. Differentiating between non-derivative, first derivative and second derivative minimization methods. (Analysing)
5. To predict the protein structures by employing different approaches. (Evaluating)
6. To design new hit molecules which can be used as lead molecules for drug design. (Creating)

Module I: Introduction to Molecular Modelling (10 lectures)

Module II: Force Fields (14 lectures)

Module III: Energy Minimization and Computer Simulation (12 lectures)

Module IV: Molecular Dynamics & Monte Carlo Simulation (12 lectures)

Module V: Structure Prediction and Drug Design (12 lectures)

Suggested Readings
1. Molecular Modelling Principles and Application, A. R. Leach, Longman.

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CHIM0146: Instrumental Methods of Chemical Analysis
(4-0-0)

Course Outcomes
1. Recalling various spectroscopic and separation techniques in chemistry. (Remembering)
2. Explain the principles of elemental analysis and separation techniques. (Understanding)
3. Application of various techniques. (Applying)
4. Analyse and draw conclusions based on experimental data. (Analysing)

Module I: Introduction to spectroscopic methods of analysis (4 lectures)
Recap of the spectroscopic methods covered in detail in the core chemistry syllabus:
Treatment of analytical data, including error analysis, classification of analytical methods and the types of instrumental methods, consideration of electromagnetic radiation.

Module II: Molecular spectroscopy (16 lectures)
Infrared spectroscopy: Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation
of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR), samples and results expected, applications: Issues of quality assurance and quality control, special problems for portable instrumentation and rapid detection. UV-Visible/ Near IR – emission, absorption, fluorescence and photo acoustics, excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photo acoustics, fluorescent tags).

Module III: Separation techniques (16 lectures)
Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), electrophoresis (plates and capillary) and use with DNA analysis.
Immunassays and DNA techniques
Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole, resolution, time and multiple separations, detection and interpretation (how this is linked to excitation).

Module IV: Elemental analysis (8 lectures)
Mass spectrometry (electrical discharges). Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

Module V: NMR spectroscopy (4 lectures)
Principle, Instrumentation, factors affecting chemical shift, spin coupling, applications.

Module VI: Electroanalytical Methods (4 lectures)
Potentiometry & Voltammetry.

Module VII: Radiochemical Methods (4 lectures)

Module VIII: X-ray analysis and electron spectroscopy (surface analysis) (4 lectures)

Suggested Readings
2. Instrumental Methods of Analysis, W. Merritt, D. Settle.
6. Infrared Spectral Interpretations: A Systematic Approach, Smith, B.
7. Physical Chemistry, Moore, W. J.

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CHSC0147: Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II
(4-0-0)

Course Outcomes
1. Recall the concepts of solutions, electrochemistry and phase equilibrium. (Remembering)
2. Explain the properties and reactivity of different organic compounds. (Understanding)
3. Solve problems on electrochemistry, phase equilibrium, solutions etc. (Applying)
4. Differentiating between the primary, secondary, tertiary and quaternary structure of proteins. (Analysing)
5. Decide which synthetic route to apply when solving problems on organic chemistry. (Evaluating)

Module I: Physical Chemistry (30 Lectures)
a. Solutions

b. Phase Equilibrium
Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clusius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, FeCl3-H2O and Na-K only).

c. Conductance
Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes.

Immiscibility of liquids. Conductometric titrations (only acid-base).

d. Electrochemistry

Module II: Organic Chemistry (30 Lectures)

a. Carboxylic acids and their derivatives (6 Lectures)

b. Amines and Diazonium Salts (6 Lectures)
Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, Gabriel’s Phthalimide synthesis, Hofmann Bromamide reaction.
Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.

c. Amino Acids, Peptides and Proteins (10 Lectures)

d. Carbohydrates (8 Lectures)
Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disaccharides (sucrose, cellobiose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

Suggested Readings
1. Physical Chemistry, G. M. Barrow, Tata McGraw-Hill.
Mapping of COs to syllabus

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CHCS0148: Chemistry of d-block elements, Quantum Chemistry & Spectroscopy
(4-0-0)

Course outcomes
1. Recall properties of d- and f- block elements. (Remembering)
2. Explain the principles of quantum mechanics and spectroscopy. (Understanding)
3. Calculate positions of absorption lines of molecules and energies and wavefunctions. (Applying)
4. Differentiate between theories behind the formation of coordination compounds. (Analysing)
5. Assess the right approach to apply when predicting properties or calculating wavefunctions. (Evaluating)
6. Predict shapes and structure of molecules of coordination compounds. (Creating)

Module I: Inorganic Chemistry (30 Lectures)

a. Transition Elements (12 Lectures)
   General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu. Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

b. Coordination Chemistry (8 Lectures)

c. Crystal Field Theory (10 Lectures)
   Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

Module II: Physical Chemistry (30 Lectures)

a. Quantum Chemistry & Spectroscopy (24 Lectures)
   Microwave (pure rotational) spectra of diatomic molecules. Selection rules. Structural information derived from rotational spectroscopy.
   Vibrational Motion: Schrödinger equation of a linear harmonic oscillator and brief discussion of its results (solution not required). Quantization of vibrational energy levels. Selection rules, IR spectra of diatomic molecules. Structural information derived from vibrational spectra. Vibrations of polyatomic molecules. Group frequencies. Effect of hydrogen bonding (inter- and intramolecular) and substitution on vibrational frequencies.

b. Photochemistry (6 Lectures)

Suggested Readings
1. Physical Chemistry, G. M. Barrow, Tata McGraw-Hill.
6. A New Concise Inorganic Chemistry, J. D. Lee, E. L. B. S.

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**CHML0149: Molecules of Life**

(4-0-0)

**Course outcomes**

1. Recall the physicochemical properties of biomolecules. (Remembering)
2. Explain the properties and functions of the biomolecules they study. (Understanding)
3. Write mechanisms of biomolecular reactions. (Applying)
4. Differentiate between different biomolecules. (Analysing)
5. Assess the importance of biomolecules in specific processes. (Evaluating)

**Module I: Carbohydrates (10 lectures)**

Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

**Module II: Amino Acids, Peptides and Proteins (12 lectures)**

Classification of Amino Acids, Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNF and Edman method) and C-terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

**Module III: Enzymes and correlation with drug action (12 lectures)**

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and Non-competitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group, -NH2 group, double bond and aromatic ring.

**Module IV: Nucleic Acids (10 lectures)**

Components of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

**Module V: Lipids (8 lectures)**

Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

**Module VI: Concept of Energy in Biosystems (8 lectures)**

Suggested Readings

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CHSL0200: Elements of Service

(2–0–0)

Course Outcomes
1. Understanding social responsibility of higher educational institutes. (Understanding)
2. Identifying problems in the community and where students originated. (Applying)
3. Influence to get involved in the local community to gain insight into local issues. (Evaluating)
4. Adopt strong leadership skills which allow students to work well in a team. (Creating)

Module I (6 lectures)
Understanding social responsibility of higher educational institutes; community university engagement (CUE) and its importance, engaged teaching, engaged research. Community Based Participatory Research (CBPR). Statutory bodies of higher educational institutions and social responsibility.

Module II (9 lectures)
Service learning and active learning; principles of service learning; classification of service learning models; service learning vis a vis other community experiences; historical context of university community partnership; chemistry and service learning; service Learning for a postgraduate chemistry student and its scope in research.

Module III (15 lectures)
Conceptualisation of the idea of service learning through their practical implementations (any two): (i) demonstrating experiments to inoculate scientific temper for nearby communities, (ii) organising awareness programmes for school children to eradicate the fear of pursuing higher studies in science, (iii) engaging with communities to find out various possibilities of providing the solutions to societal problems from chemistry point of view, (iv) providing consultancy to school students for various inter school science competitions.

Suggested Readings

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LABORATORY COURSES

CHIQ6002: Inorganic Qualitative and Quantitative Analysis – Lab

(0–0–3)

Course Outcomes
1. Recall the procedures followed to carry out the qualitative and quantitative analysis. (Remembering)
2. Explain the reason behind each step for Analysing mixtures and preparing compounds and metal nanoparticles.
3. Apply different spectroscopic methods to characterize coordination compounds. (Applying)
4. Design protocols for Analysing inorganic mixtures and synthesizing nanoparticles. (Creating)

Experiments:
- Qualitative analysis (tertiary mixtures, alloys, ores).
- Quantitative analysis (binary mixtures, alloys, ores).
- Inorganic preparation (crystallization, precipitation, calcination).
- Coordination compounds through ligand synthesis and spectroscopic characterization, magnetic properties.
- Metal Nanoparticle synthesis and characterization.

Suggested Readings
2. Vogel’s Qualitative Inorganic Analysis, G. Svehla and S. Mittal, Pearson Education.

Mapping of COs to Syllabus

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CHEQ6003: Experimental Physical Chemistry – Lab
(0-0-3)

Course Outcomes
1. Recall the theoretical concepts of experiments related to chemical kinetics and electrochemistry etc. (Remembering)
2. Explain the principles and the procedures for spectrophotometry based experiments. (Understanding)
3. Apply the theoretical knowledge for determination of rate constant, pH, emf etc. (Applying)
4. Analyse the practical utility of different theories of chemical kinetics, electrochemistry, adsorption etc. (Analysing)

Experiments:
- Chemical Kinetics based experiments.
- Electrochemistry based experiments.
- Spectrophotometry based experiments.
- pH-metric Titrations.
- Adsorption on porous materials - equilibrium, kinetic and thermodynamic studies.

Suggested Readings

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CHQA6004: Organic Qualitative Analysis and Synthesis Lab
(0-0-3)

Course Outcomes
1. Recall the procedures for qualitative analysis, separation of binary mixtures of organic compounds. (Remembering)
2. Explain the chemistry behind the preparation of some important organic compounds. (Understanding)
3. Apply different chromatographic techniques for the identification and purification of organic compounds. (Applying)
4. Analyse practical utility of chromatographic techniques. (Analysing)
5. Identify and extract different types of natural products. (Applying)

a. Qualitative analysis of binary mixtures of organic compounds
1. Separation of binary mixture into individual components.
2. Qualitative analysis of individual components by
   I. Detection of extra elements N, S, Halogens.
   II. Test for functional groups by systematic analysis.
   III. Solubility, melting point.
   IV. Preparation of a derivative and determination of its melting point.
b. Preparation of organic compounds by using single and multistep process.
   1. Chromatographic techniques
   2. Qualitative TLC separation and identification.
   3. Column chromatographic separation of a mixture of compounds.
c. Extraction of natural products.

Suggested Readings

Mapping of COs to Syllabus

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CHRP6005: Research Project
(0-0-12)

Course Outcomes
This will be a research-based module, whereby, students will carry out either theoretical or wet lab experiments and present their findings in a thesis and perhaps as a paper in a conference or a journal.
1. Learn to carry out experiments to fulfil their research objectives and will in the process learn a wide range of techniques both scientific and statistical, and also probably add to the existing body of scientific knowledge. (Remembering)
2. Develop an understanding of the methods they use to carry out their research and why a certain set of methods is chosen. (Understanding)
3. Apply their understanding to steer their research in the right direction. (Applying)
4. Troubleshoot when a chosen approach does not yield the expected result. (Analysing)
5. Critically analyse the results they obtain to decide whether the data obtained proves or disproves a stated hypothesis. (Evaluating)
6. Learn to choose a methodology or approach to fulfil a set of objectives or prove or disprove a hypothesis. (Creating)

In this course, each student undertakes research on a topic that he/she chooses in project phase I or on a topic assigned to him/her by the concerned mentor.
To this end, the student will first review the current status of research on the selected topic, state a hypothesis or a set of objectives and then carry out experiments (either wet-lab or theoretical) to gather data, which he/she will then analyse, draw conclusions and finally present in a dissertation at the end of the semester.

The format for the final dissertation will be as prescribed by the department. There will be a viva voce examination on the dissertation by an expert committee comprising external and internal members of the department. The mode and components of the evaluation and the weightages attached to them shall be published by the department at the beginning of the semester.

CHAB6101: Inorganic Chemistry-I: Atomic Structure & Chemical Bonding
(0-0-2)

Course Outcomes
1. Recall the knowledge related to primary and secondary standard solutions. (Remembering)
2. Explain the concept of molarity, normality, molality etc. (Understanding)
3. Apply the concept of acid-base titration for estimation. (Applying)
4. Analyse the amount of free alkali present in various soaps or detergents. (Analysing)
5. Estimate metals using internal and external indicators. (Evaluating)
6. Build the setup for the estimation of an unknown mixture of ions and interpretation of results. (Creating)

a. Titrimetric Analysis
   2. Preparation of solutions of different Molarity/Normality of titrants.

b. Acid-Base Titrations
   1. Estimation of carbonate and hydroxide present together in mixture.
   2. Estimation of carbonate and bicarbonate present together in a mixture.
   3. Estimation of free alkali present in different soaps/detergents.

c. Oxidation-Reduction Titrimetry
   1. Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution.
   2. Estimation of oxalic acid and sodium oxalate in a given mixture.
   3. Estimation of Fe(II) with K2Cr2O7 using internal (diphenylamine, anthranilic acid) and external indicator.

Suggested Readings

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CHIS6102: Physical Chemistry-I: States of Matter & Ionic Equilibrium – Lab
(0-0-2)

Course Outcomes
1. Recall principles and methods to measure the properties of liquids. (Remembering)
2. Explain the principles of experiments related to pH meter. (Understanding)
3. Measure the properties of liquids and the dissociation constant of unknown weak acids. (Applying)
4. Analyse the results of the experiments. (Analysing)
5. Set up an experimental protocol for measuring the property of an unknown sample. (Creating)

Surface tension measurements.
1. Determine the surface tension by (a) drop number (b) drop weight method.
2. Study the variation of surface tension of detergent solutions with concentration.

Viscosity measurement using Ostwald's viscometer.
1. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.
2. Study the variation of viscosity of sucrose solution with the concentration of solute.

Indexing of a given powder diffraction pattern of a cubic crystalline system.

pH metre
1. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures. Preparation of buffer solutions of different pH
   I. Sodium acetate-acetic acid.
   II. Ammonium chloride-ammonium hydroxide. pH metric titration of
2. Strong acid vs. strong base.
3. Weak acid vs. strong base.
4. Determination of dissociation constant of a weak acid. Any other experiment carried out in the class.

Suggested Readings
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CHBH6103: Organic Chemistry-I: Basics & Hydrocarbons Lab
(0-0-2)

Course Outcomes
1. Recall the concept of purification techniques. (Remembering)
2. Understand the chromatographic technique for separation and purification of mixture of organic compounds. (Understanding)
3. Apply the concept of paper chromatography technique for separation of a mixture of two sugars. (Applying)
4. Analyse the compounds by comparing their retention factor with the standard. (Analysing)
5. Evaluate the purity of organic compounds. (Evaluating)
6. Identify unknown compounds by applying these already mentioned techniques. (Creating)

Experiments:
- a. Checking the calibration of the thermometer.
- b. Purification of organic compounds by crystallization using the following solvents:
  - I. Water
  - II. Alcohol
  - III. Alcohol-Water
- c. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus).
- d. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.
- e. Determination of boiling point of liquid compounds (boiling point lower than and more than 100 °C by distillation and capillary method).
- f. Chromatography:
  - I. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography.
  - II. Separation of a mixture of two sugars by ascending paper chromatography.
  - III. Separation of a mixture of o- and p-nitrophenol or o- and p-aminophenol by thin layer chromatography (TLC).

Suggested Readings

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CHCT6104: Physical Chemistry-II: Chemical Thermodynamics & its Applications Lab
(0-0-2)

Course Outcomes
1. Recall principles and methods used to measure heats of reaction. (Remembering)
2. Explain methods and principles to carry out the thermodynamic measurements. (Understanding)
3. Measure heats of reactions following the appropriate procedures. (Applying)
4. Calculate the heats of reactions in each experiment. (Analysing)
5. Design experiments to measure enthalpy changes in the solution. (Creating)
Thermochemistry
a. Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
b. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
c. Calculation of the enthalpy of ionization of ethanoic acid.
d. Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
e. Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
f. Determination of enthalpy of hydration of copper sulphate.
g. Study of the solubility of benzoic acid in water and determination of $\Delta H$. Any other experiment carried out in the class.

Suggested Readings

Mapping of COs to Syllabus

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CHAH6105: Atomic Structure, Bonding, General Organic Chemistry and Aliphatic Hydrocarbons Lab
(0-0-2)

Course Outcomes
1. Recall the concept of titration and chromatography for estimation and separation. (Remembering)
2. Explain the principles of titration and chromatography. (Understanding)
3. Applying the concept of titration and chromatography to the estimation of samples. (Application)
4. Decide the method for appropriate chromatographic separation of organic molecules in a mixture. (Analysis)

Section A: Inorganic Chemistry - Volumetric Analysis
a. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
b. Estimation of oxalic acid by titrating it with KMnO4.
c. Estimation of water of crystallization in Mohr’s salt by titrating with KMnO4.
d. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.
e. Estimation of Cu (II) ions iodometrically using Na2S2O3.

Section B: Organic Chemistry
a. Purification of OC by crystallisation (from water and alcohol) and distillation.
c. Detection of extra elements (N, S, Cl, Br, I) in organic compounds.
d. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)
   1. Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.
   2. Identify and separate the sugars present in the given mixture by paper chromatography.

Suggested Readings
1. Vogel’s Qualitative Inorganic Analysis, A. I. Vogel, Prentice Hall.

Mapping of COs to Syllabus

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CHCF6106: Chemical Energetics, Equilibria and Functional Group Organic Chemistry Lab
(0-0-2)

Course Outcomes
1. Recall principles and methods used to measure heats of reaction. (Remembering)
2. Explain methods and underlying principles used to carry out the experiments related to ionic equilibria. (Understanding)
3. Learn to prepare specific organic compounds using appropriate procedures. (Applying)
4. Analyses of organic compounds possessing monofunctional groups. (Analysing)
5. Assess the advantages and drawbacks of the methods used for carrying out the experiments. (Evaluating)

a. Physical Chemistry Thermochemistry:
   1. Determination of heat capacity of calorimeter for different volumes.
   2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
   3. Determination of enthalpy of ionization of acetic acid.
   4. Determination of integral enthalpy of solution of salts (KNO3, NH4Cl).
   5. Determination of enthalpy of hydration of copper sulphate.

b. Ionic equilibria
   1. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilutesolutions of soaps and shampoos to prevent damage to the glass electrode) using pH meter.
   2. Preparation of buffer solutions
      i. sodium acetate-acetic acid.
      ii. Ammonium chloride-ammonium hydroxide.
      iii. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

c. Organic Chemistry
   1. Preparations: Mechanism of various reactions involved to be discussed, recrystallization, determination of melting point and calculation of quantitative yields to be done.
      i. Bromination of phenol/aniline.
      ii. benzylation of amines/phenols.
      iii. Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone.
   2. Systematic qualitative organic analyses of organic compounds possessing monofunctional groups (alcohols,phenols, carbonyl, -COOH) and preparation of one suitable derivative.

Suggested Readings
3. Senior Practical Physical Chemistry, B. D. Khosla, S. Chand & Co.

Mapping of COs to Syllabus

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CHOS6113: Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy Lab
(0-0-2)

Course Outcomes
1. Qualitative analysis of the organic sample. (Remembering)
2. Explain the concepts of retention factors in chromatographic techniques. (Understanding)
3. Application of paper chromatography techniques. (Applying)
4. Preparation of transition metal complex and comparison of their conductance. (Analysing)
5. Derivative preparation and comparing the properties with literature. (Evaluating)
6. Functional group analysis and structure determination of unknown organic sample. (Creating)

Inorganic Chemistry
1. Separation of mixtures by chromatography: Measure the Rf value in each case. (Combination of two ions to be given)
   i. Paper chromatographic separation of Fe²⁺, Al³⁺ and Cr³⁺.
   ii. Paper chromatographic separation of Ni²⁺, Co²⁺, Mn²⁺ and Zn²⁺.
2. Preparation of any two of the following complexes and measurement of their conductivity:
   i. Tetraaminecarbonatocobalt (III) nitrate.
   ii. Tetraaminecopper (II) sulphate.
   iii. Potassiumtrioxalatoferrate (III) trihydrate.
   iv. Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl₂ and LiCl₃.

Organic Chemistry
Systematic Qualitative Organic Analysis of Organic Compounds possessing mono functional groups (COOH, alcoholic, phenolic, carbohydrates, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

Suggested Readings
1. Qualitative Inorganic Analysis, A. I. Vogel, Prentice Hall.
2. Quantitative Chemical Analysis, A. I. Vogel, Prentice Hall.

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CHCK6114: Chemistry of s- and p- Block Elements, States of Matter and Chemical Kinetics Lab
(0-0-2)

Course Outcomes
1. Gain knowledge about semi-micro qualitative analysis of salt. (Remembering)
2. Explanation of group analysis for basic radicals present in salt. (Understanding)
3. Apply the concept of salt analysis to identify ions present in a mixture of salts. (Applying)
4. Comparison of acidic strength by studying the kinetics of hydrolysis of the ester. (Analysing)
5. Surface tension and viscosity measurement by following standard methodology. (Evaluating)
6. Derivation of rate laws for various chemical reactions using the concept of chemical kinetics. (Creating)

Inorganic Chemistry
Semi-micro qualitative analysis of mixtures using H₂S or any other scheme- not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:
- Cations: NH⁴⁺, Pb²⁺, Bi₃⁺, Cu²⁺, Fe³⁺, Al³⁺, Co³⁺, Ni²⁺, Mn²⁺, Zn²⁺, Ba²⁺, Sr²⁺, Ca²⁺, K⁺
- Anions: CO₃²⁻, S²⁻, SO₄²⁻, NO₃⁻, CH₃COO⁻, Cl⁻, Br⁻, I⁻, NO₂⁻, SO₄²⁻, PO₄³⁻, BO₃³⁻, C₂O₄²⁻, F⁻
(Spot tests should be carried out wherever feasible)

Physical Chemistry
Surface tension measurement (use of organic solvents excluded).
   i. Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
   ii. Study of the variation of surface tension of a detergent solution with concentration.

Viscosity measurement (use of organic solvents excluded).
   i. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
   ii. Study of the variation of viscosity of an aqueous solution with concentration of solute.

Chemical Kinetics: Study the kinetics of the following reactions.
   i. Initial rate method: Iodide-persulphate reaction.
   ii. Integrated rate method:
      • Acid hydrolysis of methyl acetate with hydrochloric acid.
      • Saponification of ethyl acetate.
• Compare the strengths of HCl and H2SO4 by studying kinetics of hydrolysis of methyl acetate.

Suggested Readings
1. Qualitative Inorganic Analysis, A. I. Vogel, Prentice Hall.
2. Quantitative Chemical Analysis, A. I. Vogel, Prentice Hall.
3. Senior Practical Physical Chemistry, B. D. Khosla, R. Chand & Co.

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CHBM6115: Organic Chemistry IV: Biomolecules Lab
(0-0-2)

Course Outcomes
1. Recall principles of estimation of some amino acids and proteins. (Remembering)
2. Understand the principles involved in estimations of amino acids, proteins. (Understanding)
3. Apply the principles they learn to carry out the aforementioned estimations. (Applying)
4. Analyse the experimental data of these experiments. (Analysing)
5. Evaluate experimental data as well as procedures to conclude. (Evaluating)

Experiments:
a. Estimation of glycine by Sorensor’s formalin method.
b. Study of the titration curve of glycine.
c. Estimation of proteins by Lowry’s method.
d. Study of the action of salivary amylase on starch at optimum conditions.
e. Effect of temperature on the action of salivary amylase.
f. Saponification value of an oil or a fat.
g. Determination of iodine number of an oil/ fat.
h. Isolation and characterization of DNA from onion/ cauliflower/peas.

Suggested Readings

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CHQS6116: Physical Chemistry V: Quantum Chemistry and Spectroscopy Lab
(0-0-2)

Course outcomes
1. Remember the laws to apply when carrying out UV-visible absorbance measurements. (Remembering)
2. Explain how the laws can be used to determine concentrations or molar extinction coefficients of molecules. (Understanding)
3. Carry out measurements of molecular absorption in the lab. (Applying)
4. Suggest alternative ways of carrying out experiments or analysis of data. (Creating)

UV/Visible spectroscopy:

a. Study the 200-500 nm absorbance spectra of KMnO4 and K2Cr2O7 (in 0.1 M H2SO4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule⁻¹, kJ mol⁻¹, cm⁻¹, eV).
b. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of K2Cr2O7.
c. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colorimetry:
  a. Verify Lambert-Beer’s law and determine the concentration of CuSO4/KMnO4/K2Cr2O7 in a solution of unknown concentration.
  b. Determine the concentrations of KMnO4 and K2Cr2O7 in a mixture.
  c. Study the kinetics of iodination of propanone in acidic medium.
  d. Determine the amount of iron present in a sample using 1, 10-phenanthroline.
  e. Determine the dissociation constant of an indicator (phenolphthalein).
  f. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
  g. Analysis of the given vibration-rotation spectrum of HCl(g).

Suggested Readings

Mapping of COs to Syllabus

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CHAC6117: Application of Computers in Chemistry Lab
(0-0-2)

Course Outcomes
1. Remember the concepts involved in the programming language. (Remembering)
2. Understand the aforementioned concepts. (Understanding)
3. Apply the concepts to write programs for chemical calculations. (Applying)
4. Analyse how different software can be used in chemistry. (Analysing)
5. Evaluate the written programs and the results. (Evaluating)

Experiments:
  a. Roots of equations: (e.g. volume of gas using van der Waals equation and comparison with ideal gas, pH of a weak acid).
  b. Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations).
  c. Numerical integration (e.g. entropy/enthalpy changes from heat capacity data).
  d. Probability distributions (gas kinetic theory) and mean values.
  e. Matrix operations.
  f. Graphical programs related to Chemistry problems. e.g. van der Waals isotherm, Compressibility versus pressure curves, Maxwell distribution curves, concentration-time graph, pH metric titration curve, conductometric titration curves, Lambert Beer’s law graph, s, p, d orbital shapes, radial distribution curves, etc.

Use of Software Products
  a. Computer Software like Scilab and Excel, etc. for data handling and manipulation.
  b. Simple exercises using multimedia visualization software like Chemsketch, Arguslab and Accelrys J Draw, geometry optimization and potential energy surface of molecules like carbon dioxide, water, ethane, cyclohexane and benzene (local and global minima).

Suggested Readings
3. The Chemical Maths Book, E. Steiner, Oxford University Press.
5. Quantitative Chemical Analysis, D. C. Harris, Freeman.

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CHAM6118: Analytical Methods in Chemistry Lab
(0-0-2)

Course Outcomes
1. Recall the principles of different separation techniques. (Remembering)
2. Explain the ion exchange process. (Understanding)
3. Apply solvent extraction and partitioning method to perform experiments. (Applying)
4. Analyse the experimental data in the laboratory. (Analysing)
5. Discuss soil analysis. (Evaluating)

Separation Techniques Chromatography:
   a. Separation of mixtures
      i. Paper chromatographic separation of Co²⁺ and Ni²⁺.
      ii. Separation and identification of the amino acids present in the given mixture by paper chromatography. Reporting the Rf values.

Solvent Extractions:
   To separate a mixture of Ni²⁺ & Fe²⁺ by complexation with DMG and extracting the Ni²⁺ DMG complex in chloroform, and determine its concentration by spectrophotometry.

Analysis of soil:
   a. Determination of pH of soil.
   b. Total soluble salt.
   c. Estimation of calcium, magnesium.
   d. Qualitative detection of nitrate, phosphate.

Ion exchange:
   a. Determination of exchange capacity of cation exchange resins and anion exchange resins.
   b. Separation of amino acids from organic acids by ion exchange chromatography.

Spectrophotometry: Verification of Lambert-Beer’s law and determination of concentration of a coloured species (CuSO₄, KMnO₄⁻)

Suggested Readings

Mapping of COs to Syllabus

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CHNS6119: Novel Inorganic Solids Lab
Course Outcomes
1. Explanation of the principle involved in the ion-exchange process. (Remembering)
2. Understand the chemistry behind the cation-exchange, co-precipitation and hydrogel process. (Understanding)
3. Application of co-precipitation method for synthesizing nanoparticles. (Applying)
4. Analysing the effect of concentration on the synthesis of gold and silver nanoparticles. (Analysing)
5. Methodology development for the determination of total difference of solids. (Evaluating)
6. Designing a green method for synthesis of nanomaterials. (Creating)

Experiments:
- Determination of cation exchange method.
- Determination of total difference of solids.
- Synthesis of hydrogel by co-precipitation method.
- Synthesis of silver and gold metal nanoparticles.

Suggested Readings

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CHPC6120: Polymer Chemistry Lab
(0-0-2)

Course Outcomes
1. Recall different methods of preparing, characterizing and analysing polymers. (Remembering)
2. Understand the aforementioned methods. (Understanding)
3. Carry out preparations and characterization of polymers in the lab. (Applying)
4. Analyse and interpret experimental results. (Analysing)
5. Suggest alternative methods for the preparation and characterization of polymers. (Creating)

Polymer synthesis
- Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
  - Purification of monomer.
  - Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN).
- Preparation of nylon 66/6.
  - Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein.
  - Preparation of IPC.
  - Purification of IPC.
  - Interfacial polymerization.
- Redox polymerization of acrylamide.
- Precipitation polymerization of acrylonitrile.
- Preparation of urea-formaldehyde resin.
- Preparations of novalac resin/resold resin.
- Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization
- Determination of molecular weight by viscometry:
  - Polyacrylamide-aq. NaNO2 solution.
  - Poly vinyl propyldine (PVP) in water.
- Determination of the viscosity-average molecular weight of poly (vinyl alcohol) (PVOH) and the fraction of —head-to-head— monomer linkages in the polymer.
- Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
d. Testing of mechanical properties of polymers.
e. Determination of hydroxyl number of a polymer using colorimetric method.

Polymers analysis
a. Estimation of the amount of HCHO in the given solution by sodium sulphite method.
b. Instrumental Techniques.
c. IR studies of polymers.
d. DSC analysis of polymers.
e. Preparation of polyacrylamide and its electrophoresis.
*at least 7 experiments to be carried out.

Suggested Readings

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CHOC6121: Inorganic Chemistry IV: Organometallic Chemistry Lab
(0-0-2)

Course Outcomes
1. Recall the principles of separating and identifying ions in a mixture. (Remembering)
2. Interpret the chemistry of the reactions for separation and identification of ions. (Understanding)
3. Apply the principles to carry out the separation of ions in a mixture in the laboratory. (Applying)
4. Analyse the experimental results in the laboratory. (Analysing)
5. Evaluate the process of chromatographic separations of metal ions. (Evaluating)

Qualitative analysis:
Qualitative semi-micro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:
CO\(^{2-}\), NO\(^{-}\), S\(^{2-}\), SO\(^{2-}\), S Q\(^{2-}\), H\(_{2}\)CO\(_{3}\), F\(^{-}\), Cl\(^{-}\), Br\(^{-}\), I\(^{-}\), BO\(^{3-}\), C Q\(^{2-}\), BrO\(^{2-}\), NH\(_{4}\)\(^{+}\), K\(^{+}\), Rb\(^{+}\), Cs\(^{+}\), Cu\(^{2+}\), Cd\(^{2+}\), Bi\(^{3+}\), Sn\(^{2+}\), Sb\(^{3+}\), Fe\(^{3+}\), Al\(^{3+}\), Cr\(^{3+}\), Zn\(^{2+}\), Mn\(^{2+}\), Ca\(^{2+}\), Ba\(^{2+}\), Sr\(^{2+}\), Mg\(^{2+}\).
Mixtures should preferably contain one interfering anion, or insoluble component (BaSO\(_{4}\), SrSO\(_{4}\), PbSO\(_{4}\), CaF\(_{2}\) or Al\(_{2}\)O\(_{3}\)) or combination of anions e.g. CO\(^{2-}\)andSO\(^{2-}\), NO\(^{-}\)and NO\(^{-}\), Cl\(^{-}\),Br\(^{-}\), and I\(^{-}\), Br\(^{-}\)and I\(^{-}\), NO\(^{-}\)and SO\(_{4}\)\(^{2-}\), NO\(^{-}\)and I\(^{-}\). Spot tests
should be done whenever possible.

**Chromatography:**
Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:
1. Ni (II) and Co (II).
2. Cu(II) and Cd(II).

**Suggested Readings**
1. Vogel's Qualitative Inorganic Analysis, Revised by G. Svehla.
2. A Textbook of Quantitative Analysis, A. I. Vogel, ELBS.

**Mapping of COs to Syllabus**

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**CHSP6122: Organic Chemistry V: Spectroscopy Lab**

(0-0-2)

**Course Outcomes**
1. Recall the principles involved in the extraction of organic compounds. (Remembering)
2. Explain the procedure for the extraction of caffeine from tea leaves. (Understanding)
3. Carry out extractions and preparation of specific organic compounds. (Applying)
4. Analyse organic compounds with the help of chemical tests and spectroscopic techniques. (Analysing)

**Experiments:**

a. Extraction of caffeine from tea leaves.
b. Preparation of urea formaldehyde resin.
c. Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, e.g. salicylic acid, cinnamic acid, nitrophenols etc.
d. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).
e. Preparation of methyl orange.

**Suggested Readings**

**Mapping of COs to Syllabus**

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**CHGC6123: Green Chemistry Lab**

(0-0-2)

**Course Outcomes**
1. Recall principles of Green Chemistry. (Remembering)
2. Understand the principles. (Understanding)
3. Apply the principles of green chemistry in the laboratory. (Applying)
4. Analyse and interpret experimental data. (Analysing)
5. Suggest alternative procedures for experiments done in the lab. (Creating)
Safer starting materials
Preparation and characterization of nano particles of gold using tea leaves.

Using renewable resources
Preparation and characterization of biodiesel from vegetable oil/ waste cooking oil.

Avoiding waste
b. Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.
c. Preparation of propene by two methods can be studied.
   • Triethylamine ion + OH- → propene + trimethyl propene + water H2SO4/H2O
   • 1-propanol propene + water
The other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

Use of enzymes as catalysts
Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

Alternative Green solvents
a. Extraction of D-limonene from orange peel using liquid CO2 prepared from dry ice.
b. Mechno chemical solvent free synthesis of azomethines.

Alternative sources of energy
a. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
b. Photoreduction of benzophenone to benzoin oncol in the presence of sunlight.

Suggested Readings
2. Greener approaches to undergraduate chemistry experiment, M. Kirchoff, and M. A. Ryan, American Chemical Society, Washington DC.
3. Introduction to Green Chemistry, M. A. Ryan, American Chemical Society, Washington DC.
5. Real world cases in Green Chemistry, M. C. Cann and M. E. Connelly, American Chemical Society.
6. Real world cases in Green Chemistry, M. C. Cann and P. Thomas, American Chemical Society.

Mapping of COs to Syllabus

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CHII6124: Inorganic Materials of Industrial Importance Lab
(0-0-2)

Course Outcomes
1. Recall the principles of inorganic estimation. (Remembering)
2. Understand the aforementioned principles. (Understanding)
3. Apply knowledge and understanding in carrying out lab experiments. (Applying)
4. Analyse and interpret experimental data. (Analysing)
5. Suggest alternative procedures of doing experiments. (Creating)

Experiments:
   a. Determination of free acidity in ammonium sulphate fertilizer.
   b. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
   c. Estimation of phosphoric acid in superphosphate fertilizer.
d. Electroless metallic coatings on ceramic and plastic material.
e. Determination of composition of dolomite (by complexometric titration).
f. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
g. Analysis of Cement.
h. Preparation of pigment (zinc oxide).

Suggested Readings
1. Industrial Chemistry, Vol I, E. Stocchi, Ellis Horwood Ltd. UK.

Mapping of COs to Syllabus

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CHCE6125: Industrial Chemicals & Environment Lab

(0-0-2)

Course Outcomes
1. Recall the various processes required for measuring environmental pollutants. (Remembering)
2. Understand the principle involved in the estimations of water quality parameters. (Understanding)
3. Estimation of total alkalinity of water samples using the standard method. (Applying)
4. Study of some of the common bio-indicators of pollution. (Analysing)
5. Estimation of harmful pollutants using standard methodology. (Evaluating)
6. Designing innovative technology for controlling environmental pollution. (creating)

Experiments:

a. Determination of dissolved oxygen in water.
b. Determination of Chemical Oxygen Demand (COD).
c. Determination of Biological Oxygen Demand (BOD).
d. Percentage of available chlorine in bleaching powder.
e. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO₃ and potassium chromate).
f. Estimation of total alkalinity of water samples (CO₂⁻, HCO₃⁻) using double titration method.
g. Measurement of dissolved CO₂.
h. Study of some of the common bio-indicators of pollution.
i. Estimation of SPM in air samples.
j. Preparation of borax/ boric acid.

Suggested Readings
1. Industrial Chemistry, Vol-I, E. Stocchi, Ellis Horwood Ltd. UK.

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CHSP6126: Inorganic Chemistry II: s- and p-block elements Lab
(0-0-2)

Course Outcomes
1. Recall the idea of different types of estimations of inorganic compounds. (Remembering)
2. Explain the principles of different types of iodimetric titrations. (Understanding)
3. Utilize the methods of preparation of some inorganic complexes. (Applying)
4. Analyse the principles of complexometric titrations for the estimation of inorganic compounds. (Analysing)

Iodo / Iodimetric Titrations
1. Estimation of Cu(II) and K₂Cr₂O₇ using sodium thiosulphate solution (iodometrically).
2. Estimation of antimony in tartar-emetic iodometrically.

Complexometric titrations using disodium salt of EDTA
1. Estimation of Mg²⁺, Zn²⁺.
2. Estimation of Ca²⁺ by substitution method.

Inorganic Preparations
1. Cuprous chloride, Cu₂Cl₂.
2. Manganese (III) phosphate, MnPO₄₂H₂O.
3. Aluminium potassium sulphate KAl(SO₄)₂.12H₂O (potash alum) or chrome alum.

Suggested Readings
1. A textbook of quantitative inorganic analysis, A. I. Vogel, ELBS.

Mapping of COs to Syllabus

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CHOG6127: Organic Chemistry II: Oxygen Containing Functional Groups Lab
(0-0-2)

Course Outcomes
1. Recall principles and procedures involved in functional group detection of organic compounds and preparations. (Remembering)
2. Explain the chemistry behind the detection of functional groups. (Understanding)
3. Carry out reactions to transform functional groups. (Applying)
4. Assess optimal conditions for organic reactions. (Evaluating)
5. Design conditions for oxidation of an alcohol, benzoylation of an amine etc. (Creating)

Experiments:

a. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.

b. Organic preparations:
   Acetylation of one of the following compounds: amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method:
   I. Using conventional method.
   II. Using green approach.
   III. Benzoylation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and one of the following phenols (β-naphthol, resorcinol, p- cresol) by Schotten-Baumann reaction.
   IV. Oxidation of ethanol/ isopropanol (iodoform reaction).
   V. Selective reduction of meta dinitrobenzene to m-nitroaniline.
   VI. Hydrolysis of amides and esters.
   VII. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
   VIII. S-Benzylisothiouronium salt of one of each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl
acetic acid and phthalic acid).

IX. Aldol condensation using either conventional or green method.

X. The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization and melting point.

Suggested Readings

Mapping of Cos to Syllabus

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CHPC6128: Physical Chemistry III: Phase Equilibria and Chemical Kinetics Lab
(0-0-2)

Course Outcomes
1. Recall the determination of the rate constant for chemical reactions. (Remembering)
2. Explain the concepts and methods for determining critical solution temperature (CST). (Understanding)
3. Measure the distribution coefficient of liquids, CST and equivalence points through potentiometric titrations. (Applying)
4. Find out how CST of the phenol-water system is affected by impurities. (Analysing)
5. Construct phase diagrams of different types of systems. (Creating)
6. Explain the different isotherms using adsorption techniques. (Understanding)

Experiments:
- Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.
- Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method:
  I. simple eutectic and
  II. congruently melting systems.
- Distribution of acetic/ benzoic acid between water and cyclohexane.
- Study the equilibrium of at least one of the following reactions by the distribution method:
  I. \( I_2(aq) + I^- \rightarrow I_3^-(aq) \)
  II. \( Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n\).
- Study the kinetics of the following reactions:
  I. Initial rate method: iodide-persulphate reaction.
  II. Integrated rate method:
     - Acid hydrolysis of methyl acetate with hydrochloric acid.
     - Saponification of ethyl acetate.
- Compare the strengths of HCl and H2SO4 by studying kinetics of hydrolysis of methylacetate.
- Adsorption
  Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

Suggested Readings

Mapping of COs to Syllabus

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CHCC6129: Inorganic Chemistry III: Coordination Chemistry Lab
(0-0-2)

Course Outcomes:
1. Recall principles and methods for gravimetric analysis of inorganic compounds. (Remembering)
2. Explain the principle of gravimetric estimation of some transition metal complexes. (Understanding)
3. Apply the principles and methods to know the properties of complexes. (Applying)
4. Adopt suitable methods to prepare inorganic compounds. (Creating)

Gravimetric Analysis:
2. Estimation of copper as CuSCN.
3. Estimation of iron as Fe₂O₃ by precipitating iron as Fe(OH)₃.
4. Estimation of Al(III) by precipitating with oxine and weighing as Al(oxine)₃ (aluminium oxinate).

Inorganic Preparations:
1. Tetraamminecopper (II) sulphate, [Cu(NH₃)₄] SO₄.H₂O.
2. Acetylacetonate complexes of Cu²⁺/Fe³⁺.
3. Tetraamminecarbonatocobalt (III) nitrate.
4. Potassium tri(oxalato)ferrate(III).

Properties of Complexes:
1. Measurement of 10 Dq by spectrophotometric method.
2. Verification of spectrochemical series.
3. Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

Suggested Readings:
1. A text book of Quantitative Analysis, A.I. Vogel, ELBS.

Mapping of COs to Syllabus

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CHHC6130: Organic Chemistry III: Heterocyclic Chemistry Lab
(0-0-2)

Course Outcomes:
1. Gain knowledge about Qualitative analysis of organic compounds. (Remembering)
2. Explain the chemistry of various tests used in the detection of functional groups and elements present in an organic sample. (Understanding)
3. Qualitative analysis for the identification of organic compounds from mixtures. (Applying)
4. Analyse the melting point of the compound and its derivative for the determination of its exact structure. (Analysing)
5. Purify organic compound via recrystallization and estimate their purity via melting point comparison with literature data. (Evaluating)

Experiments:
a. Functional group test for nitro, amine and amide groups.
b. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols, carbonyl compounds and esters).

Suggested Readings:

Mapping of COs to Syllabus

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**CHEL6131: Physical Chemistry IV: Electrochemistry Lab**

(0-0-2)

**Course Outcomes**
1. Recall the basic concepts of conductometry and potentiometry. (Remembering)
2. Explain the principles of conductometric and potentiometric titrations. (Understanding)
3. Determine the cell constant, conductivity, equivalence points through conductometry. (Applying)
4. Analysing and the data obtained from conductometric and potentiometric titrations. (Analysing)
5. Design experiments to measure the equivalence point of an acid-base reaction conductometrically. (Creating)

**Conductometry**
a. Determination of cell constant.
b. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid. Perform the following conductometric titrations:
   i. Strong acid vs. strong base.
   ii. Weak acid vs. strong base.
   iii. Mixture of strong acid and weak acid vs. strong base.
   iv. Strong acid vs. weak base.

**Potentiometry:**
Perform the following potentiometric titrations:
1. Strong acid vs. strong base.
2. Weak acid vs. strong base.
3. Dibasic acid vs. strong base.
4. Potassium dichromate vs. Mohr’s salt.

**Suggested Readings**

Mapping of COs to Syllabus

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**CHMD6132: Molecular Modelling & Drug Design Lab**

(0-0-2)

**Course outcomes**
1. Recall principles and techniques of molecular modelling. (Remembering)
2. Explain the underlying theories of molecular modelling. (Understanding)
3. Use different simulations techniques on macromolecules to calculate various properties. (Applying)
4. Analysing the results from the computations. (Analysing)
5. Assessing the theoretical and practical challenges in computational modelling. (Evaluating)
6. To create a test and training set for studying structure-activity relationship. (Creating)
Experiments:

a. Compare the optimized C-C bond lengths in ethane, ethene, ethyne and benzene. Visualize the molecular orbitals of the
ethane σ bonds and ethene, ethyne, benzene and pyridine π bonds.

b. (i) Perform a conformational analysis of butane. (ii) Determine the enthalpy of isomerization of cis and trans 2-butene.

c. Visualize the electron density and electrostatic potential maps for LiH, HF, N₂, NO and CO and comment. Relate to the
dipole moments. Animate the vibrations of these molecules.

d. (i) Relate the charge on the hydrogen atom in hydrogen halides with their acid character. (ii) Compare the basicity’s of
the nitrogen atoms in ammonia, methylamine, dimethylamine and trimethylamine.

a. (i) Compare the shapes of the molecules: 1-butanol, 2-butanol, 2-methyl-1-propanol, and 2-methyl-2-propanol. Note the
dipole moment of each molecule. (ii) Show how the shapes affect the trend in boiling points: (118 °C, 100 °C, 108 °C, 82
°C, respectively).

b. Build and minimize organic compounds of your choice containing the following functional groups. Note the dipole
moments of each compound: (a) alkyl halide (b) aldehyde (c) ketone (d) amine (e) ether (f) nitrile (g) thiol (h) carboxylic acid
(i) ester (j) amide.

c. (i) Determine the heat of hydration of ethylene. (ii) Compute the resonance energy of benzene by comparison of its
enthalpy of hydrogenation with that of cyclohexene.

d. Arrange 1-hexene, 2-methyl-2-pentene, (E)-3-methyl-2-pentene, (Z)-3-methyl-2-pentene, and 2,3-dimethyl-2-butene in
order of increasing stability.

e. (i) Compare the optimized bond angles H₂O, H₂S, H₂Se. (ii) Compare the HAH bond angles for the second row dihydrides
and compare with the results from qualitative MO theory.

c. Note: Software: Chem Sketch, Argus Lab (www.planaria-software.com), TINKER 6.2 (dasher.wustl.edu/ffe), Web Lab
Viewer, Hyperchem, or any similar software.

Suggested Readings
1. Molecular Modelling Principles and Application, A. R. Leach, Longman.

Mapping of COs to Syllabus

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CHIM6133: Instrumental Methods of Chemical Analysis Lab

(0-0-2)

Course outcomes
1. Recall the safety practices in the Chemistry laboratory. (Remembering)
2. Explain the principle involved in the determination of chemical properties. (Understanding)
3. Use of various techniques to determine unknown property. (Applying)
4. Assess the advantages and drawbacks of the various methods. (Evaluating)

Experiments:

a. Safety Practices in the Chemistry Laboratory.

b. Determination of the isoelectric pH of a protein.

c. Titration curve of an amino acid.

d. Determination of the void volume of a gel filtration column.

e. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.).

f. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water).

g. IR Absorption Spectra (Study of Aldehydes and Ketones).

h. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption.

i. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride).

j. Separation of Carbohydrates by HPLC.

k. Determination of Caffeine in Beverages by HPLC.

l. Potentiometric Titration of a Chloride-Iodide Mixture.

m. Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple.
n. Nuclear Magnetic Resonance.
o. Use of fluorescence to do “presumptive tests” to identify blood or other body fluids.
p. Use of “presumptive tests” for anthrax or cocaine.
q. Collection, preservation, and control of blood evidence being used for DNA testing.
r. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome).
s. Use of sequencing for the analysis of mitochondrial DNA.
t. Laboratory analysis to confirm anthrax or cocaine.
u. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives.
v. Detection of illegal drugs or steroids in athletes.
w. Detection of pollutants or illegal dumping.
x. Fibre analysis.

At least 10 experiments to be performed.

Suggested Readings
2. Instrumental Methods of Analysis, Merritt Willard, Settle Dean.

Mapping of COs to Syllabus

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CHPC6137: Petroleum Chemistry
(1-0-1)

Course Outcomes
1. To gain knowledge about the composition of crude petroleum and the refining process. (Remembering)
2. To correlate the quality of fuels with various parameters. (Understanding)
3. Determination of different types of water testing parameters required in thermal power plant. (Applying)
4. Analysing of chemical impurities and their separation techniques. (Analysing)

Module I: Oil Section (15 Lectures)
Renewable and non-renewable source of energy, Petroleum, Composition of crude petroleum, Hydrocarbon, Distillation (Upper distillation, middle distillation, Residue distillation), crude distillation unit, Fractional distillation, petroleum refining-applications of various fractions, Cracking, Reforming, Petrol, Diesel, viation turbine fuel, Kerocene, LPG, CNG, LNG, clean fuels, Octane number, Cetane number, Flash point, calorific value, knocking and antiknocking, isomerization, smoke point, Lubricants, viscosity index, cloud point, pore point, Density, Gas chromatography, HPLC.

Module II: Water section (15 Lectures)
Thermal power plant station, concept of zero discharge refinery, Oil content, Effluent treatment plant, boiler, demineralization, uses of cationic and anionic resin during neutralization reaction, requirement of pH determination, BOD, COD, TDS, TSS, DO, Microbiological treatment, Scavenger, alkalinity, corrosion monitoring, permanent alkalinity, Total hardness, temporary hardness, silica and phosphate removal process, removal of sulphate, sulphite, ammonia, cyanide, water testing.

Suggested Readings
2. Industrial Chemistry, B. K. Sharma, Goel Publishing House, Meerut

Mapping of COs to Syllabus

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<th>Course Outcomes</th>
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### CHPA6138: Pharmaceutical Chemistry and its applications
(1-0-1)

**Course Outcomes**
1. Explanation of the preliminary concept of drug and their classification. (Remembering)
2. To understand the mode of action of different kinds of drugs. (Understanding)
3. Synthesis of simple drug molecules and their purification techniques. (Applying)
4. Extraction of the medicinally active component from a plant source and their characterization techniques. (Analysing)
5. To provide knowledge of computational chemistry in designing drug molecules. (Evaluating)

**Module I: Introduction and importance of drug Chemistry (15 Lectures)**
Definition of drug, pro-drug, host-receptors interactions in connection to biological response, pharmacokinetics and mechanism of drug action-absorption, distribution, metabolism, and excretion (ADME), Structure activity relationship (SAR and QSAR), drug classification based on mode of action, analgesics and anti-inflammatory drug, COX-2 inhibitors, mode of action of NSAID and SAID, anti-histamine drugs, antidepressant drugs, narcotics, sedative-hypnotics and their mechanism of action, antibiotics, antiviral drugs, anti-bacterial drugs, anti-neoplastic drug, drugs derived from natural origin including plants and bacteria, chemotherapy, nano-drug delivery systems, toxicology, positive and negative aspect of drug chemistry, future scope of drug chemistry.

**Module II: Hands on experience on drug chemistry (15 Lectures)**
Experimental aspect of drug chemistry: Synthesis of simple drug molecules, various techniques used for purification including crystallization / recrystallization, acid-base purification, column chromatography, quality control / purity determination of drugs using GC-MS, HPLC etc., extraction of active ingredient from various plants in North-eastern region having medicinal importance, procedure for bioactivity test.

**Theoretical feature of drug chemistry:** Application of computational chemistry in designing of drug molecule, computer simulation to assist in solving chemical problems, drug-DNA interaction study, drug-delivery study.

**Suggested Readings**
2. Introduction to Medicinal Chemistry, A. Gringauz, Wiley India Pvt Ltd.

**Mapping of COs to Syllabus**

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VISION:
To elucidate the philosophy of Mathematical principles coupled with the exhibition of Mathematical laws in fundamental and frontier areas of science whereupon fostering an intuitive mathematical mind.

MISSION:
- To provide adequate understanding of Mathematical laws by means of both conventional techniques and skilful approaches.
- To familiarize students as well as faculty members with the state-of –the –art by means of talks, workshops, symposia.
- To invoke interest tinged with anxiety to facilitate further pursuit in terms of research pertaining to advanced knowledge.

PROGRAM OUTCOMES – BSC PROGRAMME
PO 1: **Disciplinary Knowledge**: Capable of demonstrating comprehensive knowledge and understanding of one or more other disciplines that form a part of an undergraduate programme of study.
PO 2: **Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives. Critically evaluate practices, policies and theories by following scientific approach to knowledge development.
PO 3: **Communication Skills**: Ability to express thoughts and ideas effectively in writing and orally; communicate with others using appropriate media; confidently share one’s views and express herself/himself; demonstrate the ability to listen carefully; and present complex information in a clear and concise manner to different groups.
PO 4: **Social Interaction**: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group and act together as a group or a team in the interests of a common cause. Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO 5: **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO 6: **Moral and Ethical Awareness**: Ability to embrace moral/ethical values in conducting one’s life, possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
PO 7: **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.
PO 8: **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes. Critical sensibility to lived experiences, with self-awareness and reflexivity of both and society.
PO 9: **Information and Digital Literacy**: Capability to use ICT in a variety of learning situations. Demonstrate ability to access, evaluate and use a variety of relevant information sources; and use appropriate software for analysis of data.
PO 10: **Research –related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problematizing, synthesizing and articulating; Ability to recognize cause- and- effect relationships, define problems, formulate hypotheses, interpret and draw conclusions from data, ability to plan, execute and report the results of an experiment or investigation. Ability to apply one’s learning to real life situations.

PROGRAM SPECIFIC OUTCOMES - BSC MATHEMATICS (HONOURS)
PSO 1: **Solid Foundation in Knowledge**: Bachelor Degree in Mathematics is the culmination of in-depth knowledge of many core branches of mathematics, viz. Algebra, Calculus, Geometry, Differential Equations, Mechanics, Real and Complex Analysis including some related areas like Computer Science and Statistics. Thus, this programme helps students in building a solid foundation for further higher studies and research in Mathematics.
PSO 2: **Competency in Skills:** The skills and knowledge gained has intrinsic beauty, which leads to proficiency in analytical reasoning, critical understanding, analysis and synthesis in order to solve theoretical and practical problems. This can orient students towards applications of mathematics in other disciplines and moreover, can also be utilised in modelling and solving real life problems.

PSO 3: **Problem Solving:** Students undergoing this programme learn to logically question assertions, to recognize patterns and to distinguish between essential and irrelevant aspects of problems. This helps them to learn behave responsibly in a rapidly changing interdependent society.

PSO 4: **Interdisciplinary and Research Skills:** Students completing this programme will be able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of mathematics to non-mathematicians.

PSO 5: **Proficiency in Employments:** This programme will help students to enhance their employability for Government jobs, jobs in banking, insurance and investment sectors, data analysis jobs, and jobs in various other public and private enterprises.

### COURSES OFFERED IN BSC MATHEMATICS (HONOURS)

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### BSC MATHEMATICS (HONOURS) MAPPING OF COURSES WITH POS/PSOS

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**PROGRAM OUTCOMES – MSC PROGRAMME**

**PO 1: Critical Thinking:** Inculcate critical thinking to carry out scientific investigation objectively. Formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. Critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.

**PO 2: Knowledge Skill:** Equip the student with skills to analyse problems, formulate a hypothesis, evaluate and validate results, and draw reasonable conclusions thereof. Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge.

**PO 3: Scientific Communication Skills:** Imbibe effective scientific and / or technical communication in both oral and writing. Ability to show the importance of the subject as precursor to various scientific developments since the beginning of the civilization.

**PO 4: Ethics:** Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in the subject concerned. Ability to identify unethical behaviour such as fabrication, falsification or misrepresentation of data and adoptive objective, unbiased and truthful action(s) in all aspects.

**PO 5: Enlightened Citizenship:** Create awareness to become an enlightened citizen with commitment to deliver one’s responsibilities within the scope of bestowed rights and privileges

**PO 6: Analytical Reasoning:** Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyse and synthesise data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.

**PO 7: Multicultural Competence:** Development of a set of competencies in order to enhance and promote the growth of multicultural sensitivity within universities. Integrating multicultural awareness such as race, gender, physical ability, age, income and other social variables, and by creating an environment that is, “welcoming for all students”.

**PO 8: Lifelong Learning:** Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning throughout life, through self-paced and self-directed learning aimed at personal development, and
adapting to changing academic demands of work place through knowledge/ skill development/ reskilling.

PO 9: **Leadership Qualities**: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination in a smooth and efficient way.

PO 10: **Research Skills**: Prepare students for pursuing research or careers in industry in concerned subject and allied fields. Capability to use appropriate software to solve various problems and to apply programming concepts of C++ and Mathematica/ Matlab to various scientific investigations, problem solving and interpretation.

**PROGRAMME SPECIFIC OUTCOMES FOR MSC MATHEMATICS**

PSO 1: **Strong Foundation in Knowledge**: Have strong foundation in core areas of Mathematics, and able to communicate Mathematics effectively.

PSO 2: **Abstract Skills**: Evaluate hypotheses, theories, methods and evidence within their proper contexts

PSO 3: **Problem Solving**: Solve complex problems by critical understanding, analysis and synthesis

PSO 4: **Proficiency in Interdisciplinary Skills**: Select, interpret and critically evaluate information from a range of sources that include books, scientific reports, journals, case studies and internet.

PSO 5: **Application and Research Efficiency**: Provide a systematic understanding of the concepts and theories of mathematics and their application in the real world- to an advanced level, and enhance career prospects in a huge array of fields, viz. in industry, commerce, education, finance and research.

PSO 6: **Lifelong Practical Knowledge**: Recognise the need to engage in lifelong learning through continuous education, and research leading to higher degrees like PhD, DSc etc.

**COURSES OFFERED IN MSC MATHEMATICS**

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**MSC CHEMISTRY- MAPPING OF COURSES TO PO/PSO**

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DEPARTMENT OF MATHEMATICS

DETAILED SYLLABUS THEORY COURSES

MARA0014: REAL ANALYSIS
(4-0-0)

COURSE OUTCOMES
1. Classify the convergence of sequences and series of real numbers, and study various tests. (Understanding)
2. Recall the fundamental properties of continuity and uniform continuity. (Remembering)
3. Test for uniform convergence of sequence and series of real valued functions. (Analysing)
4. Solve problems of the Riemann integrals and improper integrals. (Evaluating)
5. Develop the concepts of compact sets, connected sets and their properties. (Creating)

Module I: (14 lectures)
Review of set theory, relations and functions, finite and infinite sets, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequence of real numbers, bounded sequence, limsup, liminf, Cauchy sequences, Series, convergence of series, root and ratio tests, absolute convergence.

Module II: (8 lectures)
Limit, Continuity, types of discontinuity, Intermediate value theorem, Fixed point theorem, uniform continuity, Monotonic functions.

Module III: (14 lectures)
Sequence and series of real valued functions, Point wise and uniform convergence, uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration. Cauchy criterion for uniform convergence. Series of functions and convergence, Weierstrass M-test.

Module IV: (12 lectures)
Riemann sums and Riemann integral, Riemann-Stieltjes Integrals, Improper Integrals Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems.

Module V: (16 lectures)
Open and closed sets, limit points, interior points, Euclidean space, compact spaces, Bolzano Weierstrass theorem, Heine Borel theorem in R only.

Suggested Readings

Mapping of COs to Syllabus

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MALA0015: LINEAR ALGEBRA
(4-0-0)

COURSE OUTCOMES
1. Find the fundamental concepts and properties associated with vector spaces. (Remembering)
2. Demonstrate the algebra of matrices, eigenvalues and eigenvectors. (Understanding)
3. Develop the representation between linear transformations and Matrix theory. (Applying)
4. Choose various examples in Inner product spaces and study the applications to various problems. (Evaluating)
5. Elaborate quadratic forms and solve related problems. (Creating)

Module I: (10 lectures)
Vector spaces, subspaces, quotient spaces, linear dependence, basis, dimension of a vector space, LinearTransformations.

Module II: (20 lectures)
Algebra of Matrices, trace of matrices, rank and determinant of matrices, system of linear equations. Eigenvalues and eigenvectors, relation between characteristic and minimal polynomial, Cayley- Hamilton theorem, Diagonalizability.

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Module III: (10 lectures)
Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms.

Module IV: (15 lectures)
Inner product spaces, properties of inner products and norms, Cauchy-Schwarz inequality, Orthogonality and orthogonal complements, orthonormal basis, Gram-Schmidt process.

Module V: (5 lectures)
Quadratic forms, reduction and classification of quadratic forms.

Suggested Readings
2. Linear Algebra, G.E. Shilov, Prentice Hall.

Mapping of COs to Syllabus

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MAAB0016: ABSTRACT ALGEBRA
(4-0-0)

COURSE OUTCOMES
1. Find the concepts of Group theory and the application of Sylow theorems. (Understanding)
2. Categorize among unique factorization domain, Euclidean domain, Principal ideal domain and irreducible criteria. (Analysing)
3. Organize the characteristics of field extensions, Algebraic extension, Galois theory. (Applying)
4. Develop the concepts related to representation theory and study their application. (Creating)

Module I: (15 lectures)
Review of Groups, Cayley’s theorem, class equations, Sylow theorems and its applications, Direct products of groups, Solvable groups, Jordan-Holder theorem.

Module II: (20 lectures)
Rings, ideals, prime and maximal ideals, quotient rings, Euclidean domain. Principal ideal domain, unique factorization domain, Polynomial ring over a field, reducible and irreducible polynomials, irreducibility criteria.

Module III: (20 lectures)
Fields, finite fields, field extensions, Algebraic extensions, Galois Theory.

Module IV: (5 lectures)
Fundamentals of representation theory.

Suggested Readings
4. Algebra, Dummit & Foote, John Wiley & Sons

Mapping of COs to Syllabus

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MADE0017: DIFFERENTIAL EQUATIONS
(4-0-0)

COURSE OUTCOMES
1. Find the classification of differential equations with existence and uniqueness criteria. (Remembering)
2. Develop appropriate methods to solve linear differential equations. (Applying)
3. Examine the solvability of differential equation and partial differential equation. (Analysing)
4. Determine various methods for the solution of Partial Differential Equation. (Evaluating)

Module I: (16 lectures)
Classification of Differential Equations, their origin and solution; Exact differential equation and integrating factors, special integrating factors, linear equation and Bernoulli equations. existence and uniqueness for initial Value problem: Peano and Picard theorem.

Module II: (18 lectures)

Module III: (26 lectures)
Origin of Partial Differential Equation, Linear and quasi-linear partial differential equations, method of characteristics, Lagrange’s and Charpit’s method to solve first order PDE, Cauchy problem for first order PDE, Classification of PDEs (second order), Method of separation of variables for Heat (one and two dimension), Wave and Laplace equation.

Suggested Readings
2. Partial Differential Equations an introduction, W. Strauss, John Wiley and Sons Ltd.
3. Linear PDE for scientist and engineers, Tye Myint U and L. Debnath; Birkhauser, Boston.

Mapping of COs to Syllabus

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MAMT0018: MATHEMATICAL METHODS I
(4-0-0)

COURSE OUTCOMES
1. Explain basic numerical methods to solve algebraic and transcendental equations. (Understanding)
2. Classify interpolation formulae and solve different numerical problems. (Applying)
3. Make use of interpolation formulae to solve numerical differentiation and integration. (Evaluating)
4. Compose various methods to obtain numerical solutions of ODE and PDE. (Creating)
5. Determine the methods to solve linear programming problems. (Evaluating)

Module I: (10 lectures)
Numerical solution of algebraic and Transcendental equations: Bisection method, Regula-Falsi methods and Newton- Raphson method; Rate of convergence of these methods. Of systems of linear algebraic equations: Gauss elimination method, Gauss-Jordan method, Gauss-Seidel methods, Error analysis.

Module II: (6 lectures)
Interpolation: Finite differences, Newton’s forward and backward difference interpolations, Central difference interpolation, Lagrange’s and Newton’s divided difference interpolation, Hermite and spline interpolation.

Module III: (15 lectures)
Numerical differentiation and integration: Differentiation using interpolation formulae (Newton’s forward and backward difference interpolation, Central difference interpolation, Lagrange’s and Newton’s divided difference interpolation), Numerical integration by trapezoidal and Simpson’s 1/3 and 3/8 rule, Romberg method.

Module IV: (14 lectures)
Numerical solutions of ODE and PDE: Initial value problem for ODE of first and second order, Taylor series method, Picard’s method, Euler and modified Euler methods, Runge-Kutta methods, Milne’s and Adam’s predictor and corrector methods, Finite difference solution of second order ODE and PDE.

Module V: (15 lectures)
Mathematical formulation of LPP, Solution of a LPP by graphical method, simplex method, Revised simplex method, Duality. Transportation and Assignment problem, Two person-zero sum games. Equivalence of Rectangular game and linear
DEPARTMENT OF MATHEMATICS

programming.

Suggested Readings

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MATF0019: TOPOLOGY AND FUNCTIONAL ANALYSIS
(4-0-0)

COURSE OUTCOMES
1. Demonstrate the basic characteristics and properties of metric spaces. (Understanding)
2. Categorize the various properties related to Topological Spaces. (Creating)
3. Examine the Connectedness and Compactness of Topological Spaces. (Analysing)
4. Deduct various results from separation axioms and Metrization theorem. (Evaluation)
5. Explain basic results related to Normed linear spaces, Banach spaces and Hilbert spaces. (Understanding)

Module I: (10 lectures)
Metric spaces, open and closed sets, limit points, interior points, convergence, Cauchy sequence, completeness, completion in metric spaces, separable spaces.

Module II: (10 lectures)
Topological Spaces, Basis for a topology, The order topology, The product topology, The subspace topology, Closed sets and limit points, convergent sequence, Continuous function, homeomorphism, metric topology.

Module III: (10 lectures)
Connected spaces, connected subspaces of real line, Components, local connectedness, Compact spaces, compact spaces of real line, limit point compactness, local compactness.

Module IV: (15 lectures)
The countability axioms, the separation axioms, Urysohn Lemma, Urysohn metrization theorem. Tychonoff’s theorem, Stone-Cech Compactification.
Local finiteness, the Nagata Smirnov Metrization theorem, paracompactness, the Smirnov Metrization theorem, space of continuous function.

Module V: (15 lectures)
Normed linear spaces, properties of normed linear spaces, Banach space, Hahn-Banach theorem, Open mapping theorem, Closed graph theorem, Principle of uniform boundedness, Hilbert spaces, Orthogonal complements, orthonormal sets, the Reisz representation theorem, Bessel’s inequality, Parseval’s identity, The dual space, self –adjoint, normal and unitary operators.

Suggested Readings
1. Introduction to topology and modern analysis, G. F. Simmons, Tata-McGraw-Hill.
3. Introductory functional analysis with application, E. Kreyszig, John Willey and Sons.

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MACA0020: COMPLEX ANALYSIS
(4-0-0)
COURSE OUTCOMES
1. Define the concept analytic functions and the significance of CR-equations. (Remembering)
2. Explain the basic concepts and theorems associated with complex functions. (Understanding)
3. Apply Cauchy Integrals formulae and Residue theorem to evaluate real and complex integrals. (Applying)
4. Analyse various theorems associated with entire functions and Complex integrals. (Analysing)

Module I: (10 lectures)
Complex numbers and their properties, Complex Plane, Polar form of complex numbers, Powers and roots, set of points in the complex plane. Complex function, Special power functions, Reciprocal function.

Module II: (15 lectures)
Limits and Continuity, differentiability and analyticity, Cauchy-Reimann equations, Harmonic functions, Exponential and Logarithmic functions, complex powers, Trigonometric and Hyperbolic functions.

Module III: (20 lectures)
Complex integrals, Cauchy-Goursat Theorem, Cauchy's integral formula and their consequences, Taylor and Laurent series, Zeros and poles, Residues and residue theorem and consequences, evaluation of real improper integrals.

Module IV: (15 lectures)
Entire function, Liouville’s theorem, Maximum modulus principle, Schwarz Lemma, Schwarz-Pick Lemma, OpenMapping theorem. Conformal Mapping, Linear Fractional Transformations, Cross Ratio.

Suggested Readings
1. Foundation of Complex Analysis, S. Ponnusamy, Alpha science International.
2. Functions of one Complex variable I, J. B. Conway, Springer.
3. Complex variable, Murray Spiegel, Seymour Lipschutz, John Schiller, Dennis Spellman, Schum’s outlines.

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MAMP0021: MEASURE THEORY AND PROBABILITY THEORY
(4-0-0)

COURSE OUTCOMES
1. Explain the concept of algebra of sets, measure and Lebesgue measure. (Understanding)
2. Demonstrate understanding of the statement and proofs of monotone convergence theorems and their applications. (Understanding)
3. Explain the axioms and properties of probability theory. (Understanding)
4. Develop probabilistic concepts within the framework of measure theory. (Applying)

Module I: (12 lectures)

Module II: (18 lectures)

Module III: (10 lectures)
Probability axioms, sample spaces, events, law of total probability, conditional probability, Bayes Theorem and independence.

Module IV: (20 lectures)
Random Variables, types of random variables, distribution functions, function of random variables, standard univariate discrete and continuous distributions and their properties; expectations, moments, moments generating functions; Chebyshev’s inequality, joint, marginal and conditional distributions; covariance, correlation; Random vectors, functions of random vectors, strong and weak law of large numbers, central limit theorem.

Suggested Readings

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5. Measure Theory, Halmos, P. R., Springer-Verlag.

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MAMD0022: MATHEMATICAL METHODS II
(4-0-0)

COURSE OUTCOMES
1. Gain the knowledge fundamentals concepts of calculus of variation and integral equations and their applications. (Understanding)
2. Use concept of Laplace and Fourier transform in solving science and engineering problems. (Applying)
3. Analyse and classify Differential Equations, Partial Differential Equations and Integral Equations and their solutions by various methods. (Analysing)
4. Determine the solutions of various classes of differential equations and special functions with their properties. (Evaluating)

Module I: (10 lectures)
Linear functional, minimal functional theorem, general variation of a functional, Euler- Lagrange equation, Necessary and sufficient conditions for extrema, strong extremum and weak extremum, broken extremum; Weirstrass Erdmann corner conditions.

Module II: (10 lectures)
Linear integral equation of the first and second kind of Fredholm and Volterra type Reduction of ordinary differential equations into integral equations, Solution of integral Equations with separable kernels, Characteristic numbers and eigenfunctions, resolvent kernel.

Module III: (10 lectures)

Module IV: (12 lectures)
Laplace Transform and its properties, Convolution theorem, Inverse Laplace Transform, Application of Laplace Transform to solution of ordinary and partial differential equations of initial boundary value problems.

Module V: (18 lectures)
General solution of Bessel equation, Recurrence relations, Orthogonal sets of Bessel functions, Modified Bessel functions, Applications. General solution of Legendre equation, Legendre polynomials, Associated Legendre polynomials, Rodrigues formula, Orthogonality of Legendre polynomial, Concept and calculation of Green’s function, Approximate Green’s function, Green’s function method for differential equations.

Suggested Readings
1. Introduction to Theory and Application of Laplace Transforms, Doetsch G., Springer Verlag.
3. Integral Transforms & their applications, Brian Daries, Springers.
4. Integral Transforms & their applications, L Debnath, D Bhatia, Chapman & Hall/CRC.
7. Introduction to Fourier analysis and wavelets, Graduate Studies in Mathematics, Mark A. Pinsky, AmericanMathematical Society.

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MACL0023: CLASSICAL MECHANICS
COURSE OUTCOMES
1. Learn and understand the fundamental of motion and its governing equations. (Understanding)
2. Extend the concept of rigid body in two dimensions. (Understanding)
3. Apply concepts of Lagrangian and Hamiltonian methods to model various practical situations. (Applying)
4. Analyse diverse physical motions by studying the properties of mathematical model. (Analysing)
5. Evaluate different practical situations by discussing the properties of existing models. (Evaluating)

Module I: (18 lectures)
Introduction to the ideas of constrained motion, Different classifications of constraints of motion, Holonomic and nonholonomic constraints, rheonomic and scleronomic dynamical constraints, Concept of degree of freedom.

Module II: (12 lectures)
Two-dimensional motion of rigid bodies, Euler’s dynamical equations of motion for a rigid body, Motion of a rigid body about an axis, motion about revolving axis, Eulerian angles, Euler’s theorem on the motion of a rigid body, infinitesimal rotations, rate of change of a vector, Coriolis force, Euler’s equations of motion, force free motion of a rigid body.

Module III: (15 lectures)
Hamilton’s principle, Lagrange’s equations from Hamilton’s principle, extension of Hamilton’s principle to non-conservative and non-holonomic systems, conservation theorems and symmetry properties. Hamilton’s equations of motion, conservation theorems and physical significance of Hamiltonian, Hamilton’s equations from variational principle, principle of least action.

Module IV: (15 lectures)
Hamilton Jacobi Method: Hamilton - Jacobi equation, Time independent Hamilton - Jacobi equation, canonical transformation generated by Hamilton characteristic function, application of Hamilton-Jacobi equation in solving problems of mechanics.

Suggested Readings

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MADS0030: DISCRETE MATHEMATICS
(4-0-0)

COURSE OUTCOMES
1. Explain how to work with some of the discrete structures which include sets, relations, functions, graphs and recurrence relation. (Understanding)
2. Construct mathematical statements using logical connectives and quantifiers. (Creating)
3. Apply basic counting techniques to solve combinatorial problems. (Applying)
4. Develop the given problem as graph networks and solve with techniques of graph theory. (Understanding)

Module I: Set Theory (18 lectures)

Module II: Logic (15 lectures)

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Predicate Calculus.

Module III: Combinatorics (12 lectures)
Combinatorics: Mathematical induction, recursive mathematical definitions, basics of counting, permutations, combinations, inclusion-exclusion, recurrence relations (nth order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relation), generating function (closed form expression, properties of generating functions, solution of recurrence relation using generating functions, solution of combinatorial problem using generating functions).

Module IV: Graphs and Trees (15 lectures)
Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges; trees.

Suggested Readings

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MACP0031: COMPUTER PROGRAMMING IN C
(2-0-0)

COURSE OUTCOMES
1. Interpret the concepts of C language’s syntax. (Understanding)
2. Choose the loops and the decision-making statements to solve various problems. (Applying)
3. Implement standard algorithms and translate pseudo-codes into C programs. (Applying)
4. Apply their analytical skills for choosing the right data structure, function, data types and develop logic to solve various instances of problems. (Analysing)

Module I: Introduction to Algorithms and Programming Languages (8 lectures)
Introduction to structured programming and problem-solving methods: Algorithms, key features of algorithms, flowcharts, pseudocode, generation of programming languages, structured programming languages. Overview of C: Introduction to C, basic structure of a C program, compiling and executing C programs, comments, characteristics of a good program, character set, identifiers, keywords, data types, constants and variables, I/O statements, operators and expressions, precedence and associativity of operators, type conversion and type casting.

Module II: Decision Control Statements, Loops and Functions (8 lectures)
Decision Control Statements and Loops: Introduction to decision control statements, conditional branching statements, goto statements, while loop, do-while loop, for loop, nested loops, break and continue statements Functions: Need for functions, function declaration and definition, user defined and library functions, passing parameters to function, return statement, scope of variables, storage classes, recursive functions.

Module III: Arrays (7 lectures)
Arrays: One-dimensional arrays, passing array to function, multidimensional arrays and their applications, character arrays, dynamic memory allocation. Some algorithms and programs on theory of matrices and numbers like Sieve method for primality test, generation of twin primes, solution of congruence using complete residue system, addition, subtraction and multiplication of matrices, transpose, and determinant.

Module IV: Structures, Files (7 lectures)
Structures and Unions: Declaration of structures and simple implementation of structures, unions, enumerated data types. Files: Introduction to files, file managements-open, close, input/output operations, command line arguments.

Suggested Readings
4. Programming with C (Schaum’s outlines series), Gottfried Byron S., Tata McGraw Hill publishing company limited,
5. New Delhi.
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MARM0032: RESEARCH METHODOLOGY FOR MATHEMATICAL SCIENCES
(3-0-0)

COURSE OUTCOMES
1. Learn and understand some basic concepts of research and its methodologies. (Remembering)
2. Compare different results and identify appropriate research topics with the help of literature review. (Understanding)
3. Select and define appropriate research problem and parameters. (Applying)
4. Organize and conduct research (advanced project) in a more appropriate manner. (Evaluating)
5. Design and write a research proposal, research report and thesis. (Creating)

Module I: (12 lectures)
Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, literature survey of a research topic, Importance of knowing how Research is done, Research Process, Criteria of good Research, Problems encountered by Researchers in India.

Defining the Research problem: Selecting the Problem, Necessity of Defining the Problem, Techniques involved in defining a problem.

Module II: (15 lectures)

Module III: (18 lectures)
Research tools: MathSciNet, Scopus, ISI Web of Science, Impact factor, h-index, Google Scholar, ORCID, JStor, Online and open access journals, Virtual library of various countries. Scientific writing and presentation: LaTeX, Beamer. Software for Mathematics: MATHEMATICA, MATLAB.

Suggested Readings
2. LaTeX, a Document Preparation System, L. Lamport, Addison-Wesley.

MAFA0033: FIELD THEORY AND COMMUTATIVE ALGEBRA
(4-0-0)

COURSE OUTCOMES
1. Define the key notions of field theory and outline their interrelation. (Remembering)
2. Demonstrate the key concepts by interpreting them under various hypotheses. (Understanding)
3. Identify perfect fields using separable extensions, construct examples of automorphism group of a field. (Applying)
4. Analyse the proof a theorem by imposing the rules of commutative algebra. (Analysing)
5. Determination of validity of a problem such as insolvability of quantic by field theoretic techniques. (Evaluating)

Module I: (10 lectures)

Module II: (15 lectures)
Degree of extension. Algebraic elements and algebraic extensions; finite extensions. Algebraic numbers. Geometric constructions

Module III: (15 lectures)
Separability. Example of inseparable polynomial. Separability of all polynomials in characteristic zero. Separable extensions. Separability of intermediate extensions. Degree of the extension corresponding to a group of field automorphisms.

Module IV: (12 lectures)
Integral extension, integral closure of a ring, finitely generated modules, localization of a ring, construction, localization of modules, Dedekind domain, factorization ideals, unique factorization of ideals.

Module V: (8 lectures)
Galois groups of normal separable extensions, Galois extensions, factorization of prime ideals in Galois extensions, discrete valuation.

Suggested Readings
1. A First Course in Abstract Algebra, J.B. Fraleigh, Addison-Wesley.
2. Galois Theory, I. Stewart, Chapman and Hall.

Mapping of COs to Syllabus

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MANT0034: NUMBER THEORY
(4.0.0)

COURSE OUTCOMES
1. Identify and analyse different types of divisibility tests, Euler’s theorem, Wilson theorem etc and solve various related problems. (Applying)
2. Apply Quadratic Reciprocity law and other methods to classify numbers as primitive roots, quadratic residues, and quadratic nonresidues. (Applying)
3. Evaluate primitive roots and Pell’s equation with the use of continued fraction. (Evaluating)
4. Perceive classical cipher and public cryptosystem and their cryptanalysis. (Evaluating)

Module I: (15 lectures)
Divisibility, Congruences, complete residue system, reduced residue system, Chinese remainder theorem., Arithmetic modulo p, Fermat’s little theorem, Wilson’s theorem. Arithmetic functions-Mobius function, Euler function.

Module II: (15 lectures)
Quadratic residues and congruences of second degree in one unknown, Legendre symbol, Jacobi symbol, congruences of second degree with prime modulus and with composite modulus.

Module III: (18 lectures)
Primitive roots and indices, order, necessary and sufficient condition for the existence of primitive roots, construction of reduced residue system. Continued fractions, simple continued fractions, approximation of irrational numbers by continued fractions, solution of Pell’s equation. Introduction to partitions, geometric representation, generating functions, Euler’s Pentagonal number theorem.

Module IV: (12 lectures)
Basic of Cryptography: History of cryptography, terminologies used in cryptography; Substitution Techniques- The Caesar Cipher, One Time Pads, The Vernam Cipher, Book Cipher; Transposition Techniques-Encipherment/Decipherment Complexity, Public Key Cryptography: Characteristics of Public Key System; RSA Technique-Encryption –Method; Diffie- Hellman Scheme.

Suggested Readings

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MAML0035: MATHEMATICAL LOGIC
(4-0-0)

COURSE OUTCOMES
1. Interpret any Mathematical statement into the language of logic. (Understanding)
2. Analyse various methods of proofs and deduction theorems. (Analysing)
3. Interpret the syntax of first order logic and semantics of first order languages. (Understanding)
4. Analyse the validity a problem by means of completeness and consistency. (Analysing)
5. Determine the valuation and validity of various logical statements. (Evaluating)

Module I: (15 lectures)

Module II: (15 lectures)
Formal definition of proof, various methods of proof, theorem and deduction, theory of L of statement calculus. Valuation and tautology in L, extensions of L, adequacy theorem of L.

Module III: (15 lectures)
First order logic, truth values of well-formed formulas, first order systems with equality, first order arithmetic, formal set theory.

Module IV: (15 lectures)
Completeness and compactness, notion of consistency, Boolean algebra, incompleteness, first incompleteness theorem, undecidability.

Suggested Readings

Mapping of Cos to Syllabus

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MAFS0036: FUZZY SETS AND APPLICATIONS
(4-0-0)

COURSE OUTCOMES
1. Classify the crisp and fuzzy set theorems. (Understanding)
2. Apply fuzzy set theory in modelling and analysing uncertainty in a decision problem. (Applying)
3. Analyse and examine the difference between the crisp set and fuzzy set concepts. (Analysing)
4. Determine fuzzy set theory and uncertainty concepts. (Evaluating)

Module I: (17 lectures)
Fuzzy sets - Fuzzy numbers, fuzzy numbers in the set of Integers, arithmetic with fuzzy numbers. Definition of fuzzy sets, α-level sets, convex fuzzy sets. Basic operations on fuzzy sets, types of fuzzy sets, Cartesian products, algebraic products, bounded sum and difference, t-norms and t-conorms. Fuzzy sets in contrast of probability theory.

Module II: (12 lectures)
The extension principle - the Zadeh’s extension principle, image and inverse image of fuzzy sets. Fuzzy relations, basic properties of fuzzy relations, fuzzy relations and approximate reasoning.
Module III: (16 lectures)
Fuzzy relations and fuzzy graphs, composition of fuzzy relations, min-max composition and its properties, fuzzy equivalence relations, fuzzy relational equations, fuzzy graphs.

Module IV: (15 lectures)
Possibility Theory: Fuzzy measures, evidence theory, necessity measure, probability measure, possibility measure, possibility distribution, possibility theory and fuzzy sets, possibility theory and probability theory.

Suggested Readings
3. Fuzzy sets, fuzzy logic applications, G. Bojadziev and M. Bojadziev, World Scientific.

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MAFD0037: FLUID DYNAMICS I
(4-0-0)

COURSE OUTCOMES
1. Develop an appreciation for the properties of Newtonian fluids. (Remembering)
2. Understand the dynamics of fluid flows and the governing non-dimensional parameters. (Understanding)
3. Apply concepts of mass, momentum and energy conservation to flows. (Applying)
4. Formulate the problems on buoyancy and solve them. (Evaluating)

Module I: (20 lectures)
Classification of fluids, Lagrangian and Eulerian methods. Equation of continuity. Irrotational flow, vorticity vector, equiv- potential surfaces. Streamlines, pathlines, streak lines of the particles, stream tube and stream surface. Mass flux density, conservation of mass leading to equation of continuity. (Euler’s form.) Conservation of momentum and its mathematical formulation: Euler’s form. Integration of Euler’s equation under different conditions. Bernoulli’s equation, steady motion under conservative body forces.

Module II: (15 lectures)

Module III: (10 lectures)

Module IV: (15 lectures)

Suggested Readings
1. A Treatise on Hydrodynamics, W. H. Besant and A. S. Ramsey, CBS.
2. Text book of Fluid Dynamics, F. Charlton, CBS.
5. Ideal and incompressible fluid dynamics, N.E. Neill and F. Charlton, Ellis Horwood Ltd.

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MARCO038: RIEMANNIAN GEOMETRY AND TENSOR CALCULUS
(4-0-0)

COURSE OUTCOMES
1. Recall the concept of calculating length of a curve and area of a domain in manifold M. (Remembering)
2. Explain the Riemannian metric on surfaces embedded in Euclidean space. (Understanding)
3. Apply the properties of geodesics on a Riemannian manifold in Euclidean space and for Lobachevski plane. (Applying)
4. Evaluate Riemann curvature tensor. (Evaluating)

Module I: (15 lectures)
Introduction to Tensor, space of n dimensions, subspaces; transformation of coordinates; scalar; contravariant (tangent) and covariant (cotangent) vectors; scalar product of two vectors; tensor space of rank more than one contravariant and covariant tensors; symmetric and skew-symmetric tensors; addition and multiplication of tensors; contraction; composition of tensors; quotient law; reciprocal symmetric tensors of the second order, relative tensor, group properties.

Module II: (15 lectures)
Riemannian space; fundamental tensor; length of a curve; magnitude of a vector; associated covariant and contravariant vectors; inclination of two vectors, orthogonal vectors; coordinate hypersurfaces; coordinate curves; field of normals to a hypersurface; principal directions for a symmetric covariant tensor of the second order; Euclidean space of n dimensions.

Module III: (15 lectures)
Levi-Civita tensors; Christoffell symbols and second derivatives; need for covariant derivative; parallel transformations; covariant derivative of a contravariant and covariant vector; curl of a vector and its derivative; covariant differentiation of a tensor; divergence of a vector.

Module IV: (15 lectures)
Gaussian curvature; Riemann curvature tensor; geodesics; differential equations of geodesics; geodesic coordinates; geodesic deviation; Riemannian coordinates; geodesic in Euclidean space; straight lines.

Suggested Readings

Mapping of COs to Syllabus

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MANS0039: NUMERICAL SOLUTION OF PDE
(4-0-0)

COURSE OUTCOMES
1. Define matrix norm, normed linear space and related results. (Remembering)
2. Classify initial value problems (IVPs) and Boundary Value Problems (BVPs). (Understanding)
3. Apply different numerical methods to PDEs. (Applying)
4. Analyse accuracy of common numerical methods. (Analysing)
5. Assess different numerical methods in order to find the approximate numerical solution of the PDEs. (Evaluating)

Module I: (10 lectures)

Module II: (20 lectures)
Classification of PDEs, Finite difference approximations to partial derivatives. Solution of one-dimensional heat conduction equation by Explicit and Implicit schemes (Schmidt and Crank Nicolson methods), CFL condition, stability and convergence criteria.

Module III: (15 lectures)
Hyperbolic equation, explicit/implicit schemes, method of characteristics. Solution of wave equation. Solution of 1st order Hyperbolic equation. Von Neumann stability.

Module IV: (15 lectures)
Finite difference method for stationary heat conduction, stability and convergence analyse.

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Suggested Readings

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MACN0040: COMPUTATIONAL NUMBER THEORY
(4-0-0)

COURSE OUTCOMES
1. Explain basic of fundamental number theoretic algorithms. (Understanding)
2. Apply finite field theory in cryptography. (Applying)
3. Analyse primality testing algorithms and their uses in Cryptography. (Analysing)
4. Explain the number theoretic foundations of cryptography and the principles behind their security. (Understanding)

Module I: (10 lectures)
Representation of integers and polynomials, Divisibility and the Euclidean algorithm, extended Euclidean algorithm, Congruences, Chinese Remainder theorem, Hensel’s lifting lemma, Modular exponentiation - Some applications to factoring.

Module II: (15 lectures)
Finite Fields, Multiplicative generators, Uniqueness of fields with prime power elements, Quadratic residues and reciprocity.

Module III: (20 lectures)
Primality Testing: Probabilities Primality testing, primality testing for numbers of a special form, AKS primality test including detecting perfect powers; Computing the Order of an element and generating primitive roots (and elements of a certain order), Computing Discrete Logarithms, Factoring Integers, factoring polynomials and tests constraining irreducible polynomials; Solving equations over Finite fields including computing square roots.
Elliptic curves: The Geometry of elliptic curves, the Algebra of elliptic curves, elliptic curves overs finite fields, The elliptic curve Discrete Logarithm Problem.

Module IV: (15 lectures)
Cryptosystems and basic cryptographic tools: Secret –key cryptosystems, Public-key cryptosystems, block and stream ciphers, message integrity; message authentication codes, Signature schemes, nonrepudiation, certificates, Hash functions; Some simple cryptosystems, Shift cipher, Substitution cipher, Affinecipher, Vigenère cipher, Hill cipher, Permutation cipher, Stream ciphers, Cryptanalysis of affine, substitution, Vigenère, Hill and LFSR stream ciphers. RSA cryptosystem and Rabin encryption.

Suggested Readings

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MASC0041: SCIENTIFIC COMPUTING
(4-0-0)

COURSE OUTCOMES
1. Classify initial conditions and boundary conditions specific to the problem. (Understanding)
2. Apply different numerical methods to ODEs. (Applying)
3. Analyse accuracy of iterative numerical methods. (Analysing)
4. Assess the approximate numerical solution of the linear and nonlinear problems. (Evaluating)

Module I: (13 lectures)
Initial value problems (IVPs) for the system of ordinary differential equations (ODEs); Difference equations; Numerical methods; Local truncation errors, Stability analysis; Interval of absolute stability; Convergence and consistency.

Module II: (13 lectures)
Single-step methods: Taylor series method; Explicit and implicit Runge-Kutta methods and their stability and convergence analysis; Extrapolation method; Runge-Kutta method for the second order ODEs; Stiff system of differential equations.

Module III: (16 lectures)
Multi-step methods: Explicit and implicit multi-step methods; General linear multi-step methods and their stability and convergence analysis; Adams-Moulton method; Adams-Bashforth method; Nyström method; multi-step methods for the second order IVPs.

Module IV: (18 lectures)
Boundary value problems (BVPs): Two-point non-linear BVPs for second order ordinary differential equations; Finite difference methods; Convergence analysis; Difference scheme based on quadrature formula; Difference schemes for linear eigenvalue problems; Mixed boundary conditions; Finite element methods; Assemble of element equations; Variational formulation of BVPs and their solutions; Galerkin method; Ritz method; Finite element solution of BVPs.

Suggested Readings

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MASF0042: SPECIAL FUNCTIONS
(4-0-0)

COURSE OUTCOMES
1. Define the different types of special functions and their properties. (Remembering)
2. Apply the properties of special functions in the mathematical analysis, functional analysis etc. (Applying)
3. Analyse properties of special functions by their integral representations and symmetries. (Analysing)
4. Illustrate purpose and functions of the gamma and beta functions, Fourier series and Transformation. (Understanding)

Module I: (12 lectures)
The Gamma and Beta Functions: Euler’s integral for \( \Gamma(z) \), the beta function, factorial function, Legendre’s duplication formula, Gauss’s multiplication theorem, summation formula due to Euler, behaviour of \( \log(z) \) for large \( |z| \).

Module II: (18 lectures)
The Hypergeometric function: An integral representation. Its differential equation and solutions, \( F(a,b,c;1) \) as a function of the parameters, evaluation of \( F(a,b,c;1) \), contiguous function relations, the hypergeometric differential equation, logarithmic solutions of the hypergeometric equation, \( F(a,b,c;2) \) as a function of its parameters, Elementary series manipulations, simple transformations, relation between functions of \( \Gamma(z) \) and, \( F(1-z) \) quadratic transformations, theorem due to Kummer, additional properties.

Module III: (18 lectures)

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The Confluent Hypergeometric function: Basic properties of 1F1, Kummer’s first formula. Kummer’s second formula, Generalized Hypergeometric Series: The function pFq, the exponential and binomial functions, differential equation, contiguous function relations, integral representation pFq, with unit argument, Saalshutz’ theorem, Whipple’s theorem, Dixon’s theorem, Contour integrals of Barnes’ type.

Module IV: (12 lectures)
Bessel Functions: Definition, Differential equation, differential recurrence relations, pure recurrence relation, generating function, Bessel’s integral, index half an odd integer, modified Bessel functions, Introduction to Legendre function, Meijer G-function and some basic properties.

Suggested Readings

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CAMF0043: MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE
(4-0-0)

COURSE OUTCOMES
1. Discuss application of mathematical logic to solve problems. (Remembering, Understanding)
2. Describe basic concept of set theory, graph theory and Group theory. (Understanding)
3. Derive the solution of a problem using deductive logic and prove the solution based on logical inference. (Applying)
4. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra. (Evaluating)
5. Develop the given problem as graph networks and solve with techniques of graph theory. (Applying)

Module I: (13 lectures)

Module II: (20 lectures)
Set theory: Introduction, Basic Concepts of Set Theory, Representation of Discrete Structures, Relations and Ordering, Matrix representation of relations and partial ordered sets, representation of relations by Graphs; Lattices as Partially Ordered Sets, Boolean algebra; Functions. Algebraic Structures: Introduction, Algebraic Systems, Semi groups and Monoids; Groups, Congruence Relation and Quotient Structures, permutation groups, Lagrange’s Theorem; Normal subgroups. Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields (Definition, basic properties and examples).

Module III: (12 lectures)

Module IV: (15 lectures)
Graph Theory: Basic Concepts, Sub graphs, Multi graphs Representation of Graphs, Isomorphism, Paths and Circuits, Traversing a Graph, DFS, BFS, Eulerian and Hamiltonian graphs, shortest path algorithms, Planar Graphs, Chromatic Numbers. Tree and Spanning Trees. Applications of Graph Theory.

Suggested Readings
2. Graph Theory by Narsingh Deo, Prentice-Hall of India publications.

Mapping of COs to Syllabus
MAAS0046: ADVANCED ANALYSIS
(4-0-0)

COURSE OUTCOMES
1. Apply Holder and Minkowski inequalities in $L_p$-spaces and understand completeness of $L_p$-spaces. (Applying)
2. Explain the concepts of Banach algebras, culminating in the Gelfand-Naimark theorem. (Understanding)
3. Define the concept of signed measure and significance of Hahn decomposition theorem. (Remembering)
4. Assess the product measure by integrals and discuss the applications of Fubini’s theorem. (Evaluating)

Module I: (15 lectures)
$L_p$-space, Holder inequality, Minkowski’s inequality, convergence, completeness, bounded linear functional.

Module II: (17 lectures)
Banach Algebra, Gelfand theory, algebra, Gelfand-Naimark-Segal (GNS) construction, normal operators, spectral theorem, Fredholm operator, space, calculus for normal operators.

Module III: (16 lectures)
Signed measure, Hahn decomposition theorem, mutually singular measure, Radon-Nikodým theorem, Lebesgue decomposition, Reisz representation theorem.

Module IV: (12 lectures)
Outer measure, Carathéodory theorem, product measure, Fubini’s theorem.

Suggested Readings

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MAGY0047: GRAPH THEORY
(4-0-0)

COURSE OUTCOMES
1. Relate various basic terminologies, properties and results of graph theory. (Remembering)
2. Classify different types of trees according to their properties. (Understanding)
3. Analyse different properties of factorization, covering and colorability of graphs. (Analysing)
4. Determine different results and properties of Eulerian, Hamiltonian and planner graphs. (Evaluating)

Module I: (13 lectures)
Graph, Types of Graphs, Subgraphs, walk, paths, cycles and components, intersection of graphs, Degrees, Degree sequences. operations on graphs, subdivision (of cycles), incentification (of vertices) homomorphism and contraction (of edges).

Module II: (18 lectures)
Trees, Spanning trees, Kruskal’s and Prim’s algorithm for minimal spanning tree, cycles, cocycles, cycle space, cocycle spaces, Connectivity, cut vertices, cut edges and blocks, connectivity parameters, Menger’s theorem. Matching and covers.

Module III: (14 lectures)
Eulerian and Traversable graphs: Characterization theorems, characterization attempts for Hamiltonian graphs: Two necessary and sufficient conditions for a graph to be Hamiltonian, Factorization; Basic concepts, 1- factorization, 2- factorization, coverings, critical points and lines.

Module IV: (15 lectures)
Planarity and colorability: Plane and planar graphs, outer planar graphs, Euler’s Polyhedron formula, Kuratowski’s theorems.
COURSE OUTCOMES

MACA0048: MULTIVARIABLE CALCULUS
(4-0-0)

Course Outcomes
1. Demonstrate an understanding of the concepts of multivariate and vector-valued functions and their applications. (Understanding)
2. Examine differentiability of vector valued functions on $\mathbb{R}^n$ and understand the relation between directional derivative and differentiability. (Analysing)
3. Learn about generalisation of concept of integration and ability to solve higher dimension integrals. (Understanding)
4. Demonstrate an understanding of Green’s, Stokes’ and Gauss’ theorem and of some physical applications of these theorems. (Applying)

Module I: (15 lectures)
Vectors, dot product of vectors, projection, triangle and Cauchy-Schwarz inequality, cross product of vectors and determinants. Non-linear function, parametric equation of curves, level surfaces, vector fields.

Module II: (20 lectures)
Open sets in $\mathbb{R}^n$, sequences and closed sets, function of several variables, limit of a function of several variables, continuity, sequential continuity, partial and directional derivative, differentiability, chain rule, gradient, curl, divergence, Taylor’s theorem, inverse function theorem, implicit function theorem, maximum value theorem, critical points, second derivative test.

Module III: (15 lectures)
Introduction to integration of a function of several variables, multiple integrals, iterated integral, fubini’s theorem, physical applications, determinant in $n$-dimensions, Jacobian and change of variables.

Module IV: (10 lectures)
Green’s theorem, Stokes’ theorem, Divergence theorem. Manifolds in $\mathbb{R}^n$, Differential forms.

Suggested Readings

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MAAY0049: ALGEBRAIC NUMBER THEORY
(4-0-0)

Course Outcomes
1. Demonstrate Field extensions and characterization of finite normal extensions as splitting fields and study primefields. (Understanding)
2. Illustrate cyclotomic polynomials, cyclic extensions, Radical field extensions and Ruler & Compass constructions. (Understanding)
3. Analyse the role of Minkowski’s theorem towards the proof of Four-square theorem. (Analysing)
4. Know the important applications of Galois Theory. (Applying)
5. Discuss Artin-Whaples approximation theorem and Hensel’s lemma. (Creating)

Suggested Readings

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Module I: (15 lectures)
Integral extension, integral closure of a ring, finitely generated modules, localization of a ring, construction, localization of modules, norm, trace, transitivity of trace and norm, quadratic extension of rationales, discriminant, Dedekind domain, factorization ideals, unique factorization of ideals, the ideal class group.

Module II: (12 lectures)
Factorization of prime ideals in ring extensions, ramification, Ram-Rel identity, lifting of ideals, norms of ideals, norm of a prime ideal, lattices, Minkowski’s theorem, the canonical embedding.

Module III: (12 lectures)
The Logarithmic embedding, The Dirichlet’s unit theorem, real and imaginary quadratic fields, units in quadratic fields, cyclotomic extensions, an integral basis of a cyclotomic extension.

Module IV: (12 lectures)
Galois extensions, factorization of prime ideals in Galois extensions, decomposition of inertia groups, local fields, absolutevalues, discrete valuation.

Module V: (9 lectures)
Artin-Whaples approximation theorem, completions, Hensel’s lemma.

Suggested Readings
1. Algebraic Theory of Numbers, Samuel P., Herman.
2. Algebraic Number Theory, Richard A. Mollin, CRC Press, Taylor and Francis group
3. Algebraic Number Theory, Stewart I., Tall D., Chapman and Hall.
5. Algebraic Number Fields, Janusz G.J., AMS.

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MAFL0050: FLUID DYNAMICS II
(4-0-0)

COURSE OUTCOMES
1. Explain the concept of Newtonian and non-Newtonian fluid. (Understanding)
2. Relate entropy principle to various thermal engineering applications. (Understanding)
3. Apply the concept of second law efficiency and exergy principle to various thermal engineering applications. (Applying)
4. Analyse steady state and transient heat conduction problems of real-life Thermal systems. (Analysing)

Module I: (15 lectures)

Module II: (12 lectures)
Boundary layer concept, Boundary layer equations in two-dimensional flow, Boundary layer flow along the flat plates: Blasius solution. Shearing stress, momentum loss thickness, Boundary layer thickness and skin friction. Exact solution of the steady state boundary layer equations in two-dimensional motion. Flow past a wedge. Flow in a convergent channel.

Module III: (13 lectures)
Boundary layer on a surface with pressure gradient, Momentum integral theorems for Boundary layer, The Von Karman integral relation, Application of Momentum integral equation to Boundary layers: Von Karman-Pohlhansen method, Separation of boundary layer flow, Boundary layer control, Methods of Boundary layer control, Introduction to turbulent flow: Origin of turbulence, Reynold’s modification of Navier-Stokes equations for turbulent flow, Semi-empirical theory of turbulence.

Module IV: (20 lectures)
Basic concepts of Magnetohydrodynamics, Maxwell’s equations, Frame of reference, Lorentz force, Electromagnetic bodyforce, Fundamental equations of MHD, Ohm’s law for a moving conductor, Hall current, Conduction current, Kinematic aspect of MHD, Magnetic Reynolds number, MHD waves: alfven’s waves, MHD waves in compressible fluid, MHD approximations, Electromagnetic boundary conditions, One dimensional MHD flow, Hartmann flow, MHD Couette flow, MHD Stoke’s flow,
MHD Rayleigh’s flow, Hartmann-Stoke’s boundary layer, Alfvén’s boundary layer, Two dimensional MHD flow (a) Aligned flow (b) Stagnation point flow, MHD flows in a rotating medium, Effects of Hall current on MHD flows in a rotating channel, MHD heat transfer.

**Suggested Readings**
2. Laminar Boundary Layer, L. Rosenhead, Dover Pub.
3. Fluid Mechanics [SI Units], Cengel, Tata McGraw-Hill Education.
5. A Text Book of Magnetohydrodynamics, J.A. Shercliff, Pergamo.

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**MACM0051: CONTINUUM MECHANICS**

(4-0-0)

**COURSE OUTCOMES**
1. Define principles, axioms and hypothesis of governing equations of continuum mechanics. (Remembering)
2. Extend the same principles to solve deformed and un-deformed configuration of particles. (Understanding)
3. Develop the general theory to formulate and solve problems in hydrodynamics. (Applying)
4. Examine the concept of macroscopic behaviour of particles. (Analysing)
5. Estimate the elasticity behaviour of particles in continuum media. (Evaluating)

**Module I: (15 lectures)**


**Module II: (20 lectures)**


**Module III: (10 lectures)**


**Module IV: (15 lectures)**


**Suggested Readings**

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**MATR0052: THEORY OF RELATIVITY**

(4-0-0)
COURSE OUTCOMES
1. Recall the fundamental principles of inertial frames and uniform motion in relativistic mechanics. (Remembering)
2. Illustrate the concept of vacuum and various physical quantities in flat space as well as curved space time. (Understanding)
3. Apply the concept of relativistic mechanics to define physical quantities in various coordinate system. (Applying)
4. Analyse the path of motion of particles in presence of curved space-time. (Analysing)
5. Assess the relativistic frequency shifts for sources moving in a gravitational field. (Evaluating)

Module I: (20 lectures)
The special theory of relativity: inertial frames of reference; postulates of the special theory of relativity; Lorentz transformations; length contraction; time dilation; variation of mass; composition of velocities; relativistic mechanics; world events, world regions and light cone; Minkowski space-time; equivalence of mass and energy.

Module II: (10 lectures)
Energy-momentum tensors: the action principle; the electromagnetic theory; energy-momentum tensors (general); energy-momentum tensors (special cases); conservation laws.

Module III: (15 lectures)
General Theory of Relativity: introduction; principle of covariance; principle of equivalence; derivation of Einstein’s equation; Newtonian approximation of Einstein’s equations.

Module IV: (15 lectures)
Solution of Einstein’s equation and tests of general relativity: Schwarzschild solution; particle and photon orbits in Schwarzschild space-time; gravitational red shift; planetary motion; bending of light; radar echo delay.

Suggested Readings

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MAFE0053: FINITE ELEMENT METHODS
(4-0-0)

COURSE OUTCOMES
Learn and relate some basic concept of variational methods and finite element method. (Remembering)
1. Relate simple problems into finite elements. (Understanding)
2. Develop finite element models. (Applying)
3. Analyse finite element method in two dimensional problems. (Analysing)

Module I: (15 lectures)
Integral formulations and variational methods: Weighted integral and weak formulations of boundary value problems, Rayleigh-Ritz method, Method of weighted residuals.

Module II: (15 lectures)
Finite element analysis of one - dimensional problems: Discretization of the domain, Derivation of element equations, Connectivity of elements, Imposition of boundary conditions, Solution of equations, Applications.

Module III: (15 lectures)
Time dependent problems in one dimension: Formulation of eigenvalue problem, Finite element models, Applications of semi discrete finite element models for time-dependent problems, Applications to parabolic and hyperbolic equations.

Module IV: (15 lectures)

Suggested Readings

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**Course Outcomes**

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**Suggested Readings**

- Collection algorithms for equal files, External search trees. Memory Management: The issues in memory management, Managing equal structures.
- Module IV: (12 lectures)
  - b. Algorithms Analysis Techniques: Efficiency of algorithms, analysis of recursive programs, solving recurrence equations, a general solution for large class of recurrences.

**Module I: (16 lectures)**

- b. Algorithms Analysis Techniques: Efficiency of algorithms, analysis of recursive programs, solving recurrence equations, a general solution for large class of recurrences.

**Module II: (10 lectures)**

- a. Sorting and Order Statistics: The sorting problem, Radix sorting, Sorting by comparison, Heapsort-an O(n logn) comparison sort, quicksort-an O(n logn) expected time sort, Order Statistics, Expected time of order statistics.

**Module III: (14 lectures)**


**Module IV: (12 lectures)**


**Module V: (8 lectures)**


**Suggested Readings**

MAIC0055: INTRODUCTION TO CRYPTOGRAPHY  
(4-0-0)  

COURSE OUTCOMES  
1. Define the terms and concepts of symmetric key ciphers. (Remembering)  
2. Identify the importance of modular arithmetic, modulo operator and algebraic structures in symmetric key cipher. (Applying)  
3. Discuss some asymmetric-key cryptography, Diffie-Hellman Key Exchange, Knapsack Cryptosystem, RSA-Cryptosystem. (Analysing)  
4. Discuss some primality test algorithms and their efficiencies. (Analysing)  
5. Explain the concept of elliptic curve cryptosystems. (Understanding)  

Module I: [14 lectures]  
Introduction to Cryptography, classical cryptosystem, cryptanalysis on Substitution Cipher, Play Fair Cipher, Block Cipher. Data Encryption Standard (AES), Triple DES, Modes of Operation, Stream Cipher, Pseudorandom Sequence.  

Module II: (16 lectures)  
LFSR based stream cipher; Modular inverse, Extended Euclid Algorithm, Fermat’s Little Theorem, Euler Phi-Function, Euler's theorem, Quadratic Residue, Polynomial Arithmetic. Advanced Encryption Standard (AES), Introduction to Public Key Cryptosystem, Diffie-Hellman Key Exchange, Knapsack Cryptosystem, RSA Cryptosystem.  

Module III: (18 lectures)  
Primality Testing: Probabilities Primality testing, primality testing for numbers of a special form, AKS primality test including detecting perfect powers; Computing the Order of an element and generating primitive roots (and elements of a certain order), Computing Discrete Logarithms, Factoring integers, factoring polynomials and tests constricting irreducible polynomials; Solving equations over Finite Fields including computing square roots. ElGamal Cryptosystem.  

Module IV: (12 lectures)  

Suggested Readings  
3. An Introduction to theory of numbers, Niven, Zuckerman and Montgomery, Wiley.  
5. An Introduction to Cryptography, R.A. Mollin, Chapman & Hall.  
6. Rational Points on Elliptic Curves, Silverman and Tate, Springer.  
8. Elementary Number Theory, Jones and Jones, Springer.  

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MADS0059: DYNAMICAL SYSTEMS AND CHAOS  
(4-0-0)  

COURSE OUTCOMES  
1. Define the concepts of nonlinearity, iterated functions, fixed points, differential equations, metric space and topology. (Remembering)  
2. Interpret the link between regular systems and unpredictable systems with chaotic nature. (Understanding)  
3. Classify and interpret the dynamical properties for a given problem in a dynamical system. (Analysing)  
4. Derive the model on of given physical situations to prove the basic dynamic behaviour with the existence of chaos. (Applying)  
5. Determine bifurcation points, Topological entropy, Topological transitivity, Devaney chaos, Li-Yorke chaos. (Evaluating)  

Module I: Dynamical Systems and Vector Fields (12 lectures)  
The notion of Dynamical systems and Vector Fields, The fundamental theorem on existence and uniqueness, Orbits, Topological conjugacy and orbits, Phase Portraits, Graphical analysis of orbits, Periodic orbits and stability theory, Nonlinear analysis on
Module II: Discrete systems and Bifurcations (12 lectures)
Period doubling bifurcations, Saddle-node bifurcation, Transcritical bifurcation, Pitchfork bifurcation, various universal routes to chaos, Feigenbaum universality, Chaos, Strange attractor, Fractals, Sharkovskii Order, Period 3 implies chaos.

Module III: Continuous systems and Dynamics (12 lectures)
First order continuous autonomous systems, Classification of fixed points of autonomous systems, Attractors and repellers, Second order continuous autonomous systems, Phase curves and fixed points, Classification of fixed points of linear systems.

Module IV: Topological Dynamics (12 lectures)
Topological Dynamical systems, Examples and Basic Properties, Topological transitivity, Mixing, Weak mixing, Devaney chaos, Li-Yorke chaos, Topological entropy and Application.

Module V: Symbolic Dynamics (12 lectures)
Shifts- one-sided and two-sided, Sub shifts and codes, Shift spaces, Languages, The Perron Frobenius theorem, Higher block shifts and Higher Power shifts, Entropy and application , Finite type constraints , Graph representations of shifts of finite type and their properties.

Suggested Readings
1. Nonlinear Dynamics and Chaos with application to Physics, Biology, Chemistry, and Engineering, Steven H Strogatz,West view Press.
3. An Introduction to Symbolic Dynamics and Coding, Douglas Lind and Brian Marcus, Cambridge University Press.
7. Nonlinear Oscillations, Dynamical Systems and Bifurcation of Vector Fields, J Guckenheimer and P Holmes, Springer.
8. Introduction to Dynamical Systems, D K Arrowsmith, Cambridge University Press.

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MACO0060: CONVEX OPTIMIZATION
(4-0-0)

COURSE OUTCOMES
1. Define some basic concept of functions and operations research. (Remembering)
2. Analyse and solve a given a mathematical problem, classifying its algebraic structure. (Analysing)
3. Derive the solution of a problem using mathematical methods and computing approach. (Applying)
4. Determine the mathematical and social system solution procedure and analysing the results. (Evaluating)

Module I: Introduction (5 lectures)
Mathematical Optimization, least square and linear programming, convex optimization, nonlinear optimization.

Module II: Convex sets and functions (15 lectures)
Convex sets: Affine and convex sets, examples, operations that preserve convexity, generalised inequalities, separating and supporting hyperplanes, dual cones and generalised inequalities. Convex functions: Basic properties and examples, conjugate function, quasi-convex functions, log- concave and log convex functions, convexity with respect to generalised inequalities.

Module III: Convex optimization problems (20 lectures)

Module IV: Applications (20 lectures)
Geometric problems- Projection on a set, distance between sets, Euclidean distance and angle, external volume ellipsoid, centering, classifications, placement and location, floor planning. Approximation and fittings- Norm, least- norm, regularised, robust, function fitting and interpolation, some problems involving two quadratic functions.

Suggested Readings
2. Introductory lectures on convex optimization, Yurii Nesterov, Kluwer Academic Publisher.

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#### MAGT0061: INTRODUCTION TO GAME THEORY

(4-0-0)

**COURSE OUTCOMES**
1. Define some basics of game theory, concepts of players, strategies, payoff etc. (Remembering)
2. Illustrate different types of game strategies. (Understanding)
3. Apply different methods to solve games and recommend which strategy to implement. (Applying)
4. Analyse real life competitive situations using game theoretic techniques. (Analysing)
5. Determine the methods of solution using simple real-life problem. (Evaluating)

**Module I: Introduction (8 lectures)**
Basics of game theory, Types of games, zero-sum games, non-zero-sum game, Simultaneous games, Sequential games, Prisoners Dilemma, Other Interesting two person games, Ultimate Game, Public Good Game, Theory of rational choice, Interacting decision makers, Solution of Game by Simplex method.

**Module II: Games with Perfect Information (10 lectures)**
Strategic games, the Prisoner’s Dilemma, Nash equilibrium, Best response functions, Dominated actions, Equilibrium in a single population: symmetric games and symmetric equilibria, Cournot’s model of oligopoly, Bertrand’s model of oligopoly, Electoral competition, The War of Attrition, Auctions, Accident law.

**Module III: Mixed strategy Nash Equilibrium (12 lectures)**
Strategic games with randomization, Mixed strategy Nash equilibrium: concept and examples, Correlated equilibrium, Expected Payoffs, Mixed Strategy Equilibrium, Dominated Actions, Formation of Players’ beliefs, Information and Bayesian Games: examples, Bayesian game applications, Juries and Information Aggregation, Auctions with Private Information.

**Module IV: Extensive Games (12 lectures)**
Definitions, Subgame perfect equilibrium, the ultimatum game and the holdup game, Stackelberg’s model of duopoly, buying vote, Extensive Games with Perfect Information: Extensions and Discussion, Coalitional Games and the Core, examples, Bayesian Games, Spence Signalling Game, Crawford and Sobel Cheap Talk Game.

**Module V: Variants and Extensions (18 lectures)**

**Suggested Readings**
2. An Introduction to Game Theory, Osborne, M.J., Oxford University Press.
4. Primer in Game Theory, Gibbons, R.A, Pearson Education.

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#### MAAN0062: ALGEBRAIC GEOMETRY

(4-0-0)

**COURSE OUTCOMES:**
1. Show the correspondence between algebraic objects and their geometric counterparts. (Remembering)
2. Explain the interplay between algebraic geometry and commutative algebra. (Understanding)
3. Analyse the connection between algebraic objects and geometric properties. (Analysing)
4. Evaluate the properties of local rings with their validity in more generalized setting. (Evaluating)

Module I: (17 lectures)
Review of properties of polynomial rings on several variables, properties of algebraic sets, Nullstellensatz (weak form), Zariski topology on algebraic sets, correspondence between ideals of zero set and radical ideals, Nullstellensatz (strong form), irreducibility in Zariski topology, affine line and Zariski topology, Noetherian decomposition.

Module II: (15 lectures)
Topological dimension, Krull dimension, height of a prime ideal, ring of polynomial functions on affine variety, open sets and basic open sets in Zariski topology, quasi compactness, characterizing affine varieties, correspondence between k algebras and morphisms, the coordinate ring of an affine variety, automorphism of affine spaces and polynomial rings.

Module III: (16 lectures)
Projective spaces, projective spaces as copies of affine spaces, graded rings and homogeneous ideals, homogeneous localization and related properties, local rings, local rings at a point of a projective space, function fields, global regular functions on projective varieties, category of varieties, properties of homogeneous coordinate rings.

Module IV: (12 lectures)
Isomorphism of local rings, geometric interpretation of isomorphism of local rings, birationality, idea of non-singularity, smooth manifolds, correspondence between hypersurfaces and varieties.

Suggested Readings
2. Undergraduate Commutative Algebra, Reid Miles, Cambridge university press.
3. Elementary Algebraic Geometry, Hulek Klaus, AMS Student mathematical library.

Mapping of COs to Syllabus

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MANO0063: NUMERICAL OPTIMIZATION
(4-0-0)

COURSE OUTCOMES
1. Learn some basic concept of numerical methods and operations. (Remembering)
2. Illustrate the different optimization problem and their solving methods. (Understanding)
3. Classify the algebraic structure and the solution procedure for a given a mathematical problem. (Analysing)
4. Derive the solution of a problem using computing approach. (Applying)
5. Evaluating the mathematical and social system solution procedure and analysing the results. (Evaluating)

Module I: Mathematical Formulation (5 lectures)
Transportation problem, continuous and discrete, constrained and unconstrained, global and local, stochastic and deterministic convexity, and optimization algorithms.

Module II: Fundamental of unconstrained optimization (10 lectures)
Solution of unconstrained problems, local minimum, non-smooth problems. Two strategies- Line search and Trust Region, search direction for linear search methods, models for Trust Region method, steepest Descent method, first order methods-Gauss- Seidel, method of successive approximation or Gradient method.

Module III: Line Search (15 lectures)
General scheme, computing new t, optimal step size, Wolfe's rule. Newton methods- Forcing global convergence, alleviating the method, Quasi-Newton methods, global convergence, local convergence. Conjugate gradient- developing the method, computing the direction, orthogonalization process.

Module IV: Trust Region (18 lectures)
Elementary problems, curvilinear search incidence on the sequence x_k, least square, Gauss-Newton, algorithm based on Cauchy point, improving on the Cauchy point. Quadratic programming-basic mechanism, solution algorithm and convergence.

Module V: Newton's methods in constrained optimization (12 lectures)
Differential calculus, existence and uniqueness of solutions, first order optimality condition, second order optimality condition, speed of convergence, projection onto a closed convex set.

Suggested Readings

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### MAML0064: MACHINE LEARNING

(4-0-0)

#### COURSE OUTCOMES

1. Explain the basic concepts of Machine learning, Data Mining and AI and their importance in real life. (Understanding)
2. Illustrate the various characteristics machine learning. (Understanding)
3. Utilize the ML algorithms for finding solutions of real-life problem. (Applying)
4. Analyse ML methods for identifying problems. (Analysing)
5. Determine the performances of ML by implementing Python. (Evaluating)

#### Module I: Introduction to Statistics and Machine learning (8 lectures)


#### Module II: Supervised Learning (12 lectures)

Classification, Regression, Random Forest, Decision tree, Linear Regression, Gradient Descent, Polynomial Regression, Learning Curves, Regularized Linear Models, Logistic Regression, Ridge Regression.

#### Module III: Unsupervised Learning (12 lectures)

Clustering, Partitioning Clustering, Hierarchical Clustering, Grid based clustering, Clustering algorithms, K-means algorithm, Applications of Clustering in different fields.

#### Module IV: Advanced Machine Learning concepts and techniques (10 lectures)

Ensemble methods, Boosting, Support Vector Machines, Linear SVM Classification, Nonlinear SVM Classification, SVM Regression, ANN, Deep Learning, Semi-supervised learning, Tensor flow, Evaluation in ML.

#### Module V: Dimensionality Reduction (8 lectures)

The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, PCA, Kernel PCA, LLE, Other Dimensionality Reduction Techniques.

#### Module VI: Introduction Python in Machine Learning (10 lectures)

Introduction to Python, Python Basics, Variables and Data Types, Decision Making and Loops, Functions, Modules and Packages, Exception handling, File and Directories, Classes and objects, Regular expressions, Socket programming.

#### Suggested Readings

1. The Elements of Statistical Learning, T. Hastie, R. Tibshirani, J. Friedman; Springer Series in Statistics.
3. Introduction to Machine Learning with Python, Andreas C. Muller and Sarah Guido, Sebastopol.

### Mapping of Cos to syllabus

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COURSE OUTCOMES

1. Understand and use the basic mathematical formalism needed for describing the dynamics of continuous media (Understanding)
2. Have a very good knowledge of mathematical models for plasma and will be able to distinguish the dynamics of plasmas and neutral fluid media. (Remembering)
3. Use the general theory to formulate and modify the basic dynamic fluid equations to account for the dynamics of plasma media at different levels: from MHD to kinetic scales (Applying)
4. Able to describe the propagation of waves in plasmas, plasma turbulence, instabilities and derive the dispersion relation for these waves (Analyzing)
5. Solve complex model for the various astrophysical regions, and obtain analytical expressions for some characteristic quantities (Evaluating)

Module I (10 lectures) Introduction

Basic properties of plasmas: Definition, occurrence and importance of plasmas, Debye shielding, Quasi-neutrality, plasma parameter, plasma frequency, Larmor orbits (basics), Non-ideal plasmas

Module II (10 lectures) Elements of plasma dynamics

Single particle motion: Cyclotron motion, Electrodynamic equations for a conducting fluid (Maxwell’s equations, Conservation of electric charge, Generalized Ohm’s law etc.), Guiding center drifts: ExB, curvature and gradient., Magnetic moment, adiabatic invariants, magnetic mirrors

Module III (18 lectures) Plasma as fluids

Introduction: The fluid equation of motion (Continuity equation, Momentum balance equation, Equations of state, Two-fluid equations, Plasma resistivity

Waves in plasmas: Plasma oscillations, Langmuir waves, ion-acoustic waves; Electromagnetic waves (parallel and perpendicular to B0)

Module IV (12 lectures) Kinetic plasma theory

Vlasov and Boltzmann equations, Obtaining fluid equations from Boltzmann equation, From the two-fluid to MHD description of plasmas; Longitudinal and transverse waves in an unmagnetized plasma. Solution of initial value problem by Landau’s method. Landau damping.

Module V: (10 lectures) Nonlinear effects in plasmas

Introduction, The Sagdeev potential, Derivation of KdV equation for ion-acoustic waves, Soliton solution in one dimension, Elementary ideas about the ponderomotive force and parametric instability.

Suggested Readings:

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MASL0100: MATHEMATICS AND SERVICE LEARNING (THEORY AND PRACTICE)

(2-0-0)

COURSE OUTCOMES

1. Understanding the relation between service learning and mathematical applications. (Understanding)
2. Apply theoretical knowledge to address real life issues in service learning. (Applying)
3. Analyse mathematically the expected result. (Analysing)
4. Evaluate the practical outcomes in a systematic manner. (Evaluating)

Module I: (10 lectures)

Module II: (10 lectures)

Module III: (10 lectures)
Concepts of community, Community engagement, Models and Frameworks, Principles of Community engagement, Successful examples in the Field, managing organizational support for community engagement, Challenges and Social Networking in Improving Community engagement in Research.

Module IV: Field Works
a. By visiting a local school/ college/ academic institution, take a test (both written and oral) on science education, and explain the outcome by using Statistical methods / appropriate other methods.
b. By visiting a nearby hospital/ clinic, take data of the number of patients visited the hospital during the last one month, explain the outcome, social ideology, etc. of the doctors and the medical team by adopting appropriate scientific tools.
c. By visiting a social media/ TV channel, take data of new news forecasted during last one month and explain the effects of these news in society/ general public by adopting scientific tools.
d. By visiting a Newspaper office, take the data of new news for the last one month published in that paper, and explain the effects of these news in society/ general public by adopting scientific tools.
e. By visiting a local village, take the data of the education, monthly income, etc, and explain the data by adopting scientific methods along with suggestions for better development of that community.
f. Any other suitable project related to the Community engagement and development with scientific exposition.

Suggested Readings
2. Service Learning as Civic Pedagogy, A Narrative Inquiry Exploring the Community College Student Experience, Keith E Robinder, PhD Thesis, Colorado State University, USA.

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MACS0101: CALCULUS
(4-0-2)

**COURSE OUTCOMES**
1. Apply derivative test in optimization problems appearing in social science, physical sciences etc.(Applying)
2. Determine area of surfaces of revolution and the volume of solids by integrating over cross-sectional areas.(Evaluating)
3. Use mathematical properties in different coordinate systems of reference, sketch curves in a plane. (Analysing)
4. Illustrate of the properties of curve tracing, conics and vector function. (Understanding)

Module I: (18 lectures)
Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L’Hospital’s rule, applications in business, economics and life sciences.

Module II: (16 lectures)
Reduction formulae, derivations and illustrations of reduction formulae of the type, volumes by slicing, disks and washers’ methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

Module III: (12 lectures)
Techniques of sketching conics, reflection properties of conics, rotation of axes and second-degree equations, classification into conics using the discriminates, polar equations of conics.

Module IV: (14 lectures)
Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration, modelling ballistics and planetary motion, Kepler ‘s second law.

Suggested Readings
4. Introduction to Calculus and Analysis (Volumes I & II), R. Courant and F. John, Springer-Verlag, New York, Inc.

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MAAG0102: ALGEBRA
(5-1-0)

COURSE OUTCOMES
1. Apply De Moivre’s theorem in a number of applications to solve numerical problems. (Applying)
2. Learn division algorithm and apply Euclid’s algorithm and backwards substitution to find greatest common divisor. (Applying)
3. Illustrate the concepts of Inequality and the use of Fundamental theorem of algebra. (Understanding)
4. Solve a System of Linear equations stressing on various methods to determine the result. (Evaluating)

Module I: (17 lectures)
Polar representation of complex numbers, nth roots of unity, De Moivre’s theorem for rational indices and its applications.

Module II: (20 lectures)
Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

Module III: (23 lectures)
Inequalities involving arithmetic, geometric and harmonic means, Cauchy Schwarz inequality, relations between roots and coefficients of polynomial equation of degree n, roots of symmetric functions, Cardon’s methods solution of cubic equation.

Module IV: (30 lectures)
Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence. Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of $\mathbb{R}^n$, dimension of subspaces of $\mathbb{R}^n$ and rank of a matrix, Eigenvalues, Eigen Vectors and Characteristic Equations of a matrix.

Suggested Readings
1. Complex Numbers from A to Z, Titu Andreescu and Dorin Andrica, 2006, Burkhous.

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MAER0103: REAL ANALYSIS
(5-1-0)

COURSE OUTCOMES
1. Learn the basic properties of Real number $\mathbb{R}$. (Remembering)
2. Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence. (Understanding)
3. Test for convergence and absolute convergence of an infinite series of real numbers. (Analysing)

Module I: (30 lectures)
Review of Algebraic and Order Properties of $\mathbb{R}$, neighbourhood of a point in $\mathbb{R}$, Idea of countable sets, uncountable sets and uncountability of $\mathbb{R}$. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The
Completeness Property of \( R \), The Archimedeany Property, Density of Rational (and Irrational) numbers in \( R \), Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.

**Module II: (30 lectures)**


**Module III: (30 lectures)**


**Suggested Readings**


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**MADQ0104: DIFFERENTIAL EQUATIONS**

(4-0-2)

**COURSE OUTCOMES**

1. Learn basics of differential equations and formulate Differential Equations for various Mathematical models. (Creating)
2. Solve first order non-linear differential equation and linear differential equations of higher order using various techniques. (Evaluating)
3. Apply these techniques to solve and analyse various mathematical models. (Applying)

**Module I: (18 lectures)**

Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

**Module II: (20 lectures)**

Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting.

**Module III: (22 lectures)**

General solution of homogeneous equation of second order, principle of superposition for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non- homogeneous equations of higher order with constant coefficients, Euler’s equation, method of undetermined coefficients, method of variation of parameters.

Equilibrium points, Interpretation of the phase plane, predator-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.

**Suggested Readings**

3. Differential Equations, S.L. Ross, John Wiley and Sons, India.

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COURSE OUTCOMES
1. Find the concept of nth derivatives of the function and consequences of mean value theorems. (Remembering)
2. Evaluate integral value of function by using appropriate reduction formulae. (Evaluating)
3. Apply integral formulae to determine length, area, surface area and volume of a revolution of curves. (Applying)
4. Identify, analyse and subsequently solve physical situations whose behaviour can be described by ordinary differential equations. (Analysing)
5. Determine solutions to second order homogeneous and non-homogeneous differential equations with constant coefficients. (Evaluating)

Module I: (17 lectures)
a. Derivatives, higher order derivatives, successive differentiation and Leibnitz’s rule and its applications; Mean value Theorem, Taylor’s Theorem, tangents and normals, concavity and inflection points, curvature, L’Hospital’s rule.
b. Partial differentiations, partial derivative as a slope, partial derivative as a rate, higher order partial derivatives (two and three variables), Euler’s theorem on homogeneous functions. Maxima, minima and saddle points; Method of Lagrange multipliers.

Module II: (16 lectures)
Standard methods of integration, integration of irrational function, reduction formulae, derivations and illustrations of the type.

Module III: (12 lectures)
Applications of Integrals: Area of plane curves, volume and surface area of solids of revolution, parametrization of a curve, arc length of parametric curves.

Module IV: (17 lectures)
Differential equations; general, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

Module V: (18 lectures)
General solution of homogeneous equation of second order, principle of superposition for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler’s equation, method of undetermined coefficients, method of variation of parameters.

Suggested Readings
3. Differential Equations - S.L. Ross, John Wiley and Sons, India.

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MALG0106: ALGEBRA
(5-1-0)

COURSE OUTCOMES
1. Apply De Moivre’s theorem in a number of applications to solve numerical problems. (Applying)
2. Develop the knowledge of a matrix and learn to solve systems of linear equations and application problems requiring them. (Understanding)
3. Relate the fundamental concepts of Groups and symmetrical figure. (Remembering)
4. Learn about the fundamental theory of two objects, namely - rings and vector spaces. (Understanding)

Module I: (24 lectures)
Polar representation of complex numbers, nth roots of unity, De Moivre’s theorem for rational indices and its applications; expansion of cos x, sin x and tan x in positive integral powers of x, exponential and trigonometric function of a complex variable, Euler’s expansion for cosine and sine; Gregory’s Series; Hyperbolic functions.

Module II: (18 lectures)
Matrices, elementary matrices, row reduction and echelon forms, rank of matrix, linear independence, inverse of matrix, system of linear equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, characteristic equation of a matrix. Eigen values, Eigen Vectors, Diagonalizing matrices.
Module III: (24 lectures)
Binary operations, associative and commutative binary operations; Equivalence relations, Integer modulo n; Groups; elementary properties of groups; subgroups and examples of subgroups, permutation groups, cyclic groups and properties of cyclic groups, cosets, order of groups, Lagrange’s theorem of finite group, normal subgroups, quotient groups, homomorphism and isomorphism of groups.

Module IV: (24 lectures)
Rings and subrings in the context of C[0,1], simple examples and properties; Definition and examples of a vector space, Subspace and its properties, Linear independence, Basis and dimension of a vector space.

Suggested Readings
2. A First Course in Abstract Algebra, J. B. Fraleigh, Pearson
3. Linear Algebra and its Applications, David C. Lay, Pearson Education Asia, Indian Reprint
4. Linear Algebra, K. Hoffman and R. Kunze, Prentice Hall,
5. Complex Numbers from A to Z, Titu Andreescu and Dorin Andrica, Burkhhouse.

Mapping of COs to Syllabus

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MARF0109: THEORY OF REAL FUNCTIONS
(5-1-0)

COURSE OUTCOMES
1. Demonstrate a rigorous understanding of the concept of limit of a functions. (Understanding)
2. Define continuity and uniform continuity of functions and interpret geometrical properties of continuous functions on closed and bounded intervals. (Analysing)
3. Analyse the consequence of various mean value theorem for differentiable functions. (Analysing)

Module I: (30 lectures)
Limits of functions (approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.

Module II: (30 lectures)
Differentiability of a function at a point and in an interval, Caratheodory’s theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle’s theorem, Mean value theorem, intermediate value property of derivatives, Darboux’s theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylor’s theorem to inequalities.

Module III: (30 lectures)
Cauchy’s mean value theorem. Taylor’s theorem with Lagrange’s form of remainder, Taylor’s theorem with Cauchy’s form of remainder, application of Taylor’s theorem to convex functions, relative extrema. Taylor’s series and Maclaurin’s series expansions of exponential and trigonometric functions, ln(1 + x), 1/ax+b and (1 +x)n.

Suggested Readings
1. Introduction to Real Analysis, R. Bartle and D.R. Sherbet, John Wiley and Sons.
3. Introduction to Analysis, A. Mattuck, Prentice Hall.

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MAGT0110: GROUP THEORY I
(5-1-0)

COURSE OUTCOMES
1. Relate the fundamental concepts of groups and symmetries of geometrical objects. (Remembering)
2. Gain the basic knowledge of subgroups, normal subgroups and cyclic groups. (Understanding)
3. Make Use of Lagrange’s Theorem to analyse the cyclic subgroups of a group. (Applying)
4. Evaluate the external direct product of two groups and its order. (Evaluating)
5. Illustrate mapping structure between groups and their consequences. (Understanding)

Module I: (20 lectures)
Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups.

Module II: (30 lectures)
Subgroups and examples of subgroups, centralizer, normalizer, centre of a group, product of two subgroups. Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange’s theorem and consequences including Fermat’s Little theorem.

Module III: (20 lectures)
External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy’s theorem for finite abelian groups.

Module IV: (20 lectures)
Group homomorphisms, properties of homomorphisms, Cayley’s theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

Suggested Readings
5. Topics in Algebra, I.N. Herstein, Wiley Eastern Limited, India.

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MAMC0111: MULTIVARIATE CALCULUS
(5-1-0)

COURSE OUTCOMES
1. Learn about the differentiation and integration of the functions of two or more variables together with their various applications. (Understanding)
2. Relate inter-relationship amongst the line integral, double and triple integral formulations. (Remembering)
3. Apply multi variable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc. (Applying)
4. Evaluate double and triple integrals by applying change of variables theorems. (Evaluating)
5. Apply Greens, divergence, and Stokes theorems by combining vector differential calculus and vector integral calculus. (Applying)

Module I: (25 lectures)
Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl.

Module II: (20 lectures)
Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar coordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical coordinates.

Module III: (25 lectures)

Module IV: (20 lectures)
Green’s theorem, surface integrals, integrals over parametrically defined surfaces. Stoke’s theorem, The Divergence
theorem.

**Suggested Readings**

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**MAPC0112: PROGRAMMING IN C**  
(2-0-0)

**COURSE OUTCOMES**
1. Demonstrate the understanding of the concepts of C language syntax. (Understanding)
2. Choose the loops and the decision-making statements to solve various problems. (Applying)
3. Implement standard algorithms and translate pseudo-codes into C programs. (Applying)
4. Apply their analytical skills for choosing the right data structure, function, data types and develop logic to solve various instances of problems. (Analysing)

**Module I: (5 lectures)**
C Fundamentals:- Elementary data types, variables, constants and identifiers. Integer, character floating point and string constants, variable declarations. Syntax and semantics. Reserved word. Initialization of variable during declarations. Constant data types.

**Module II: (7 lectures)**
Expression, precedence and associativity of operators, unary, binary and ternary operators. Arithmetic operators, assignment operators, relational operators, logical operators and bit-wise operators, Expression statement.

**Module III: (10 lectures)**

**Module IV: (8 lectures)**
Functions, -call by value, call by reference. Array – declaration and use, 2D Array-declaration and use.

**Suggested Readings**

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**MALS0113: LOGIC AND SETS**  
(2-0-0)

**COURSE OUTCOMES**
1. Gain the knowledge of interpreting any Mathematical statement into the language of logic. (Remembering)
2. Explain the notion of logic and set which is fundamental in every branch of Science. (Understanding)
3. Apply the methodologies of sets in problems arising in other branches of Mathematics like combinatorics and algebra. (Applying)
4. Analyse validity of a given statements by means of principles of logic. (Analysing)

**Module I: (14 lectures)**
Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contrapositive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Module II: (7 lectures)

Module III: (9 lectures)
Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, binary relations.

Suggested Readings
2. Naive Set Theory, P.R. Halmos, Springer.

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MAPEO114: PDE and Systems of ODE
(4-0-2)

COURSE OUTCOMES
1. Define various types of partial differential equations and transform into canonical form. (Remembering)
2. Explain the relationship of various functions in differential problems. (Understanding)
3. Develop derivative techniques to predict the behaviour of nonlinear phenomena and find solution. (Applying)
4. Analyse boundary conditions of problems which are not solvable initially. (Analysing)
5. Assess various higher order methods for the solution of complex problem. (Evaluating)

Module I: (14 lectures)

Module II: (18 lectures)

Module III: (10 lectures)
Derivation of Heat equation, Wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

Module IV: (18 lectures)

Suggested Readings
2. Differential equations, John Wiley and Sons, India.

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MANM0115: NUMERICAL METHODS
(4-0-2)

COURSE OUTCOMES
1. Solve an algebraic or transcendental equation using an appropriate numerical method. (Evaluating)
2. Apply the different numerical methods for interpolation, differentiation, integration and solving set of ordinary
differential equations. (Applying)
3. Perform an error analysis for a given numerical method. (Analysing)
4. Applications of numerical differentiation and integration to convert differential equations into difference equations for
numerical solutions. (Applying)

Module I: (20 lectures)
 Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation. Transcendental and Polynomial equations:
Bisection method, Newton's method, Secant method. Rate of convergence of these methods.

Module II: (22 lectures)
 System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. GaussJacobi method, Gauss Seidel method
and their convergence analysis.
 Interpolation: Lagrange and Newton’s methods. Error bounds. Finite difference operators. Gregory forward and
backward difference interpolation.

Module III: (18 lectures)
 Numerical Integration: Trapezoidal rule, Simpson’s rule, Simpsons 3/8th rule, Boole’s Rule. Midpoint rule, Composite Trapezoidal

Suggested Readings
1. A Friendly Introduction to Numerical Analysis, Brian Braide, Pearson Education, India.
International Publisher, India.

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MAMC0116: MECHANICS
(5-1-0)

COURSE OUTCOMES
1. Define basic mechanical concepts related to force and equilibrium of systems. (Remembering)
2. Illustrate the laws and relation between discrete and continuous mechanical systems. (Understanding)
3. Describe planar and spatial motion of a rigid body. (Remembering)
4. Analyse the motion of a system of particles using conservation laws. (Analysing)

Module I: (30 lectures)
 Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force
system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two
point equivalent loading, problems arising from structures, static indeterminacy.

Module II: (30 lectures)
 Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through
belts, screw jack, wedge, first moment of an area and the centroid, other centres, Theorem of Pappus-Guldinus, second moments
and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar
moment of area, principal axes.

Module III: (30 lectures)
Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy
expression based on centre of mass, moment of momentum equation for a single particle and a system of particles, translation
and rotation of rigid bodies, Chasles’ theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

**Suggested Readings**


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**MACG0117: COMPUTER GRAPHICS**

(2-0-0)

**COURSE OUTCOMES**

1. Explain the basic concepts and the functioning of graphic processors. (Understanding)
2. Implement various algorithms to scan, convert the basic geometrical transformations. (Applying)
3. Analyse graphics devices to produce a graphics image of desired quality. (Analysing)
4. Evaluate the utility of a certain graphics model by writing a program. (Evaluating)

**Module I (14 lectures)**

Development of computer Graphics: Raster Scan and Random Scan graphics storages, displays processors and character generators, colour display techniques, interactive input/output devices.

**Module II (16 lectures)**

Points, lines and curves: Scan conversion, line-drawing algorithms, circle and ellipse generation, conic-section generation, polygon filling antialiasing. Two-dimensional viewing: Coordinate systems, linear transformations, line and polygon clipping algorithms.

**Suggested Readings**


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**MAGY0118: GRAPH THEORY**

(2-0-0)

**COURSE OUTCOMES**

1. Define basic concepts of graphs and properties of graphs. (Remembering)
2. Apply Dijkstra’s algorithm to find a shortest path spanning tree in a graph or digraph. (Applying)

**Module I (15 lectures)**

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles.

**Module II (15 lectures)**

The adjacency matrix, weighted graph, travelling salesman’s problem, shortest path, Dijkstra’s algorithm, Floyd-Warshall algorithm.

**Suggested Readings**

2. Discrete Mathematics with Graph Theory, Edgar G. Goodaire and Michael M. Parmenter, Pearson Education(Singapore) P. Ltd.

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### MAMC0126: METRIC SPACES AND COMPLEX ANALYSIS

(5-1-0)

**COURSE OUTCOMES**

1. Explain the basic concepts of metric spaces and these concepts to their counter parts in real analysis. (Understanding)
2. Understand several concepts of metric spaces, their properties and connectedness. (Understanding)
3. Identify the continuity of a function in complex problems. (Applying)
4. Apply Cauchy Residue theorem to evaluate Contours integrals. (Applying)

**Module I:** (23 lectures)


**Module II:** (12 lectures)

Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, Banach Fixed point Theorem. Connectedness, connected subsets of R.

**Module III:** (30 lectures)

Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions.

**Module IV:** (25 lectures)


### Suggested Readings

3. Introduction to Topology and Modern Analysis, G.F. Simmons, McGraw-Hill.

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### MART0127: RING THEORY AND LINEAR ALGEBRA I

(5-1-0)

**COURSE OUTCOMES**

1. Develop the fundamental concept of Rings, Fields, subrings, integral domains and the corresponding morphisms. (Understanding)
2. Recall ring homomorphism and isomorphism theorems of rings. (Remembering)
3. Elaborate the concept of linear independence of vectors over a field, the idea of a finite dimensional vector space, basis of a vector space and the dimension of a vector space. (Creating)
4. Learn about basic concepts of linear transformations, matrix of a linear transformation, algebra of transformations and the change of basis. (Understanding)
Module I: (24 lectures)
Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Module II: (18 lectures)
Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.

Module III: (24 lectures)
Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Module IV: (24 lectures)
Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Suggested Readings
5. Introduction to Linear Algebra, S. Lang, Springer.

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MANT0128: NUMBER THEORY
(5-1-0)

COURSE OUTCOMES
1. Prove some results including the prime number theorem, Chinese remainder theorem, Wilson’s theorem and their consequences. (Evaluating)
2. Identify and understand different types of divisibility tests, and reduced set of residue problems. (Applying)
3. Learn about number theoretic functions, modular arithmetic and their applications. (Understanding)
4. Find primitive roots of prime and composite numbers. (Evaluating)

Module I: (29 lectures)
Divisibility, The division algorithm theorem, Linear Diophantine equation, prime counting function.

Module II: (25 lectures)
Fundamental Theorem of arithmetic, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem, Fermat’s Little theorem, Wilson’s theorem.

Module III: (18 lectures)
Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function.

Module IV: (18 lectures)
Euler’s phi-function, Euler’s theorem, reduced set of residues, some properties of Euler’s phi-function. The order of an integer modulo n, Primitive roots for primes, Composite numbers having primitive roots; Definition of quadratic residue of an odd prime, and Euler’s criterion.

Suggested Readings

Mapping of COs to Syllabus

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Module I: (18 lectures)
Automorphisms and Properties: Automorphism, inner automorphism, Automorphism groups, Automorphism groups of finite and infinite cyclic groups, Characteristic subgroups, Commutator subgroup and its properties; Applications of factor groups to automorphism groups.

Module II: (18 lectures)
Formulate basic concepts such as automorphism, classifications of groups, conjugacy, class equation, simplicity, etc. (Understanding)
2. Analyse finite groups in terms properties of direct product of groups leading to fundamental theorem of finite abelian groups. (Analysing)
3. Illustrate how a group is interpreted in terms of a symmetric group by means of Cayley’s theorem. (Understanding)
4. Apply the notion of simple group in Galois theory which leads to determine the solvability of polynomial equations. (Applying)
5. Evaluate the simplicity of a group based on various non-simplicity test. (Evaluating)

Module I: (18 lectures)
Automorphisms and Properties: Automorphism, inner automorphism, Automorphism groups, Automorphism groups of finite and infinite cyclic groups, Characteristic subgroups, Commutator subgroup and its properties; Applications of factor groups to automorphism groups.

Module II: (18 lectures)
Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, classifications of groups of order $p^2$, $p$ is prime, Fundamental Theorem of finite abelian groups.

Module III: (24 lectures)
Group actions: Group actions and permutation representations; stabilizers and kernels, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley’s theorem, Index theorem.

Module IV: (30 lectures)
Conjugacy class, The class equation, $p$-groups, Sylow’s theorems and consequences, applications of Sylow theorems; Finite simple groups, non-simplicity tests; Generalized Cayley’s theorem, Index theorem, Embedding theorem and applications. Simplicity of $A_5$ for $n \geq 2$.

Suggested Readings

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MALP0130: LINEAR PROGRAMMING
(5-1-0)

COURSE OUTCOMES
1. Recall several possible solutions of linear programming problems, unconstrained and constrained problems etc. (Remembering)
2. Explain the concept of convex set and extreme points. (Understanding)
3. Apply the concept of LPP to game problems. (Understanding)
4. Analyse the primal and dual problems, and sensitivity analysis of LPP. (Analysing)
5. Formulate an optimization problem from its physical consideration to Linear programming problem. (Analysing)

Module I: (24 lectures)
The Linear Programming Problem: Standard, Canonical and matrix forms, Graphical solution. Hyperplanes, Extreme points, Convex and polyhedral sets. Basic solutions; Basic Feasible Solutions; Reduction of any feasible solution to a basic feasible solution; Correspondence between basic feasible solutions and extreme points.

Module II: (30 lectures)
Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Module III: (18 lectures)
Duality, Formulation of Dual problem; Primal-Dual relationships; economic interpretation of the dual.

Module IV: (18 lectures)
Transportation Problem: Basic concept and Mathematical formulation of transportation problem; Methods of finding initial basic feasible solutions; North West corner rule. Least cost method; Vogel’s Approximation method; Algorithm for solving Transportation Problem; Assignment Problem : Mathematical formulation and Hungarian method of solving. Game Theory: Basic concept, Formulation of two-person zero-sum games, Games with mixed strategies, Linear Programming method of solving a game.

Suggested Readings
1. Linear Programming and Network Flows, Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, John Wiley and Sons, India.
5. An Introduction to Linear Programming and Game Theory, Thie, Paul R., & Keough, G. E., Wiley India Pvt. Ltd.

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**MAR10131: RIEMANN INTEGRATION AND SERIES OF FUNCTIONS**
(5-1-0)

**COURSE OUTCOMES**
1. Discuss the properties of Riemann integrable functions, and the applications of the fundamental theorems of integration. (Creating)
2. Importance of improper integrals including Beta and Gamma functions. (Evaluating)
3. Apply different tests to check the convergence of the different functions and improper integrals. (Applying)
4. Examine the advantages and limitations convergence of power series. (Analysing)

**Module I: (25 lectures)**
Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability. Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals; Fundamental theorems of Calculus.

**Module II: (20 lectures)**
Improper integrals; Convergence of Beta and Gamma functions.

**Module III: (24 lectures)**
Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

**Module IV: (21 lectures)**
Power series, radius of convergence, Abel’s Theorem; Weierstrass Approximation Theorem.

**Suggested Readings**

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MART0132: RING THEORY AND LINEAR ALGEBRA II
(5-1-0)

COURSE OUTCOMES
1. Discuss the properties of Riemann integrable functions, and the applications of the fundamental theorems of integration. (Creating)
2. Importance of improper integrals including Beta and Gamma functions. (Evaluating)
3. Apply different tests to check the convergence of the different functions and improper integrals. (Applying)
4. Examine the advantages and limitations convergence of power series. (Analysing)

Module I: (18 lectures)
Polynomial rings over commutative rings, division algorithms and consequences, principal ideal Domains.

Module II: (20 lectures)
Factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in \(\mathbb{Z}[x]\). Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.

Module III: (29 lectures)
Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator.

Mod IV: (23 lectures)
Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel’s inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

Suggested Readings
3. Elements of Real Analysis, Charles G. Denlinger, Jones & Bartlett.

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MAIM0133: INDUSTRIAL MATHEMATICS
(5-1-0)

COURSE OUTCOME
1. Recall and facilitate mathematical concepts in solving the problems of daily life. (Remembering)
2. Develop the competency in using mathematical tools to study geological anomalies. (Applying)
3. Analyse the different types of mathematical simulation used in the medical diagnosis. (Analysing)
4. Evaluate processing of X-ray scan output using Mathematical Algorithms. (Evaluating)
5. Apply math and algebraic theories, concepts and skills to Image Reconstruction Technology. (Applying)
6. Evaluate the applications of different transformations like IFT in image reconstructions. (Evaluating)

Module I: (18 lectures)
Medical Imaging and Inverse Problems. The content is based on Mathematics of X-ray and CT scan based on the knowledge of calculus, elementary differential equations, complex numbers and matrices.

Module II: (24 lectures)
Introduction to Inverse problems: Why should we teach Inverse Problems? Illustration of Inverse problems through problems taught in Pre-Calculus, Calculus, Matrices and differential equations. Geological anomalies in Earth’s interior from measurements at its surface (Inverse Problems for Natural disaster) and Tomography.

Module III: (19 lectures)
X-ray: Introduction, X-ray behaviour and Beer’s Law (The fundamental question of image construction) Lines in the place.

Module IV: (12 lectures)
Radon Transform: Definition and Examples, Linearity, Phantom (Shepp - Logan Phantom - Mathematical phantoms).

Module V: (5 lectures)
Back Projection: Definition, properties and examples.

Module VI: (12 lectures)
CT Scan: Revision of properties of Fourier and inverse Fourier transforms and applications of their properties in image reconstruction. Algorithms of CT scan machine. Algebraic reconstruction techniques abbreviated as ART with application to CT scan.

**Suggested Readings**
2. Inverse Problems, Activities for Undergraduates, C.W. Groetsch, the Mathematical Association of America.

**Mapping of COs to Syllabus**

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**MAMF0134: MATHEMATICAL FINANCE**

(5-1-0)

**COURSE OUTCOMES**
1. Explain the basics of financial markets and derivatives including options and futures. (Understanding)
2. Relate the concepts Pricing and hedging of options, interest rate swaps and no-Arbitrage pricing concept. (Remembering)
3. Importance of stochastic analysis of stock price and the Black-Scholes model. (Evaluating)
4. Learn about pricing and hedging of options, as well as interest rate swaps. (Understanding))
5. Learn the concepts of trading strategies and valuation of currency swaps. (Understanding)

**Module I: Interest Rates (17 lectures)**
Types of rates, Measuring interest rates, Zero rates, Bond pricing, Forward rate, Duration, Convexity, Exchange traded markets and OTC markets, Derivatives—Forward contracts, Futures contract, Options, Types of traders, Hedging, Speculation, Arbitrage.

**Module II: Mechanics and Properties of Options (23 lectures)**
No Arbitrage principle, Short selling, Forward price for an investment asset, Types of Options, Option positions, Underlying assets, Factors affecting option prices, Boundson option prices, Put-call parity, Early exercise, Effect of dividends.

**Module III: Stochastic Analysis of Stock Prices and Black-Scholes Model (25 lectures)**
Binomial option pricing model, Risk neutral valuation (for European and American options on assets following binomial tree model), Lognormal property of stock prices, Distribution of rate of return, expected return, Volatility, estimating volatility from historical data, Extension of risk neutral valuation to assets following GBM, Black-Scholes formula for European options.

**Module IV: Hedging Parameters, Trading Strategies and Swaps (25 lectures)**
Hedging parameters (the Greeks: Delta, Gamma, Theta, Rho and Vega), Trading strategies involving options, Swaps, Mechanics of interest rate swaps, Comparative advantage argument, Valuation of interest rate swaps, Currency swaps, Valuation of currency swaps.

**Suggested Readings**
1. Investment Science, David G. Luenberge, Oxford University Press, Delhi.
2. Options, Futures and Other Derivatives, John C. Hull, Prentice-Hall India.

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**MABM0135: BIO- MATHEMATICS**

(5-1-0)

**COURSE OUTCOMES**
1. How to put the relationship of different parameters, and then their physical interpretation. (Remembering)
2. For a given a mathematical problem, classify the problems based on solution procedure and then study their significance in the practical fields. (Analysing)
3. Derive the solution of a problem by using the existed methods and interpret the results. (Creating)
4. Evaluate the mathematical and biological system solution procedure and analyse the results. (Evaluating)
5. Develop the new solution methods for the new problems and models. (Creating)

Module I: (20 lectures)

Module II: (15 lectures)

Module III: (15 lectures)

Module IV: (15 lectures)
Dynamics of Infectious Diseases: Historical Aside on epidemics, Simple Epidemic Models and Practical Applications, Modelling the Population Dynamics of Acquired Immunity to Parasite Infection, Age-Dependent Epidemic Model and Threshold Criterion, Simple Drug Use Epidemic Model and Threshold Analysis.

Module V: (15 lectures)

Suggesting Readings
2. Mathematical Models in Biology, L.E. Keshet, SIAM.
5. Elements of Mathematical Ecology, M. Kot, Cambridge University Press.

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MADG0136: DIFFERENTIAL GEOMETRY
(5-1-0)

COURSE OUTCOMES
1. Recall various properties of space curves and their applications. (Remembering)
2. Interpret geometrical orientation of parametric curves and surfaces. (Understanding)
3. Develop the physical mapping and nature of geodesic curves. (Applying)
4. Analyse the different characteristics of Christoffel symbols and their transformation. (Analysing)

Module I: (18 lectures)

Module II: (24 lectures)

Module III: (24 lectures)
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Module IV: (24 lectures)
Tensors: Summation convention and indicial notation, Coordinate transformation and Jacobian, Contra-variant and Covariant vectors, Tensors of different type, Algebra of tensors and contraction, Metric tensor and 3-index Christoffel symbols, Parallel propagation of vectors, Covariant and intrinsic derivatives.

Suggested Readings

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MAPS0137: PROBABILITY AND STATISTICS
(5-1-0)

COURSE OUTCOMES
1. Recall the basic principles of Probability Theory and Statistics. (Remembering)
2. Understand the concept of random variables and types of distribution. (Understanding)
3. Applying discrete and continuous Atas to compute the probabilities of events. (Applying)
4. Perform a regression analysis, and compute and interpret the coefficient of correlation. (Evaluating)

Module I: (17 lectures)
Probability axioms, sample spaces, events, law of total probability, conditional probability, Bayes’ theorem and independence.

Module II: (18 lectures)
Real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function.

Module III: (30 lectures)
Discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential. Joint probability distributions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables.

Module IV: (25 lectures)
The correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables. Chebyshev’s inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem.

Suggested Readings

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MANA0138: NUMERICAL ANALYSIS
(5-1-0)

COURSE OUTCOMES
1. Solve an algebraic or transcendental equation using an appropriate numerical method. (Evaluating)
2. Apply the different numerical methods for interpolation, differentiation, integration and solving set of ordinary
differential equations. (Applying)
3. Perform an error analysis for a given numerical method. (Analysing)
4. Applications of numerical differentiation and integration to convert differential equations into difference equations for
numerical solutions. (Applying)

Module I: (20 lectures)
Transcendental and Polynomial equations: Bisection method, Regula-Falsi Methods, Newton’s method, Secant method.

Module II: (30 lectures)
System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel
method; Interpolation: Lagrange and Newton’s methods. Finite difference operators. Gregory forward and backward difference
interpolation.

Module III: (25 lectures)
Numerical differentiation: First and second order derivatives; Numerical integration: Trapezoidal Rule, Simpson’s rule,
finding eigenvalues by iterations.

Module IV: (15 lectures)
Ordinary differential equation: Euler’s method, Modified Euler’s methods, Runge-Kutta methods of orders two and four.

Suggested Readings
1. Applied Numerical Methods with MATLAB for Engineers and Scientists - Chapra, Steven C., McGraw-Hill Education.

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MAVC0139: VECTOR CALCULUS AND CO-ORDINATE GEOMETRY
(5-1-0)

COURSE OUTCOMES
1. Explain the cartesian and Polar coordinate system to study 2D, 3D and shapes. (Understanding)
2. Learn about vector valued functions and to apply them to velocity, acceleration, arclength and curvature.
   (Understanding)
3. Formulate a physical problem using differential equation and find solution. (Applying)

Module I: (30 lectures)
Transformation of coordinate axis, pair of straight lines Parabola, parametric coordinates, tangent and Normal, Ellipse and
conjugate diameters with properties; general conics: tangents, condition of tangency, pole and polar, centre of a conic, equation
of pair of tangents, reduction to standards forms, central conics, equation of axes and length of the axes, polar equation of a
conic.

Module II: (30 lectures)
Scalar triple product, vector triple product; Introduction to vector functions, operations with vector valued functions, limits and
continuity of vector functions, differentiation and integration of vector functions; partial derivatives of vector point function,
gradients, curl and divergence.

Module III: (30 lectures)
Simultaneous linear differential equations, total differential equations. Partial differential equations of first order, Lagrange’s
solutions, some special types of equations which can be solved by methods other than the general method, Charpit’s general
methods of solution.

Suggested Readings
1. Differential Equations, H.T.H. Piaggio, G. Bell & Sons Ltd.
3. Ordinary and partial differential equations, M.D. Raisinghania, S.Chand and Co.
Mapping of COs to Syllabus

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MAAG0140: ANALYTICAL GEOMETRY
(5-1-0)

COURSE OUTCOMES
1. Define conic sections and transform co-ordinate systems. (Remembering)
2. Explain the ideas of conics to explain many natural phenomena. (Understanding)
3. Apply the properties of conics to solve problems in real life situations. (Applying)
4. Learn analytical geometry of 2 and 3 dimensions which include study of conics, planes, lines, sphere, cone and cylinder. (Understanding)

Module I: (26 Lectures)
Transformation of coordinates, pair of straight lines. Parabola, parametric coordinates, tangent and normal, ellipse and its conjugate diameters with properties, hyperbola and its asymptotes.

Module II: (30 Lectures)
General conics: tangent, condition of tangency, pole and polar, centre of a conic, equation of pair of tangents, reduction to standard forms, central conics, equation of the axes, and length of the axes, polar equation of a conic, tangent and normal and properties.

Module III: (34 Lectures)
Rectangular coordinates in 3-space, Spheres and Cylindrical surfaces, Vector viewed geometrically, Vectors in coordinate system, Vectors determine by length and angle, Dot product, Cross product and their geometrical properties, Parametric equations of lines in 2-space and 3-space.

Suggested Readings
1. Analytical Geometry of Two and Three Dimension And Vector Analysis - R. M. Khan, New Central Book agency.

Mapping of COs to Syllabus

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MAMM0141: MATHEMATICAL MODELLING
(5-1-0)

COURSE OUTCOMES
1. Recall some basic concept of power series solution of a differential equation and learn about Legendre’s and Bessel’s equations. (Remembering)
2. Apply Laplace transform and inverse transform for solving initial value problems. (Applying)
3. Learn about various models such as Monte Carlo simulation models, queuing models, and linear programmingmodels. (Understanding)
4. Explain various linear programming models. (Understanding)

Module I: (20 Lectures)
Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel’s equation and Legendre’s equation.

Module II: (20 Lectures)
Laplace transform and inverse transform, application to initial value problem up to second order.

Module III: (25 lectures)
Monte Carlo Simulation Modelling: Simulating deterministic behaviour (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence, Queuing Models: harbor system, morning rush hour.

Module IV: (10 Lectures)

Suggested Readings

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MAPO0142: PORTFOLIO OPTIMIZATION
(5-1-0)

COURSE OUTCOMES
1. Demonstrate idea of portfolio optimization. (Understanding)
2. Analyse difference between various sources of risk and the concept of diversification. (Analysing)
3. Explain concept of optimal capital allocation and portfolio choice decisions on real-data set. (Understanding)
4. Demonstrate measures to evaluate a portfolio’s performance and concepts of capital asset pricing model. (Understanding)

Module I: (30 lectures)

Module II: (30 lectures)
Mean-variance portfolio optimization - the Markowitz model and the two-fund theorem, risk-free assets and one fund theorem, efficient frontier. Portfolios with short sales. Capital market theory.

Module III: (30 lectures)
Capital assets pricing model - the capital market line, beta of an asset, beta of a portfolio, security market line. Index tracking optimization models. Portfolio performance evaluation measures.

Suggested Readings

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MAHM0143: HYDROMECHANICS
(5-1-0)

COURSE OUTCOMES
1. Find the fluid pressure on immerse surface and learn about Pressure equation and rotating fluids. (Evaluating)
2. Learn about Fluid pressure on plane surfaces, resultant pressure on curved surfaces, Gas law, mixture of gases. (understanding)
3. Learn about the Eulerian and Lagrangian methods of describing fluid motion. (Understanding)
4. Explain analytical techniques to solve fluid flow equations for different boundary conditions. (Understanding)

Module I: (24 lectures)
Pressure equation, condition of equilibrium, lines of force, homogeneous and heterogeneous fluids, elastic fluids, surface of equal pressure, fluid at rest under action of gravity, rotating fluids.

Module II: (18 lectures)
Fluid pressure on plane surfaces, centre of pressure, resultant pressure on curved surfaces.
Module III: (18 lectures)
Gas law, mixture of gases, internal energy, adiabatic expansion, work done in compressing a gas, isothermal atmosphere.

Module IV: (30 lectures)
Lagrangian and Eulerian methods of describing fluid motion; velocity of a fluid particle; material, local and convective derivatives; acceleration of a fluid particle; streamline motion and turbulent motion; steady flow; streamlines and path lines; velocity potential; vorticity vector; flux of a fluid; equation of continuity by Euler’s method; equation of continuity by Lagrange’s method; equivalence of the Eulerian and Lagrangian forms of the equation of continuity; equation of continuity in cartesian, spherical polar and cylindrical coordinates; certain symmetrical forms of the equation of continuity; boundary surface.

Suggested Readings

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MATE0144: THEORY OF EQUATIONS
(5-1-0)

COURSE OUTCOMES
1. Explain the general properties of polynomial equations. (Understanding)
2. Analyse the idea of symmetric function in algebraic equations. (Analysing)
3. Estimate the integral roots of an equation by using algebraic Method. (Evaluating)
4. Interpret the conditions for obtaining roots of numerical equations. (Understanding)

Module I: (30 lectures)
General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, General properties of equations, Descartes’s rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

Module II: (24 lectures)

Module III: (18 lectures)
Symmetric functions of the roots, Newton’s theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations.

Module IV: (18 lectures)
Separation of the roots of equations, Strum’s theorem, Applications of Strum’s theorem, Conditions for reality of the roots of an equation and biquadratic. Solution of numerical equations.

Suggested Readings

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MAIT0145: INTEGRAL TRANSFORMS
(5-1-0)

COURSE OUTCOMES
1. Illustrate various methods of solving differential equations. (Understanding)
2. Construct mathematical models to solve complex problems. (Applying)
3. Classify periodic functions in terms of sine and cosine functions and its application to boundary value problem. (Understanding)
4. Utilize the knowledge of Laplace and Fourier transforms in finding the solutions of initial value problems and boundary value problems. (Applying)

**Module I: (18 lectures)**
Polynomials-Orthogonal Polynomial-Lagrange’s, Chebyshev polynomials; Trigonometric polynomials; Laplace transform, Properties of Laplace transform, Laplace transform of periodic functions. Evaluations of integrals by Laplace transform.

**Module II: (24 lectures)**

**Module III: (24 lectures)**

**Module IV: (24 lectures)**

**Suggested Readings**
1. Introduction to Theory and Application of Laplace Transforms, Doetsch G., Springer Verlag.
3. Integral Transforms & their applications, Brian Daries, Springer.
4. Integral Transforms & their Applications, L Debnath, D Bhatta, Chapman & Hall/CRC.
7. Introduction to Fourier analysis and wavelets, Graduate Studies in Mathematics, volume 102, Mark A. Pinsky, American Mathematical Society.

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**MAEN0146: ECONOMETRICS**
(5-1-0)

**COURSE OUTCOMES**
1. Recall concept sampling distribution and have greater confidence in its application. (Understanding)
2. Discuss the assumptions upon which different econometric methods are based and their implications. (Understanding)
3. Tells the differences between simple linear regression analysis and multiple linear regression analysis. (Remembering)
4. Compare regression models with the help of measures like $R^2$ and adjusted $R^2$. (Analyzing)
5. Explain the nature of heteroscedasticity and understand the causes and consequences of heteroscedasticity, perform tests to determine whether a regression model has heteroscedastic errors. (Understanding)

**Module I: (29 lectures)**
Statistical Concepts Normal distribution; chi-square, t and F-distributions; estimation of parameters; properties of estimators; testing of hypotheses: defining statistical hypotheses; distributions of test statistics; testing hypotheses related to population parameters; Type I and Type II errors; power of a test; tests for comparing parameters from two samples.

**Module II: (19 lectures)**
Simple Linear Regression Model: Two Variable Case Estimation of model by method of ordinary least squares; properties of estimators; goodness of fit; tests of hypotheses; scaling and units of measurement; confidence intervals; Gauss- Markov theorem; forecasting.

**Module III: (18 lectures)**
Multiple Linear Regression Model Estimation of parameters; properties of OLS estimators; goodness of fit - R2 and adjusted R2 ;
partial regression coefficients; testing hypotheses –individual and joint; functional forms of regression models; qualitative (dummy) independent variables.

Module IV: (24 lectures)
Violations of Classical Assumptions: Consequences, Detection and Remedies Multicollinearity; heteroscedasticity; serial correlation. Specification Analysis Omission of a relevant variable; inclusion of irrelevant variable; tests of specification errors.

Suggested Readings
5. Introduction to Econometrics, Christopher Dougherty, Oxford University Press.

Mapping of COs to Syllabus:

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MAFE0147: Finite Element Methods
(5-1-0)

COURSE OUTCOMES
1. Recall some basic concept of finite element method. (Remembering)
2. Illustrate the role and significance of shape functions in finite element formulations and its interpolation.
   (Understanding)
3. Develop the ability to generate the governing finite elements governed by ordinary differential equations. (Applying)
4. Analyse finite element method in higher order problems. (Analysing)

Module I: (25 lectures)
Introduction to finite element methods, comparison with finite difference methods, Methods of weighted residuals, collocations, least squares and Galerkin’s method. Variational formulation of boundary value problems equivalence of Galerkin and Ritz methods.

Module II: (20 lectures)
Applications to solving simple problems of ordinary differential equations. Linear, quadratic and higher order elements in one dimensional and assembly, solution of assembled system.

Module III : (25 lectures)
Simplex elements in two and three dimensions, quadratic triangular elements, rectangular elements, serendipity elements and isoperimetric elements and their assembly, discretization with curved boundaries.

Module IV: (20 lectures)
Interpolation functions, numerical integration, and modelling considerations. Solution of two dimensional partial differential equations under different Geometric conditions.

Suggested Readings
1. Introduction to the Finite Element Methods, J.N. Reddy, Tata McGraw-Hill.
2. Finite Element Procedures, K.J. Bathe, Prentice-Hall.
5. Finite Element Analysis, George R. Buchanan, McGraw Hill.

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MADS0148: DESCRIPTIVE STATISTICS
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COURSE OUTCOMES

1. Discuss the meaning of statistics along with its utilities, discuss method of collecting data. (Understanding)
2. Organize, and present statistical data and analyse statistical data graphically using frequency distributions and cumulative frequency distributions. (Applying)
3. Apply the basic statistical tools like measures of central tendency, correlation and regression to solve social and scientific problems. (Applying)
4. Test appropriate statistical methods to summarize and analyses data. (Analysing)
5. Examine the strength and direction of a linear relationship between two variables and using correlation and regression method. (Analysing)
6. Discuss how to deal with qualitative data statistically. (Understanding)

Module I: (23 lectures)
Definition of statistics, Statement about statistics, Statistical prospective, Functions of Statistics, Method of collecting data, Types of statistical data, Primary and Secondary data, Statistical survey, Questionnaire and schedule. Several statistical investigations, Errors, Laws, Approximation of values, Complete Enumeration, controlled experiments, observational studies and sample surveys, quantitative and qualitative, attributes, variables, scales of measurement - nominal, ordinal, interval and ratio. Editing of data, Presentation of the data - tabular, graphical. Histogram, ogives, box plots, grouping of data, concept of frequency, stem and leaf display of data consistency and independence of data with special reference to attributes.

Module II: (23 lectures)
Measures of Central Tendency: concept and definition mathematical and positional. properties, functions, limitations, arithmetic mean (AM), weighted mean, geometric mean (GM), harmonic mean (HM), relation between AM, GH and HM, median mode, quartile, decile, percentile. Measures of Dispersion: requisites of a good measure, uses, range, quartile deviation, mean deviation, standard deviation, coefficient of variation, moments, absolute moments, relation between central and raw moments, skewness and kurtosis, Shepard’s correction.

Module III: (22 lectures)
Bivariate data: Definition, correlation, scatter diagram, Karl Pearson coefficient of correlation, Limits, assumptions of Correlation Coefficient, simple, partial and multiple correlation, (3 variables only), rank correlation; Simple linear regression, properties of regression coefficient, lines of regression, principle of least squares and fitting of polynomials and exponential curves.

Module IV: (22 lectures)
Theory of attributes: Introduction, Notations, Dichotomy, classes and class frequencies, consistency of data, conditions of consistency, independence and association of attributes, measures of association and contingency.

Suggested Readings

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MAIP0149: INTRODUCTION TO PROBABILITY THEORY
(5-1-0)

COURSE OUTCOMES

1. Define the basic principles of Probability Theory and Statistics and calculate probabilities by applying probability laws and theoretical results. (Remembering)
2. Discuss the ideas of probability and random variables, various discrete and continuous probability distributions and their properties. (Understanding)
3. Identify an appropriate probability distribution for a given discrete or continuous random variable and use its properties to calculate probabilities. (Remembering).
4. Evaluate and apply moments & characteristic functions and understand the concept of inequalities and probabilistic limits. (Evaluating)
5. Discuss convergence of sequences of random variables and its applications to statistics and stochastic processes.

**Module I: (23 lectures)**

Elementary Probability: Introduction, Types of Events, random experiments, sample space, events and algebra of events, pairwise independence of events.


**Module II: (22 lectures)**

Random Variables: Discrete and continuous random variables, distribution functions, Cumulative Distribution function, p.m.f., p.d.f., Illustrations of random variables and its properties. Expectation, variance, moments and moment generating function.

**Module III: (23 lectures)**

Standard probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, Normal, Exponential, Beta, Gamma.

**Module IV: (22 lectures)**

Convergence in probability, almost sure convergence, Chebyshev’s inequality: application and solved problems, weak law of large numbers, De-Moivre Laplace and Lindeberg-Levy Central Limit Theorem (C.L.T.) and some physical examples.

**Suggested Readings**


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**MACA0150: COMPLEX ANALYSIS**

(5-1-0)

**COURSE OUTCOMES**

1. Define the concept analytic functions and the significance of CR-equations. (Remembering)
2. Explain the basic concepts and theorems associated with complex functions. (Understanding)
3. Derive fundamental principles of contour integrals and its various versions. (Evaluating)
4. Apply Cauchy Integrals formulae and Residue theorem to evaluate real and complex integrals. (Applying)

**Module I: (24 Lectures)**

Analytic Functions: Properties of complex numbers, regions in the complex plane Functions of complex variable, Mappings; Mappings by the exponential function, Limits, Theorems on limits, Limits involving the point at infinity, Continuity, Derivatives, Differentiation formulae, Cauchy-Riemann equations, Sufficient conditions for differentiability; Analytic functions and their examples.

**Module II: (18 Lectures)**

Elementary Functions and Integrals: Exponential function, Logarithmic function, Branches and derivatives of logarithms, Trigonometric function, Derivatives of functions, Definite integralsof functions, Contours, Contour integrals and its examples, Upper bounds for moduli of contour integrals.

**Module III: (24 lectures)**


**Module IV: (24 lectures)**

Series and Residues: Taylor series and Laurent series and its examples, Absolute and uniform convergence of power series, Uniqueness of series representations of power series, Isolated singular points, Residues, Cauchy’s residue theorem, residue at infinity; Types of isolated singular points, Residues at poles and its examples.

**Suggested Readings**


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MACM0151: COMBINATORIAL MATHEMATICS
(5-1-0)

COURSE OUTCOMES
1. Apply basic counting techniques to solve combinatorial problems. (Applying)
2. Define generating function of sequence and solve second order recurrence relations by finding the corresponding generating functions. (Applying)
3. Formulate recurrence relations to solve problems involving an unknown sequence. (Creating)
4. Explain the applications of graph theory in the study of shortest path algorithms. (Understanding)

Module I: (25 lectures)
Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, counting subsets, Set-partitions, Stirling numbers, Principle of Inclusion and Exclusion, Derangements, Inversion formulae, pigeon-hole principle and applications.

Module II: (20 lectures)
Generating functions: Algebra of formal power series, generating function models, Calculating generating functions, Exponential generating functions.

Module III: (20 lectures)
Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions. Integer partitions, Systems of distinct representatives.

Module IV: (25 Lectures)
Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Coloring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges; trees.

Suggested Readings
2. Combinatorics, Theory and Application, V. Krishnamurthy, Affiliated East-West Press.
6. Introductory Combinatorics, R.A. Brualdi, Pearson Education Inc.

Mapping of COs to Syllabus

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MAFG0154: FRACTAL GEOMETRY AND APPLICATIONS
(2-0-0)

COURSE OUTCOMES
1. Explain the basic concepts of fractals and their mathematical constructions. (understanding)
2. Develop fractal dimensions and study their applications. (Applying)
3. Categorize Mandelbrot set and Julia sets, and classify their graphical representation and geometric properties. (Analysing)
4. Interpret random fractals, and study their applications to Health science and Stock markets. (Evaluating and Applying)
5. Demonstrate various chaos, renormalization, universality of chaos, and their significance. (Understanding and Creating)
6. Elaborate various applications in different fields of science and technology. (Creating)

Module I: Regular Fractals and Self-similarity (5 lectures)

Module II: Natural Fractals and Dimensions (5 lectures)
Ineffective way to measure, Fractal Dimensions and calculation, Hausdorff measure and dimension, Box counting dimension, Similarity dimension, The Moran formula, other dimensions, Area-Perim, Dim Algebra, Natural Fractals, Manufactured Fractals.

Module III: The Mandelbrot Set and Julia Sets (5 lectures)

Module IV: Random Fractals and the Stock Market (5 lectures)

Module V: Chaos and Fractals (5 lectures)
Doubling, Introduction to Chaos, Test functions, Graphical iterations, Time series, Histograms, Bifurcation diagrams, Return map, Driven IFS, Kelly plot, Fixed points, Cycles, Period doubling bifurcations, Dust in the Tent map, Tent and Logistic bifurcation diagrams, Tangent bifurcations, Intermittency, Discontinuous bifurcations, Scaling, Universality, Renormalization, Control of chaos, Synchronization of chaotic processes.

Module VI: Fractal Applications (5 lectures)
Fractal growth, Singularities of Electrostatic and gravitational potentials, Fractal Antennas, Fractal in Finance, Self-Affine set and dimension, Application to encoding images, Panorama of Fractals and their uses, Animations, application of fractal geometry to Computer science, Telecommunications, and Medicine.

Suggested Readings
3. Fractal Geometry and Applications, Michel L Lapidus, A Jubilee of Benoît Mandelbrot,

Mapping of COs to Syllabus

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<th>Course Outcomes</th>
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MAMR0153: STATISTICAL METHODS AND SOFTWARE IN RESEARCH
(3-0-0)

COURSE OUTCOMES
1. Explain the basis necessity and application of Statistics in different fields of Science and Social Sciences. (Remembering and understanding)
2. Develop the significance of data analysis and interpretation. (Applying)
3. Categorize Correlation and Regression, and interpret graphical representation. (Analysing and creating)
4. Elaborate various software to study different problems in Statistics. (Creating)

Module I: Importance, Functions, Limitations (5 Lectures)

Module II: Collection of Data, Classification and Tabulation (10 lectures)
Primary and Secondary data, Choice of methods, Direct personal observations, Information through Agencies, Sources of Secondary data, Meaning of Classification, rules of Classification, Statistical series, Frequency distribution, Continuous or Grouped Frequency Distribution Class Group Frequency, Structure and rules of Tabulation, and applications.

Module III: Correlation and Regression (10 lectures)
Significance of the study of Correlation, Correlation and Causation, Karl Pearson’s coefficient of correlation, Rank Coefficient of correlation, Correlation of time series, Significance of Regression study, Correlation and Regression, Regression equations, Standard error of estimate.

**Module IV: Statistical Analysis Software (20 lectures)**
Importance of Software in Statistical problems, SPSS (IBM), (Statistical Package for Social Sciences), R Foundation for Statistical Computing, MATLAB (MathWorks), Microsoft Excel, their algebraic results and Applications.

**Suggested Readings**
1. Statistics (Theory and Practice), RSN Pillai, and Bagavathi, S Chand & Company Ltd, New Delhi.
4. Statistical Software (Free Websites).

**Mapping of COs to Syllabus**

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**MAML0152: ESSENTIAL MATHEMATICS FOR MACHINE LEARNING**
(2-0-0)

**COURSE OUTCOMES**
1. Comprehend the basic and core concepts of vector space, matrices, matrix decompositions. (Understanding)
2. Apply the concepts statistics and linear algebra in Dimension reductions. (Applying)
3. Gain extensive knowledge of probability and statistics for analysis of data. (Analysing)
4. Apply the fundamentals of calculus to evaluate partial derivatives, gradient and other concepts of vector calculus. (Applying)

**Module I: (8 lectures)**
Vector Spaces: Definitions and examples, Vector Subspaces: Examples and Properties, Basis and Dimensions, Linear Transformations, MATRIX THEORY- Norms and spaces, eigenvalues and eigenvectors, Special Matrices and their properties, least squared and minimum normed solutions.

**Module II: (8 lectures)**
Matrix Decomposition Algorithms- SVD: Properties and applications, low rank approximations, Gram Schmidt process, polar decomposition, DIMENSIONS REDUCTION ALGORITHMS and JCF- Principal component analysis, linear discriminant analysis, minimal polynomial and Jordan canonical form

**Module III: (8 lectures)**
Probability – Basic concepts of probability: conditional probability, Bayes' theorem, independence, theorem of total probability, expectation and variance, few discrete and continuous distributions, joint distributions and covariance.

**Module IV: (6 lectures)**
Calculus – Basic concepts of calculus: partial derivatives, gradient, directional derivatives, Jacobean, hessian, convex sets, convex functions and its properties.

**Suggested Readings**

**Mapping COs to Syllabus**

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**MASL0200: COMMUNITY ENGAGEMENT AND SERVICE LEARNING**
(2-0-0)

**COURSE OUTCOMES**

212 | ADBU | Regulations and Syllabus | 2022-23 |
1. Develop understanding on Community University Engagement. (Remembering)
2. Acquire knowledge of the measures taken by HEIs towards community engagement. (Understanding)
3. Analyse a problem pertaining to the community by applying methods of participatory research. (Analysing)
4. Apply various tools of CPBR to address real life issues of the communities. (Applying)
5. Decide a suitable tool to connect with a certain community by identifying the major barriers. (Evaluating)

Module I: (Service Learning and Community University Engagement) (10 lectures)
Definition of Service Learning (SL), goals and objectives of SL. Meaning of community university engagement (CUE), Historical overview of Higher Educational Institutes (HEIs) in India, role played by various commissions in CUE, various policies adopted by University Grants Commission (UGC), objectives and structure of schemes adopted by UGC, measures taken by HEIs towards community engagement.

Module II: (Role of HEI fostering social responsibility) (10 lectures)
Understanding social responsibility of higher education institutes, forms of community engagement, notion of engaged teaching, engaged research, engaged service, meaning of an active citizen. Meaning of Community Based Participatory Research (CBPR), methods and tools associated with CBPR. Skills to utilize CPBR fostering social responsibility especially post emergency like pandemic etc.

Module III: Assignments (10 lectures)
a. Visiting nearby villages to collect data on the percentage of students enrolling into schools per year and represent the same using various Mathematical models.
b. To conduct fact finding visits in local areas to address a particular problem by helping the community understanding the situation employing tools like maps and meetings.

Suggested Readings
Where's the learning in service learning, J. Eyler, D.E. Giles Jr.

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LABORATORY COURSES

MARS6001: RESEARCH SEMINAR
(2-0-0)
Objective
Objective of the Research seminar is to conduct a research literature survey which may lead to the development of a proposed project model to be executed in the 4th semester. This will help the students to familiarize themselves with the current literature on recent trends in the chosen area.
Tasks to be performed by the students will include.
- Literature survey on the chosen topic.
- Presentation on the chosen topic, comprising the following components:
  - Presentation.
  - Report.
  - Viva Voce examination.

COURSE OUTCOMES
1. Find the steps required to do research and projects (Remembering)
2. Illustrate the methodology of research and journaling. (Understanding)
3. Apply the research presentation skills in seminars and conferences. (Applying)
4. List topics to pursue research in the field of pure and applied mathematics. (Analysing)
5. Defend their research dissertations and reports. (Evaluating)
6. Develop research topics and present the research ideas. (Creating)

MACP6002: COMPUTER PROGRAMMING IN C LAB
(0-0-1)
COURSE OUTCOMES
1. Understand the fundamentals of OS, file handling, creating and editing simple C programs. (Understanding)
2. Develop programming skills using the fundamentals and basics of C Language. (Applying)
3. Develop programs using the basic elements like control statements, Arrays and Strings. (Applying)
4. Effective usage of arrays, structures, functions and pointers. (Applying)

**List of programs**
1. Introduction to OS; file handling, directory structures, creating and editing simple C programs.
2. C programming using variables, assignment and simple arithmetic expressions.
3. Determination of roots of quadratic equations, ax²+bx+c=0, a≠0.
4. Arranging given set of numbers in increasing/decreasing order, calculation of Mean.
5. Calculation of GCD/LCM of two integers.
10. Solution of congruence using complete residue system.
11. Addition, subtraction and multiplication of matrices.
12. Transpose, determinant.

**Suggested Readings**
3. C Programming Language, Brain W. Kernighan & Dennis Ritchie, PHI.

**Mapping of COs to Syllabus**

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**MARP6003: RESEARCH PROJECT**
(8 credits)

**Objective**
The objective of the research project is to train students to carry out research/investigation in a field that is of relevance to Mathematical science. During the project period, students will start a research project/investigation applying the knowledge acquired in the first three semesters and also incorporating the recent trends in the chosen area. In the project course, the student should be able to undertake detailed literature review as a way of information search, carry out detailed investigations as a way of solving project problems, write and put together a detailed report of the investigations carried out at the end of the fourth semester. The mode and components of evaluation, supervisors and the weightages attached to them shall be published by the Department at the beginning of the semester.

**COURSE OUTCOMES**
1. Identify different areas of research in the field of Mathematical sciences or in computing. (Remembering)
2. Explain the importance of research in the chosen topic of interest. (Understanding)
3. Apply theoretical knowledge to find out an appropriate topic of importance for research in the graduate level. (Applying)
4. Analyse when a chosen approach does not yield the expected result. (Analysing)
5. Evaluate the project and present in an appropriate form. (Evaluating)
6. Learn to choose a methodology or technique or approach to fulfil a set of objectives or prove or disprove a hypothesis. (Creating)

**MACM6004: COMPUTATIONAL SKILL DEVELOPMENT: MATHEMATICA**
(2 Credits- 30 Lectures)

**COURSE OUTCOMES**
1. Learn how to use Mathematica, a powerful coding language in science and engineeringcomputing (Remembering).
2. Apply the application-oriented principle to various real-life problems (Applying)
3. Evaluate simple math computations, modeling and simulation problems, data analysis and processing, as well as visualization techniques. (Evaluating)

**Module I (10 Lectures)**

Module II (10 Lectures)
Lists, strings, rules, patterns and pattern matching, different programming paradigms (procedural, functional and rule-based), Graphics and image manipulation (the 30+ members of the plot family, pixels and voxels, the built-in image editor).

Module III (10 Lectures)

Suggested Readings

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<tr>
<th>MACS6005: COMPUTATIONAL MATHEMATICS WITH SAGE MATH</th>
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<td>(2 Credits - 30 Lectures)</td>
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<td>COURSE OUTCOMES</td>
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<tr>
<td>1. Learn and understand the basic Python</td>
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<td>programming language. (Understanding)</td>
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<td>2. Understand how to use Sagemath software</td>
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<td>and its applications. (Understanding)</td>
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<tr>
<td>3. Solve problems in Calculus, Applied Linear</td>
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<tr>
<td>Algebra, Numerical Method and differential</td>
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<tr>
<td>equations using Sagemath. (Evaluating)</td>
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<td>Module I (10 lectures)</td>
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<tr>
<td>Installation of Python; Getting Started with</td>
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<tr>
<td>Python Python as an advanced calculator; For</td>
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<td>loop in Python; While loop in Python; Use of</td>
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<td>SciPy and SymPy in Python; Classes in Python -</td>
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<td>Part 01; Classes in Python - Part 02;</td>
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<td>Module II (12 lectures)</td>
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<tr>
<td>Solving Equations in Sagemath; 2d Plotting with</td>
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<td>SageMath; 3d Plotting with SageMath; Calculus of</td>
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<td>one variable with Sagemath, Integration with</td>
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<td>SageMath; Improper Integral using Sagemath;</td>
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<td>working with vectors in sagemath; Solving</td>
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<td>systems of linear equation in sagemath, vector</td>
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<td>space in sagemath, Matrix Spaces with Sagemath;</td>
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<td>Linear Transformations with Sagemath, eigenvectors</td>
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<td>Module III (8 lectures)</td>
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<td>Finding Roots of algebraic and transcendental</td>
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<td>equations in Sagemath; Numerical solutions of</td>
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<td>linear equations and numerical integration with</td>
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<td>sagemath; Solving 1st and 2nd order ODE with</td>
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<td>Sagemath; Euler’s Method to solve 1st order ODE</td>
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<td>with Sagemath.</td>
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<tr>
<td>1. Computational Mathematics with Sagemath,</td>
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<td>Paul Zimmermann, Siam</td>
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<td>2. Mathematical Computational with Sagemath,</td>
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<td>Paul Zimmermann Alexandre Casamayou Nathann</td>
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<td>Cohen Guillaume Connan Thierry Dumont</td>
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<td>3. An introduction to Sage Programming: With</td>
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<td>applications to SAGE Interacts for Numerical</td>
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<td>methods, Razvan A Mezei, Springer</td>
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| MACS6101: CALCULUS LAB |
COURSE OUTCOMES
1. Recall the expansion of mathematical functions to solve complex equations with the help of software. (Remembering)
2. Classify Initial Value Problems (IVPs) and Boundary Value Problems (BVPs) and representing them through graphical representation. (Understanding)
3. Apply software tools to solve second order complex PDEs. (Applying)
4. Analyse accuracy of analytical solution by software tools. (Analysing)
5. Evaluate solution of curve and verifying them graphically using software tools. (Evaluating)

LIST OF EXPERIMENTS (USING MATHEMATICA/MATLAB SOFTWARE)
1. Plotting of Graphs of functions $e^{ax+b}$, $\log(ax+b)$, $\frac{1}{(ax+b)}$, $\sin(ax+b)$, $\cos(ax+b)$, $ax+b$, and to illustrate the effect of $a$ and $b$ on the graph.
2. Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.
3. Sketching parametric curves (E.g., Trochoid, cycloid, epicycloids, hypocycloid)
4. Obtaining surface of revolution of curves.
5. Tracing of conics in cartesian coordinates/polar coordinates.
6. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.
7. Matrix operation (addition, multiplication, inverse, transpose).

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MADQ6102: DIFFERENTIAL EQUATIONS LAB

(0-0-2)

COURSE OUTCOMES
1. Recall Differential Formulae using inbuilt software tools. (Remembering)
2. Classify Initial Value Problems (IVPs) and Boundary Value Problems (BVPs) and representing them through graphical representation. (Understanding)
3. Apply software tools to solve nth order ODEs and PDEs. (Applying)
4. Analyse accuracy of analytical solution by software tools. (Analysing)
5. Evaluate solution of curve and verifying them graphically using software tools. (Evaluating)

LIST OF EXPERIMENTS (USING MATHEMATICA/MATLAB SOFTWARE)
1. Plotting of second order solution family of differential equation.
2. Plotting of third order solution family of differential equation.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Lake pollution model (with constant/seasonal flow and pollution concentration).
6. Case of single cold pill and a course of cold pills.
7. Limited growth of population (with and without harvesting).
8. Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator).
10. Battle model (basic battle model, jungle warfare, long range weapons).
12. Study the convergence of sequences through plotting.
13. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequence from the plot.
14. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
15. Cauchy’s root test by plotting nth roots.
16. Ratio test by plotting the ratio of nth and (n+1)th term.

Mapping of COs to Syllabus

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MANM6103: NUMERICAL METHODS LAB
(0-0-2)

COURSE OUTCOMES
1. Recall Numerical Formulae using Inbuilt software tools. (Remembering)
2. Mapping of theoretical concepts and practical applications. (Understanding)
3. Apply software tools to solve problems using inbuilt numerical methods. (Applying)
4. Analyse accuracy of numerical solution by software tools. (Analysing)
5. Evaluate numerical solution of curve using numerical methods and verifying them graphically using software tools. (Evaluating)

LIST OF EXPERIMENTS (USING MATHEMATICA/MATLAB SOFTWARE)
1. Calculate the sum $1/1 + 1/2 + 1/3 + 1/4 + \cdots + 1/N$.
2. To find the absolute value of an integer.
3. Enter 100 integers into an array and sort them in an ascending order.
7. Regula Falsi Method.
8. LU Decomposition Method.
10. SOR method or Gauss Seidel Method.
11. Lagrange Interpolation or Newton Interpolation.
12. Simpson’s rule.

Mapping of COs to Syllabus

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MAPE6104: PDE AND SYSTEMS OF ODE LAB
(0-0-2)

COURSE OUTCOMES
1. Recall Partial and Ordinary Differential Formulae using mathematical software tools. (Remembering)
2. Classifying various initial value and boundary value points and representing them through graphical representation. (Understanding)
3. Apply software tools to solve higher order ODEs and PDEs. (Applying)
4. Analyse complex differential equations using the software tools. (Analysing)
5. Evaluate complex functions within a short span of time. (Evaluating)

LIST OF EXPERIMENTS (USING MATHEMATICA/MATLAB SOFTWARE)
1. Solution of Cauchy problem for first order PDE.
2. Finding the characteristics for the first order PDE.
3. Plot the integral surfaces of a given first order PDE with initial data.
4. Solution of wave equation \( \frac{\partial^2 u}{\partial t^2} + \frac{\partial^2 u}{\partial x^2} = 0 \) for the following associated conditions
a. \( u(x,0) = \phi(x), \ u_1(x,0) = \psi(x), \ x \in \mathbb{R}, \ t > 0. \)

b. \( u(x,0) = \phi(x), \ u_1(x,0) = \psi(x), \ u(0,t) = 0, \ x \in (0,\infty), \ t > 0. \)

c. \( u(x,0) = \phi(x), \ u_1(x,0) = \psi(x), \ u_x(0,t) = 0, \ x \in (0,\infty), \ t > 0. \)

d. \( u(x,0) = \phi(x), \ u_1(x,0) = \psi(x), \ u_{x}(0,t) = 0, \ u(l,t) = 0, \ 0 < x < l, \ t > 0. \)

**Mapping of COs to Syllabus**

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DEPARTMENT OF PHYSICS

VISION:
To endow the students with profound understanding of physics, the foundation for all natural sciences, and drive them towards critical thought for further study and research, to pave the way for suitable career opportunities and enable them to be of service to the society as responsible human beings.

MISSION:
- To strengthen the fundamental concepts of physics and provide advanced understanding of physical phenomena by emphasizing on the correlation between theory and observation.
- To spark creative interest towards the pursuit of innovative research in fundamental and applied physics.

PROGRAM OUTCOMES – BSC PROGRAMME

PO 1: **Disciplinary Knowledge**: Capable of demonstrating comprehensive knowledge and understanding of one or more other disciplines that form a part of an undergraduate programme of study.

PO 2: **Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives. Critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO 3: **Communication Skills**: Ability to express thoughts and ideas effectively in writing and orally; communicate with others using appropriate media; confidently share one’s views and express herself/himself; demonstrate the ability to listen carefully; and present complex information in a clear and concise manner to different groups.

PO 4: **Social Interaction**: Ability to work effectively and respectfully with diverse teams; facilitate cooperative coordinated effort on the part of a group and act together as a group or a team in the interests of a common cause. Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO 5: **Effective Citizenship**: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO 6: **Moral and Ethical Awareness**: Ability to embrace moral/ethical values in conducting one’s life, possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

PO 7: **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

PO 8: **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technical changes. Critical sensibility to lived experiences, with self-awareness and reflexivity of both and society.

PO 9: **Information and Digital Literacy**: Capability to use ICT in a variety of learning situations. Demonstrate ability to access, evaluate and use a variety of relevant information sources; and use appropriate software for analysis of data.

PO 10: Research-related skills: A sense of inquiry and capability for asking relevant/ appropriate questions, problematizing, synthesizing and articulating; Ability to recognize cause- and- effect relationships, define problems, formulate hypotheses, interpret and draw conclusions from data, ability to plan, execute and report the results of an experiment or investigation. Ability to apply one’s learning to real life situations.

PROGRAMME SPECIFIC OUTCOMES-BSC PHYSICS (HONOURS)

PSO 1: **Understand the core theoretical concept of physics**: Understand the core theoretical principles of physics.

PSO 2: **Acquire analytical and logical skill for higher Education**: Acquire the ability to analyse critical problems logically.

PSO 3: **Excel in experimental physics and learn good laboratory practices and safety**: Learn to handle experiments perfectly and safely.

PSO 4: **Trained to take up jobs in allied fields**: Use the knowledge of physics to seek opportunities in other allied fields.

COURSES OFFERED IN BSC PHYSICS (HONOURS)

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### BSC PHYSICS (HONOURS) MAPPING OF COURSES WITH POS/PSOS

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### 3.3 Digital Systems and Applications
### 3.4 Mathematical Physics II Laboratory
### 3.5 Thermal Physics Laboratory
### 3.6 Digital Systems and Applications Laboratory
### 3.7 Computational Physics Skills
### 3.8 Electrical circuits and Network Skills
### 3.9 Elements of Service Learning in Physics
### 3.10 Generic Elective III
### 3.11 Value Added Course
### 4.1 Mathematical Physics III
### 4.2 Elements of Modern Physics
### 4.3 Analog Systems and Applications
### 4.4 Mathematical Physics III Laboratory
### 4.5 Elements of Modern Physics Laboratory
### 4.6 Analog Systems and Applications Laboratory
### 4.7 Basic Instrumentation Skills
### 4.8 Radiation Safety
### 4.9 Generic Elective IV
### 5.1 Quantum Mechanics and Applications
### 5.2 Solid State Physics
### 5.3 Quantum Mechanics and Applications Laboratory

### 5.4 Solid State Physics Laboratory
### 5.5 Embedded systems- Introduction to Microcontroller
### 5.6 Embedded systems- Introduction to Microcontroller Laboratory
### 5.7 Physics of Devices and Instruments
### 5.8 Physics of Devices and Instruments Laboratory
### 5.9 Classical Dynamics
### 5.10 Communication Electronics
### 5.11 Communication Electronics Laboratory
### 5.12 Value Added Course
### 6.1 Electromagnetic Theory
### 6.2 Statistical Mechanics
### 6.3 Electromagnetic Theory Laboratory
### 6.4 Statistical Mechanics Laboratory
### 6.5 Nuclear and Particle Physics
### 6.6 Nano Materials and Applications
### 6.7 Nano Materials and Applications Laboratory
### 6.8 Digital Signal Processing
### 6.9 Digital Signal Processing Laboratory
### 6.10 Astronomy and Astrophysics
PROGRAM OUTCOMES – MSC PROGRAMME

PO 1: **Critical Thinking**: Inculcate critical thinking to carry out scientific investigation objectively. Formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. Critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.

PO 2: **Knowledge Skill**: Equip the student with skills to analyse problems, formulate an hypothesis, evaluate and validate results, and draw reasonable conclusions thereof. Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge.

PO 3: **Scientific Communication Skills**: Imbibe effective scientific and/or technical communication in both oral and written, Ability to show the importance of the subject as precursor to various scientific developments since the beginning of the civilization.

PO 4: **Ethics**: Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in the subject concerned. Ability to identify unethical behaviour such as fabrication, falsification or misrepresentation of data and adoptive objective, unbiased and truthful actions in all aspects.

PO 5: **Enlightened Citizenship**: Create awareness to become an enlightened citizen with commitment to deliver one’s responsibilities within the scope of bestowed rights and privileges.

PO 6: **Analytical Reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyse and synthesise data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.

PO 7: **Multicultural Competence**: Development of a set of competencies in order to enhance and promote the growth of multicultural sensitivity within universities. Integrating multicultural awareness such as race, gender, physical ability, age, income and other social variables, and by creating an environment that is “welcoming for all students”.

PO 8: **Lifelong Learning**: Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning throughout life, through self-paced and self-directed learning aimed at personal development, and adapting to changing academic demands of work place through knowledge/skill development/reskilling.

PO 9: **Leadership Qualities**: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination in a smooth and efficient way.

PO 10: **Research Skills**: Prepare students for pursuing research or careers in industry in concerned subject and allied fields. Capability to use appropriate software to solve various problems and to apply programming concepts of C++ and Mathematica/Matlab to various scientific investigations, problem solving and interpretation.

PROGRAMME SPECIFIC OUTCOMES FOR MSC PHYSICS

PSO 1: **Understand the advanced theoretical concept of physics**: Understand the advanced theoretical principles of physics.

PSO 2: **Acquire analytical and logical skill for research**: Acquire the ability to analyse critical research oriented problems logically.

PSO 3: **Expertise in experimental physics and learn to use sophisticated instruments safely**: Learn to handle sophisticated experiments perfectly and safely.
## COURSES OFFERED IN MSC PHYSICS

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### MSC Physics - Mapping of Courses to PO/PSO

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DEPARTMENT OF PHYSICS

DETAILED SYLLABUS
THEORY COURSES

PSCM0020: CLASSICAL MECHANICS
(4-0-0)

COURSE OUTCOMES
1. Explain Hamilton’s and Lagrange’s equations and use them for solving problems in physics. (Understanding)
2. Build the concepts of Canonical transformation. (Creating)
3. Explain the motion of rigid body and visualise the Euler rotations. (Understanding)
4. Solve rigid body problems. (Applying)
5. Develop the theory of special relativity in terms of four vector notation. (Creating)

Module I: (12 lectures)
Hamilton’s variational principle; derivation of Lagrange’s equations; velocity dependent forces; dissipation. Charged particles in an electromagnetic field. Space time symmetries and conservation Laws. Variational theorem. Space transformation.

Module II: (12 lectures)

Module III: (12 lectures)
Rigid body motion: fixed and moving coordinate systems; orthogonal transformations. Euler angles; angular momentum; rotational kinetic energy. Principal axes transformation; Euler equations; force free motion of a rigid body symmetric top.

Module IV: (12 lectures)

Module V: (12 lectures)

Suggested Readings

Mapping of COs to Syllabus

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<tr>
<th>Course Outcomes</th>
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PSQM0021: QUANTUM MECHANICS I
(4-0-0)

COURSE OUTCOMES
1. Conceptualise different interpretations of quantum mechanics. (Understanding)
2. Apply the concepts of quantum mechanics to different problems in physics. (Applying)
3. Make use of variational method and WKB approximation. (Applying)
4. Inspect how to encounter spin. (Analysing)
5. Comprehend the idea of symmetry in quantum mechanics. (Analysing)

Module I: (10 lectures)
Introduction and revision: inadequacy of classical mechanics; basic postulates of quantum mechanics; ensemble and Copenhagen
interpretation. Schrödinger equation; continuity equation; Ehrenfest theorem; admissible wave functions; stationary states. One dimensional problems; potential well and barriers; harmonic oscillator.

Module II: (10 lectures)
Equation of motion: Schrödinger, Heisenberg and Dirac representations; equation of motion in the respective representations. Application to linear harmonic oscillator.

Module III: (10 lectures)
Three dimensional problems: Separation of variables; orbital angular momentum; spherical harmonics. Harmonic oscillator in Cartesian and polar coordinates. A free particle and a particle in 3-D box in Cartesian and polar coordinates, Coulomb problem in spherical and parabolic coordinates - regular and irregular solutions.

Module IV: (11 lectures)

Module V: (8 lectures)

Module VI: (11 lectures)
Variational methods for bound states; lower and upper limits in simple cases. WKB approximation; connection with classical limits, validity of WKB approximation. Connection formulae; application to bound states, tunneling in one dimension. Application to radial Schrödinger equation.

Suggested Readings
1. Quantum Mechanics, E. Merzbacher, John Wiley.
2. Quantum Mechanics, G. Ahrudhas, Prentice Hall.
3. Quantum Mechanics, L. I. Schiff, McGraw Hill.
6. Principles of Non-Relativistics and Relativistic Quantum Mechanics, K. D. Krori, PHI.
8. Quantum Mechanics, Albert Messiah, Dover Publications.

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PSQM0024: QUANTUM MECHANICS II
(4-0-0)

COURSE OUTCOMES
1. Explain relativistic quantum mechanics. (Understanding)
2. Interpret path integral approach to quantum mechanics. (Understanding)
3. Apply the concept of quantum mechanics to the problems of scattering. (Applying)
4. Build concept about perturbation theory. (Applying)
5. Develop concepts on advanced topics like Hartree- Fock equation. (Applying)

Module I: (11 lectures)
Stationary perturbation theory: Non Degenerate case; first and second order of energy and wave functions, perturbation of one dimensional harmonic oscillator by potentials of the bx^2 and cx^3. Degenerate case; first order Stark effect in hydrogen; Zeeman effect without electron spin.

Module II: (9 lectures)
Time dependent perturbation theory; first order transition probabilities; constant perturbation. Transition to continuum; Harmonic perturbation; Fermi’s golden rule; Sudden and adiabatic approximations.

Module III: (10 lectures)
Many Electron Atoms: Indistinguishable particles; Pauli’s Principle; inclusion of spin; spin functions for two and three electrons; the Helium atom; central field approximation, Thomas-Fermi model of the atom; Hartree equation, Hartree- Fock equation.

Module IV: (13 lectures)
Scattering theory: asymptotic behaviour of scattering wave function; relation to cross sections, Green’s function for scattering problem; Green’s function with different boundary conditions; scattering integral equations; Born approximation and its validity criteria; scattering by screened Coulomb potential; Born series. Partial waves and phase shifts. Scattering amplitude; optical theorem; low energy scattering. Effective range; scattering length; resonance.

Module V: (12lectures)

Module VI: (5 lectures)

Suggested Readings
1. Quantum Mechanics, E. Merzbacher, John Wiley.
2. Quantum Mechanics, G. Aruldas, Prentice Hall.
3. Quantum Mechanics, L. I. Schiff, McGraw Hill.
7. Principles of Non-Relativistics and Relativistic Quantum Mechanics, K. D. Krort, PHI.

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PSCP0025: CONDENSED MATTER PHYSICS
(4-0-0)

COURSE OUTCOMES
1. Explain about crystal structure in details. (Understanding)
2. Illustrate physics of phonons. (Understanding)
3. Identify free electron and nearly free electron models. (Applying)
4. Discuss about advanced topics like plasmons, polaritons, polarons, etc. (Creating)

Module I: (11lectures)

Module II: (9 lectures)
Phonons: quantisation of lattice vibrations, dispersion relation for acoustic and optical phonon, energy gap, density of states, heat capacity, thermal conductivity and thermal expansion.

Module III: (8 lectures)
Free electron Fermi gas: Fermi energy, density of states, heat capacity, thermal conductivity and electrical conductivity. Wiedemann-Franz law.

Module IV: (10 lectures)
Nearly free electron gas: Schrodinger equation of an electron in a periodic potential, Bloch theorem, energy gaps at the zone boundary, approximation solution near a zone boundary, energy bands and their role in properties of metals, insulators and semiconductors. Holes on energy bands. Hall effect.

Module V: (12 lectures)
Shape of fermi surfaces in the free electron and nearly free electron models. Tight binding approximations. Electron orbits, hole orbits and open orbits. Quantization of orbits in a magnetic field. De Hass-van Alphen effect and its role in experimental determination of Fermi surfaces.

**Module VI: (10 lectures)**
Plasmons, polaritons and polarons: dielectric functions of the electron gas, plasmons, electrostatic screening, Mott metal-insulator transition, polaritons, polarons. Peierls instability of linear metals.

**Suggested Readings**
1. Introduction to Solid State Physics, C. Kittel, John Wiley and Sons, Inc.
2. Quantum Theory of Solids, C. Kittel, John Wiley and Sons, Inc.

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**PSED0026: ELECTRODYNAMICS**

(4-0-0)

**COURSE OUTCOMES**
1. Explain various phenomena from the standpoint of electrodynamics. (Remembering)
2. Outline the origin and propagation of electromagnetic waves. (Understanding)
3. Explain the nature of electromagnetic radiation. (Understanding)
4. Infer the extension of classical electrodynamics to the generalized 4-dimensional case. (Analysing)
5. Apply the laws of electrodynamics to solve various physical problems. (Applying)

**Module I: (7 lectures)**
Maxwell’s equations: review of Maxwell’s equations; boundary conditions at interface between different media; Poisson’s and Laplace’s equations

**Module II: (8 lectures)**
Electromagnetic waves: linear and circular polarisation; Stoke’s parameters; Poynting theorem of complex field vectors; frequency dispersion (normal and anomalous); characteristics of dielectrics, conductors and plasma and their interaction with electromagnetic waves.

**Module III: (10 lectures)**
- Simple radiating systems: Gauge invariance; Green’s function for the wave equation; concept of retarded potential, radiation from an oscillating dipole and its polarisation. Electric dipole fields, magnetic dipole and electric quadrupole fields; centre fed linear antenna, scattering at long wavelengths – viz. by dipoles induced in a small scatterer, scattering by a small dielectric sphere.
- Diffraction: Scalar diffraction theory; vectorial diffraction theory, Scattering in a short wavelength limit.
- Guided waves: waveguides, TE waves in a rectangular waveguide, coaxial transmission lines.

**Module IV: (15 lectures)**
Radiation from accelerated charge: Lienard-Wiechart potentials; radiated power from accelerated charge at low velocities. Larmor’s power formula. The fields of a point charge in arbitrary and uniform motion. Radiation from an ultra relativistic particle. Angular and frequency distribution of radiation from moving charges.

**Module V: (12 lectures)**
Special theory of relativity: matrix representation of Lorentz transformation; infinitesimal generators; Thomas precession; invariance of electric charge; covariance of electrodynamics; transformation of electromagnetic fields

**Suggested Readings**
4. Introduction to Electrodynamics, D. J. Griffiths, Prentice Hall of India.

**Mapping of COs to Syllabus**
PSAM0028: ATOMIC AND MOLECULAR PHYSICS  
(4-0-0)

COURSE OUTCOMES
1. Explain atomic and molecular spectroscopy in details. (Understanding)
2. Understand interaction of radiation with atoms. (Understanding)
3. Analyse bond formation. (Analysing)
4. Apply the concept of symmetry to molecules. (Applying)

Module I: (15 lectures)
Introduction of atomic spectrum; fine structure and hyperfine structure of energy levels. Angular momentum and magnetic moment. Doublet structure energy levels and single electron atom. Term symbols and fine structure of energy levels of two electron atoms using L-S coupling and j-j coupling schemes; identification of ground state. Interaction of nuclear and electronic magnetic moments and hyperfine structure with examples.

Module II: (10 lectures)
Interaction of radiation with atoms; spontaneous and stimulated emission; absorption; transition. Einstein’s A and B coefficients. Working principles of He-Ne laser.

Module III: (12 lectures)
Theories of molecular bond formation; van der Waals bonding, ionic bonding, valence bond and molecular orbital models of covalent bonding. Homonuclear diatomic molecules and the term symbols and their ground states.

Module IV: (8 lectures)
Vibronic states of molecules and nature of vibronic spectra; harmonic and anharmonic vibrations and potential constants; rotational spectrum and moment of inertia of molecules.

Module V: (15 lectures)
Symmetry of molecules; symmetry elements and points group; proper and improper rotations and their matrix representation. Introduction to character table of point group; reducible and irreducible representation for simple molecules such as H_2O, NH_3, etc. Normal coordinates and normal modes of vibrations. Infrared absorption and Raman scattering form molecular vibrations and rotations, and selection rules.

Suggested Readings
1. Introduction to Atomic Spectra, H. E. White, Mc-Graw Hill.

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PSCN0030: COMPUTER ORIENTED NUMERICAL METHODS  
(2-0-0)

COURSE OUTCOMES
1. Explain the concept of numerical methods. (Understanding)
2. Apply numerical techniques to solve different problems in Physics. (Applying)
3. Understand high level language through Fortran. (Understanding)

Module I: Numerical Analysis (10 lectures)
a. Introduction to numerical methods: approximate and significant figures, absolute and relative errors, general formula for errors, application of the error formula to the fundamental operations of arithmetic and to logarithms. The error of a sum, the error of a difference, the error of a product and number of correct digits, the error of quotients and number of correct digits, the relative error of a power, the relative error of a root, successive approximation, Taylor’s series, principle of least square, law of error of residuals.

b. Matrices and linear equations: addition, subtraction and multiplication of matrices, inversion of matrices, Jacobi transformation of a symmetric matrix, determinant of a matrix, transpose of a matrix, solution of equations by matrix method, Gauss-Jordan elimination Method, eigenvalues and eigenvectors.

c. The solution of numerical, algebraic and transcendental equations: Equations in one unknown: Finding approximate values of the roots, finding roots by repeated application of location theorem, bisection method, the Newton-Raphson method; their convergence and geometric significance.

Module II: Solutions of Ordinary Differential Equations (9 lectures)

a. Equations of the first order: Euler’s method and its modification, the Runge-Kutta method, checks, errors and accuracy.

b. Equations of the second order and systems of simultaneous equations: Milne’s-predictor and corrector methods, boundary value problems, conditions for convergence.

c. Minimization or maximization of functions: golden selection search in 1-D, parabolic interpolation and Brent’s method in 1-D, 1-D search with 1 derivatives, Downhill simplex method in multidimensions, Direction set (Powell’s method in Multidimensions).

Module III: (5 lectures)


b. Computation of factorials, computation of square roots, recurrence relations.

c. Conditional and looping structures, arrays, subprograms and subroutines.

d. File operations.

Suggested Readings


b. FORTRAN 77 and numerical methods, C. Xavier and R. Rajaraman, New Age International Publishers

c. FORTRAN 77 Programming, V. Rajaraman, Prentice Hall of India.


h. Introduction to Numerical Analysis, F. B. Hildebrand, McGraw-Hill Book Company Inc.

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PSSM0034: STATISTICAL MECHANICS

(4-0-0)

COURSE OUTCOMES

1. Appreciate the connection between statistical mechanics and thermodynamics. (Analysing)

2. Conceptualise quantum statistical mechanics. (Understanding)

3. Understand the physics of phase transition. (Understanding)

4. Understand non-equilibrium physics. (Understanding)

Module I: Essentials (17 lectures)


b. Classical equilibrium statistical mechanics: concept of equilibrium; Ergodic hypothesis; microcanonical, canonical and grand canonical Ensembles; partition functions and their relation to thermodynamics.

c. Classical nonequilibrium statistical mechanics: approach to equilibrium, Liouville’s theorem, Boltzmann’s H theorem
Module II: Quantum Statistics (15 lectures)
a. Quantum statistical mechanics: Schrödinger and Heisenberg Picture; pure and mixed states, the density matrix, quantum mechanical Liouville’s theorem; the fundamental postulates.
b. Quantum statistics: quantum gases of independent particles; partition functions; Bose Einstein’s and Fermi Dirac’s distributions; electrons in metals; black body radiation; Bose Einstein’s Condensation

Module III: Phase Transitions (15 lectures)
a. Phenomenology: first and second order phase transitions; elementary ideas of critical phenomena; universality of critical exponents; scaling of thermodynamic functions.

Module IV: Non Equilibrium Phenomena and Irreversible Processes (13 lectures)
a. Non equilibrium phenomena: transport theory; Boltzmann equation; Maxwell-Boltzmann distribution.
b. Irreversible processes: fluctuations; Brownian motion; Langevin’s equation; Wiener Khintchine relations, Nyquist theorem, fluctuation-Dissipation theorem; Fokker Planck equation.

Suggested Readings
1. Fundamental of Statistical and Thermal Physics, Federick Reif, McGraw Hill, Singapore.

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PSPL0036: PLASMA PHYSICS I
(4-0-0)

COURSE OUTCOMES
1. Understand and explain the basic theoretical concepts of plasma physics. (Remembering)
2. Understand the behaviour of a single charged particle in electric and magnetic fields. (Understanding)
3. Understand the purpose, principles and techniques of various plasma diagnostic. (Application)
4. Understand the underlying principles of some laboratory and naturally occurring plasma. (Analysing)
5. Know various applications of plasma. (Analysing)

Module I: Introduction to Plasma Physics (12 lectures)
Role of temperature in occurrence of plasma; definition of plasma: quasineutrality and collective behaviour of plasma; concept of temperature; Debye shielding; criteria for plasma; classification of plasma; occurrence of plasma in nature.

Module II: Single Particle Motion (12 lectures)
Uniform electric and magnetic fields; non-uniform magnetic field: grad-B drift, curvature drift, magnetic mirrors, the loss cone; non-uniform electric field; time-varying electric field; time- varying magnetic field; adiabatic invariants.

Module III: Plasma Diagnostics (14 lectures)
Langmuir probe: I-V characteristics, measurement of plasma potential, floating potential, electron temperature and electron density; double probe; optical emission spectroscopy: radiation from plasma, plasma models, temperature measurement by Boltzmann plot and line intensity ratio method, line broadening in plasma, Doppler broadening and stark broadening, applications; absorption spectroscopy; calorimetric methods; laser and microwave interferometer.

Module IV: Laboratory and Space Plasma (10 lectures)
Glow discharge plasma; production and stabilization of thermal plasma, principle of DC, AC and high frequency discharges, RF and ECR plasmas, dielectric barrier discharge plasma, laser produced plasmas; sun and solar winds, Van Allen belts, the ionosphere, formation of, accretion disks, dusty plasmas.
Module V: Applications of Plasma (12 lectures)
Thermal plasma: nanoparticle synthesis, plasma spraying, waste management; plasma sputtering; plasma nitriding; plasma processing; plasma enhanced vapour deposition; plasma assisted surface engineering; biomedical applications; the magneto-hydrodynamic generator; plasma propulsion.

Suggested Readings
1. Introduction to Plasma Physics and Controlled Fusion, F. F. Chen, Plenum.

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PSEC0037: ELECTRONICS II
(4-0-0)

COURSE OUTCOMES
1. Know about different types of transistors. (Understanding)
2. Understand the application of transistors for circuit design. (Application)
3. Utilize Describe devices like thyristors, operational amplifiers, oscillators, etc. (Analysing)
4. Understand the digital electronics design using analog devices. (Understanding)
5. Understanding the application of analog devices for electronic instruments and sensors (Application)

Module I: (20 lectures)
   a. Bipolar junction transistor: BJT biasing: fixed bias, emitter bias, voltage divider bias, D.C. collector feedback bias; DC and AC load line, Q-point, stability considerations. BJT modeling: two port representation of BJT with z, y, h- parameters; re and hybrid models of C-E, C-B, C-C configuration.
   b. Hybrid-pi model of C-E amplifier in voltage divider bias configuration, frequency response in low, mid and high frequency conditions, respective voltage gain, current gain, input and output impedances.
   c. Field effect transistors: FET biasing: self bias, fixed bias, voltage divider bias, stabilization of Q-point. Small signal AC equivalent circuit of FET as amplifier, hybrid parameters. JFET amplifiers: CS, CD amplifiers; enhancement mode MOSFET amplifier, depletion mode MOSFET amplifiers; Introduction to CMOS, characteristics, structure of MOSFET, CMOS.

Module II: (25 lectures)
   a. Thyristors: four layer diode, SCR, Photo SCR, gate controlled switch, silicon controlled switch, Diac, Triac, UJT;
   b. Op-Amp - ideal operational amplifiers: Input impedance. DC offset parameters, frequency parameters, gain- bandwidth, CMRR, SVRR, SR. Op-Amp applications in constant gain multiplier, voltage summing, log - antilog amplifier, subtractor, comparator – zero crossing detector, Schmitt trigger, integrator, differentiator and controlled sources. instrumentation amplifier. Active filters: low, high and bandpass filters; ADC and DAC.
   c. 555 timer: block diagram, monostable operation, astable operation, bistable operation, voltage controlled oscillator, ramp generator.

Module III: (15 lectures)
   b. Oscillators: introduction and classification, general form of LC oscillator, e.g. Hartley oscillator, Colpitts oscillator, RC phase shift oscillator, Wein Bridge oscillator, crystal oscillator.
   c. Regulated power supply: voltage feedback regulation, current limiting characteristics, power supply characteristics, 3 terminal IC regulators, current boosters, switching regulators.
   d. Characteristics of instruments: static characteristics, span, accuracy and precision, linearity, tolerance, error, repeatability, sensitivity, calibration, hysteresis, input impedance, resolution, bias and drift.

Suggested Readings
5. Electronic Devices and Circuits, David A. Bell, Prentice Hall of India.
7. Op-amps and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI.

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PSNS0041: NANOPHYSICS II
(4-0-0)

COURSE OUTCOMES
1. Explain different properties of nanomaterials. (Understanding)
2. Know about different methods for the synthesis of nanomaterials. (Applying)
3. Appreciate the technology associated with characterization of nanomaterials. (Applying)

Module I: (15 lectures)
Surfaces and interfaces in nanostructures; ceramic interfaces, superhydrophobic surfaces, grain boundaries in nanocrystalline materials, defects associated with interfaces; thermodynamics of nanomaterials, natural nanomaterials; toxicology of nanomaterials.

Module II: (25 lectures)
Chemical routes for synthesis of nanomaterials: electrochemical synthesis, photochemical synthesis; synthesis in supercritical fluids. hydrothermal growth of nanoparticles and different nanostructures. Ostwald ripening; zeta potential; fabrication of nanomaterials by physical methods: -inert gas condensation, arc discharge, plasma arc technique, RF plasma, MW plasma, ion sputtering, laser ablation, laser pyrolysis, ball milling, molecular beam epitaxy, physical and chemical vapour deposition method; electrodeposition. Core-shell quantum dots.

Module III: (20 lectures)
Nanostructures: zero-, one-, two- and three- dimensional structure, size control of metal nanoparticles; properties: optical, electronic, magnetic properties; surface plasmon resonance, structural characterization X-ray diffraction, small angle x-ray scattering, optical microscope and their description, scanning electron microscopy (SEM), scanning probe microscopy (SPM), TEM and EDAX, SAED analysis, scanning tunneling microscopy (STM), atomic force microscopy (AFM). Spectroscopic characterizations: basic concepts of spectroscopy, operational principle and application for analysis of nanomaterials, UV-VIS-IR spectrophotometers, principle of operation and application for band gap measurement (Taucplot).

Suggested Readings
3. Nanotechnology and Global Sustainability, D. Maclurcan and N. Radywyl (Eds.), CRC Press.
4. Fundamentals of Nanoelectronics, G. W. Hanson, Pearson.
5. Springer Handbook of Nanomaterials, R. Vajtai (Ed.), Springer.

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PSGR0044: GENERAL THEORY OF RELATIVITY AND COSMOLOGY
(4-0-0)
COURSE OUTCOMES
1. Relate the concepts from special theory of relativity with generalized tensor calculus. (Remembering)
2. Explain Einstein’s field equation from basic principles. (Understanding)
3. Illustrate the implications of the general theory of relativity. (Understanding)
4. Extend Einstein’s gravity to the cosmological scale. (Understanding)
5. Identify Newtonian gravity as a special case of general relativity. (Applying)

Module I: Theoretical Background of Relativity (15 lectures)

a. Foundations of relativity: postulates of relativity, GR units, space-time intervals, proper time; special Lorentz transformations in Minkowski space-time; four-vectors.

b. Review of tensor calculus in Euclidean space; tensor calculus in Riemannian space: generalized N-dimensional spaces, covariant and contravariant tensors; Riemann-Christoffel curvature tensor, Christoffel symbols, Einstein’s tensor, geodesics; metric tensor, covariant differentiation, Bianchi identities, Ricci tensor.

Module II: General Theory of Relativity (30 lectures)

a. Motion of a free particle in a gravitational field, equations of electrodynamics in the presence of a gravitational field; gravitational field equations – action for gravitational field, energy-momentum tensor, extremum principle, Einstein field equations, energy-momentum pseudotensor.

b. Field of gravitating bodies – Schwarzschild solution, Birkhoff’s theorem, motion in a centrally symmetric gravitational field, precession of perihelion of Mercury, deflection of light, gravitational lensing; black holes – Schwarzschild black holes, Kruskal space, black hole thermodynamics; gravitational waves – plane waves, weak field approximation, gravitational radiation, transverse-traceless gauge.

Module III: Fundamentals of Cosmology (15 lectures)

a. Cosmological principle, cosmological time; spaces of constant curvature, Hubble’s constant, Hubble’s Law, red-shift of galaxies, big bang, age and density of universe; cosmological constant Einstein space, de Sitter space, anti-de Sitter space; Robertson-Walker metric, introduction to Friedmann-Robertson-Walker (FRW) universe.

b. The observed universe and its dynamics, Friedmann-Lemaître-Robertson-Walker (FLRW) metric, Friedmann equation and its solutions; composition of the universe – origin of matter, big bang nucleosynthesis, abundance of light elements, dark matter and dark energy, cosmological constant as dark energy, origin of matter-antimatter asymmetry, baryogenesis.

Suggested Readings
1. Introduction to Tensor Calculus, Relativity and Cosmology, D. F. Lawden, Dover Publications.
3. Introduction to Cosmology, B. Ryden, Cambridge University Press.
13. Fundamentals of Special and General Relativity, K. D. Krori, PHI.

Mapping of COs to Syllabus

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PSAR0045: ASTROPHYSICS
(4-0-0)

COURSE OUTCOMES
1. Define and spell out fundamental concepts of Astronomy. (Remembering)
2. Outline the various parameters describing the behaviour of stars and their evolution. (Understanding)
3. Classify the various types of interstellar media. (Analysing)
4. Explain the physical processes underlying the energy generation in stars. (Understanding)
5. Apply astrophysical models to various observational scenarios. (Applying)

Module I: Fundamentals of Astronomy (12 lectures)
Astronomy fundamentals: celestial coordinate systems, telescope and its operational principles and mounting, atmospheric extinctions, magnitude systems. Radiation mechanism, flux density and luminosity, specific intensity, (emission/absorption coefficients, source functions), basics of radiative transfer and radiative processes.

Module II: Stellar Parameters (18 lectures)
Magnitudes, motions and distances of stars: absolute stellar magnitude and distance modulus, bolometric and radiometric magnitudes, colour-index and luminosities of stars, stellar positions and motions, velocity dispersion, statistical and moving cluster parallax, extinction, stellar temperature, effective temperature, brightness temperature, color temperature, kinetic temperature, excitation temperature, ionization temperature, spectral classification of stars, utility of stellar spectrum, stellar atmospheres. Binaries, variable stars, clusters, open and globular clusters, compact objects, shape, size and contents of our galaxy, normal and active galaxies.

Module III: Interstellar Medium (10 lectures)
Neutral and ionized gas, gaseous nebulae, HII regions, supernova remnants, photo-dissociation regions, different phases of the interstellar medium: cold neutral medium, warm neutral and ionized medium, hot medium, diffuse clouds, dense clouds.

Module IV: Stellar Physics (20 lectures)
Introduction to stars: HR diagram, a discussion on the variety of stellar phenomena, stellar structure, stellar opacities, stellar polytropes, energy generation in stars: calculation of thermonuclear reaction rates for non-resonant and beta-decay reactions, various reaction chains: pp-I, II, III, CNO, He-burning, C-burning, Si-burning, stellar degeneracy and equations of state: stellar degeneracy, Chandrasekhar mass, EoS of matter at near-nuclear and nuclear densities, final stages of stellar evolution: supernovae and neutron stars.

Suggested Readings
1. An Introduction to Astronomy and Astrophysics, P. Jain, CRC Press.

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PSPM0046: PLASMA PHYSICS II
(4-0-0)

COURSE OUTCOMES
1. Understand fluid and kinetic model of plasma and their uses in the study of plasma. (Understanding)
2. Explain the theory of various kinds of waves existing in plasma. (Understanding)
3. Explain the phenomenon of diffusion in plasma and its consequences. (Analysis)
4. Explain some basic instabilities and non linear phenomena in plasma. (Remembering)
5. Understand the principles and challenges involved in energy production by fusion. (Analysis)

Module I: Plasma as fluids and Plasma Kinetic Theory (20 lectures)
Introduction to fluid model; equation of motion; continuity equation; fluids drifts perpendicular to B; fluids drifts parallel to B; the plasma approximation; introduction to kinetic theory; equations of kinetic theory; derivation of the fluid equation; plasma oscillation; Landau damping; meaning and physical derivation.

Module II: Waves in Plasma (10 lectures)
Representation of waves; group velocity; plasma oscillation; electron plasma waves; sound waves; ion waves; validity of plasma approximation; ion acoustic waves; Alfvén waves.
Module III: Diffusion and Resistivity (10 lectures)
Diffusion and mobility; plasma decay by diffusion; steady state solution; recombination; diffusion across a magnetic field; the single MHD diffusion equation; solutions of the diffusion equation.

Module IV: Instability and Non-linear Effects (10 lectures)
Hydro-magnetic equilibrium; diffusion of magnetic field into a plasma; classifications of instability; two stream instability; plasma sheaths; ion acoustic shock waves; the ponderomotive force; parametric instabilities; plasma echoes; nonlinear Landau Damping.

Module V: Controlled Fusion (10 lectures)
Controlled fusion and problems; magnetic confinement: toruses, mirrors, pinches; laser fusion; plasma heating; fusion technology; tokamaks; ITER.

Suggested Readings
1. Introduction to Plasma Physics and Controlled Fusion, F. F. Chen, Plenum.

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PSER0047: ELECTRONICS III
(4-0-0)

COURSE OUTCOMES
1. Illustrate advanced topics of digital electronics. (Understanding)
2. Explain microprocessor, microcontroller and assembly language. (Understanding)
3. Apply the knowledge in advanced digital structures. (Applying)
4. Understand digital circuit design (Application)
5. Analyse the working of processor for execution of computer program (Analysing)

Module I: (15 lectures)

a. Number system: representation of signed integers, binary arithmetic on signed and unsigned integers and detection of overflow and underflow, weighted binary Codes: BCD, 2421, non-weighted codes: excess-3 codes, gray codes, error detecting codes, error correcting codes, alphanumeric codes: ASCII code, EBCDIC codes.

b. Boolean algebra and logic gates: rules (postulates and basic theorems) of Boolean algebra, dual and complement of Boolean expression, sum of products and product of sums forms. canonical forms. Conversion between different networks, conversion between Boolean expression and truth table; implementing logic expressions with logic gates (logic circuits).

c. Digital logic families: designing of basic logic gates with diode and transistor; elementary idea of DTL, TTL, RTL, ECL, I2L logic family and characteristics.

Module II: (15 lectures)

a. Combinational circuit: Simplification of Boolean expressions using algebraic method, Karnaugh map method and Quine-McCluskey method, Don’t Care conditions. Multiplexer, demultiplexer, encoder, decoder, half-adder, full-adder, magnitude comparator, parity checkers: basic concepts, design of parity checkers, parity generation, code converters, binary –to– gray and gray-to-binary Code converter; concept of magnitude comparator.


c. Semiconductor memory: classification of memories, main memory and secondary memory, sequential access memory, static and dynamic memory, volatile and nonvolatile memory, concept of ROM, PROM, EPROM, RAM, DRAM, SDRAM, PSRAM, memory decoding.

Module III: (30 lectures)

a. History and evolution of microprocessor; introduction to CPU: components of CPU, block diagram, buses-data, control and address; ALU, control unit; main memory and secondary memory; I/O devices; memory addressing; memory mapped I/O and I/O mapped I/O; address decoding; memory and I/O interfacing.
b. Introduction to 8085; block diagram, registers, use of register pairs, PSW, accumulator; addressing modes; Instruction set of 8085: data transfer, arithmetic, logic, branch and machine control instructions; instruction cycle: fetch, decode and execute. Delay and counter; stack and its application; interrupt and its application; assembly level language programming of 8085.

c. Interfacing: Memory interfacing; I/O interfacing; interfacing small devices like keyboard, 7-segment display, relay, event counter etc.; idea of PPIs like 8251, 8255, 8257 and 8279 (block diagram and function only); serial communication standard (RS-232C).

d. Example of 16-bit processors (introduction to 8086); microcontroller (block diagram and application of 8051).

Suggested Readings

a. Digital Logic and computer Design, M. Mano, PHI.

b. Modern Digital Electronics, R. P. Jain, TMGH.

c. Digital Fundamentals, Jain and Floyd, Pearson Education.

d. Digital Electronics, Malvino and Leach, Pearson Education.

e. Digital Computer Electronics, Malvino, TMGH.


i. Fundamentals of Digital Circuits, Anand Kumar, PHI.

j. Introduction to Microprocessors, Gaonkar, New age Publication.

k. Fundamentals of Microprocessor, B. Ram, Dhanpat Rai.

l. 8085 Microprocessor Programming and Interfacing, N. K. Srinath, PHI.

m. Microprocessor Based Design, Slater, PHI.


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PSNY0048: NANOPHYSICS III

(4-0-0)

COURSE OUTCOMES

1. Explain properties of nanomaterials in detail. (Understanding)

2. Explain quantum effects on nanostructures. (Understanding)

3. Give outline nanomechanics. (Understanding)

4. Take part in higher studies and research in nanophysics. (Analysing)

Module I: (15 lectures)
Absorption and scattering of EM waves from nanoparticles based on bulk properties. Electronic phenomena in nanostructures: electronic structures and effective mass theory for bulk Si, Ge, GaAs; excitons. Boltzmann electron transport in bulk. Electron energy states in quantum confined systems, semiconductor heterojunctions.

Module II: (20 lectures)


b. Extracted: band structure, occupied band states of clean solid surfaces as well as bonding orbital states of adsorbed molecules; fundamentals of Fourier transform infrared radiation (FTIR) and Raman spectroscopy.


Module III: (15 lectures)
Single electron phenomena: electronic states in quantum dots, without and with magnetic fields, single electron tunneling and Coulomb blockade, single electron tunneling, elastic, inelastic, spin polarized tunneling, surface density of states for different dimensions, role of tip geometry, lithography and atomic manipulation; single electron transistor. Spin-orbit interaction and spin effects.

Module IV: (10 lectures)
Nanomechanics: introduction to NEMS, CNT oscillation, nanoscale electrometer, bolometer nanophotonics; science of Graphene.
Suggested Readings

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PSEL0049: ELECTRONICS I
(4-0-0)

COURSE OUTCOMES
1. Explain about passive components and DC networks, digital electronics (Understanding)
2. Understanding physics of electronic devices and circuits (Understanding)
3. Explain electronic communication. (Understanding)
4. Experiment with electronic devices and circuits. (Applying)

Module I: Passive Components and DC Networks (15 lectures)
- Passive components: resistors, capacitors and inductors-types, characteristics and applications;
- DC networks: voltage and current sources, dependent sources, KCL, KVL, current division rule, voltage division rule, Y- Delta conversion, mesh analysis, node analysis, Thevenin’s theorem, Norton’s theorem, superposition theorem, maximum power transform theorem.

Module II: Electronic Devices and Circuits (20 lectures)
- Semiconductor concepts: semiconductor material, intrinsic semiconductor, extrinsic semiconductor, energy levels, concept of hole and electron, mobility, conductivity, n-type and p-type, majority and minority carriers, mechanism of current flow.
- Semiconductor diode: PN junction and various biasing conditions, V-I characteristics, diode equation, diode resistance, equivalent circuit, transition capacitance and diffusion capacitance; rectifier circuit with filter, clipper, clamper, voltage multiplier.
- Special purpose diodes: Zener diodes, LED, 7 segment display, photo diode, photo transistor, opto coupler, Schottky diode, varactor diode, tunnel diode.
- Transistor - BJ: construction, npn, pnp, operation and configuration, V-I characteristics, introduction to FET-JFET, MOSFET.
- OP-AMP: block diagram, ideal op-amp equivalent circuit, ideal characteristics, transfer curve, open loop and closed loop configurations, op-amp as an inverting amplifier, non-inverting amplifier, adder, subtractor.

Module III: Digital Circuits (12 lectures)
Number systems, Boolean algebra, De-Morgan’s law, AND, OR, NOT, Universal gates, combinational logic circuits.

Module IV: Communication (13 lectures)
- Introduction: communication process, source of information, communication channels, modulation types and need, block diagram of communication systems, AM, FM, PAM, PWM, PPM.
- Introduction to digital modulation: ASK, PSK, FSK.

Suggested Readings
2. Communication System, R. D. Singh and S. D. Sapre, TMGH.
4. Electronic Devices and Circuits, David A. Bell, Oxford University Press.
5. Digital electronics, Moris Mano, EEE.
PSNP0050: NANOPHYSICS I
(4-0-0)

COURSE OUTCOMES
1. Explain basic concepts of nanophysics. (Remembering)
2. Explain the working principle of various characterization techniques. (Understanding)
3. Explain various fabrication techniques. (Understanding)
4. Analyse the relation between nanoparticles size and their properties. (Analysing)
5. Understand various natural nanomaterials and bio-molecular nanoscience. (Understanding)

Module I: Introduction (20 lectures)
Distinction between nanoscience and nanotechnology, requisite definitions; historical perspectives; nanomaterials: overview, definitions, and examples; structurally confined materials: nanoparticles, islands, nanowires, thin films; metal nanoparticles: fundamentals and applications; self-assembled monolayers, semiconductor quantum dots: fundamentals and applications; ceramic nanomaterials: fundamentals and applications; carbon nanomaterials (fullerenes and carbon nanotubes and nanofibers): fundamentals and applications; magnetic nanoparticles: fundamentals and applications; bionanomaterials, computational nanomaterials, composite nanomaterials and applications.

Module II: Characterization tools (10 lectures)
Electron microscopy, atomic force microscopes, X-ray spectroscopy, surface enhanced Raman spectroscopy, lithography, computer modelling and simulation.

Module III: General Fabrication Methods (12 lectures)
Background; top down fabrication: mechanical methods, thermal methods, high energy methods, chemical fabrication methods, lithographic methods; bottom up fabrication: gaseous phase methods, liquid phase methods, template synthesis

Module IV: Basic Properties of Nanomaterials (10 lectures)
Importance of surface: natural, inorganic and the nano perspectives; particle shape and surface; surface: geometric surface to volume ratio, specific surface area; atomic structure: crystal systems.

Module V: Natural and Bio-nanoscience (8 lectures)
Natural nanomaterials: inorganic natural nanomaterials, nanomaterials from the animal kingdom, nanomaterials derived from cell walls, nanomaterials in insects; Introduction to biomolecular nanoscience: history, biomolecular nanoscience, nano perspective

Suggested Readings
3. Nanotechnology and Global Sustainability, D. Maclurcan and N. Radywyl (Eds.), CRC Press.
6. Fundamentals of Nanoelectronics, G. W. Hanson, Pearson.

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PSRM0051: RESEARCH METHODOLOGY
(3-0-0)

COURSE OUTCOMES
1. Understand the meaning, significance and ethics of research. (Understanding)
2. Conduct literature survey. (Understanding)
3. Present and defend their project accurately, both orally and written. (Applying)
4. Present and defend their research results accurately, both orally and written at specialized levels. (Creating)
5. Appreciate statistics as a tool for designing research, analysing data and drawing valid conclusions therefrom. (Analysing)

Module I: Introduction to Research (6 lectures)
Definition of research; objectives of research, importance of research, motivation in research, research methods and research methodology, importance of research methodology; types of research: Basic Research and Applied Research, theoretical; simulations and experimental research. Various stages of research; ethics in scientific research: ethical values of science, ethics of researcher, personal and internal code of conduct, conduct guidelines, ethical standards of publication, scientific fraud and malpractice; plagiarism.

Module II: Literature Survey (6 lectures)
Functions of the literature review in research, conducting a literature survey, sources of information, use of internet, technical and scientific documents, characteristics and quality indices of journals, developing theoretical and conceptual frameworks, writing literature review.

Module III: Research Documentation and Presentation (8 lectures)
Structure of scientific documents; types of scientific reports: research papers, patents, dissertation, posters, slide presentation; skills for academic writing, online communication technologies, preparation of research projects, monitoring and evaluation processes; writing dissertation using LaTeX documents and beammers; citing references and bibliography, thesis defense.

Module IV: Statistics in Research (10 lectures)
Discrete distributions – binomial, geometric, Poisson; continuous distributions – Gaussian, log-normal, gamma, chi-squared; central limit theorem; populations and samples, sample statistics – averages, variance, standard deviation, moments, covariance and correlation; standard errors and confidence limits; Bayesian inference; hypothesis testing – Neyman-Pearson test, Student’s t-test, Fisher’s F-test; goodness-of-fit.

Suggested Readings
2. Research Methodology: Methods and Techniques, C. R. Kothari, New Age International (P) Ltd.
5. Writing for Publication, Mary RenckJalongo and Olivia N. Saracho, Springer.

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PSHP0052: HIGH ENERGY PHYSICS I
(4-0-0)

COURSE OUTCOMES
1. Summarize the mathematical skills like group theory, tensors, kinematics, etc. (Understanding)
2. Explain different groups like Lorentz group, Lie group and their algebra. (Understanding)
3. Explain scalar field quantisation. (Analysing)
4. Explain quantum field theory and hence identify quantum electrodynamics. (Applying)

Module I: Preliminaries (8 lectures)
Tensor, covariant and contravariant tensors, Lorentz covariance and four vector notation; Klein-Gordon equation; Diracequation and its covariant form.

Module II: Group theory and Tensors (10 lectures)
Introduction to group theory, Lie group and Lie Algebra, representation theory, Representations of both Lorentz and Poincaré groups, Irreducible representations of the Lorentz group; Young tableau.

Module IV: Quantum field theory (22 lectures)
Concepts of fields and quantisation, Lagrangian field theory, Hamiltonian field theory, Noether’s Theorem and Conserved
Currents, canonical quantization of freefields (Scalar, complex, EM and Dirac fields), conservation of energy, momentum and charge of the field, The concept of vacuum and Fock space in field theory; C, P, T transformation of scalar and E. M. fields.

**Module V: Quantum Electrodynamics (20 lectures)**
Concepts of Causality, propagator and Feynman propagator, Green’s function, interaction picture and time evolution operator, S-matrix, path integral formalism, Covariant perturbation theory, Feynman rules in momentum space, Wick’s theorem, reduction of time-ordered products, calculation of second order process, Compton scattering, Klein-Nishima formula, Mott scattering, Basics of renormalization.

**Suggested Readings**
2. Quarks and Leptons: An Introductory Course in Modern Particle Physics, F. Halzen and A. D. Martin, Wiley India.
5. Particle Physics, Brian R. Martin and Graham Shaw, Wiley.
6. An introduction to Quantum Field Theory, Michael E. Peskin and Daniel V. Schroeder, Westview Press Inc.

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**PSEP0053: HIGH ENERGY PHYSICS II**
(4-0-0)

**Course Outcomes**
1. Explain gauge theories. (Understanding)
2. Familiarise with physics of spontaneous symmetry breaking and Higgs mechanism. (Analysing)
3. Explain standard model and physics beyond standard model. (Understanding)
4. Build the theory of neutrino physics. (Analysing)
5. Recall group theory and learn how to apply it to gauge theory. (Applying)

**Module I: Introduction (10 lectures)**
Introduction to Gauge symmetries – global and local gauge transformations, abelian group U(1) (QED), Yang-Mills (Non-Abelian) groups – SU(2) (isospin), SU(3)C (QCD).

**Module II: Spontaneous Symmetry Breaking (SSB) (12 lectures)**
Ground state with spontaneous symmetry breaking, some examples; global symmetry breaking and Goldstone bosons, proof of Goldstone theorem, local symmetry breaking and Higgs mechanism for giving masses to vector bosons, examples U(1), SU(2).

**Module III: Standard Model (SM) (12 lectures)**

**Module IV: Beyond Standard Model (12 lectures)**
a. Introduction to Grand Unified Theories (GUTs) – SU(5) and SO(10), and proton decay predictions;
b. Minimal Supersymmetric Standard Model (MSSM) and its extension, its predictions;
c. Introduction to String Theories and Planck scale physics.

**Module V: Neutrino Physics (14 lectures)**
Solar and atmospheric neutrino puzzles, theory of neutrino oscillations in vacuum and medium (MSW mechanism), neutrino masses and leptonic mixings, survey of various neutrino oscillation experiments, seesaw mechanism for small neutrino masses.

**Suggested Readings**
1. Gauge Theory of elementary particle physics, Ta-Pei Cheng and Ling-Fong Li, Oxford University Press.
2. Quarks and leptons: An introductory Course in Modern Particle Physics, Francis Halzen and Alan D. Martin, John Wiley & Sons.
3. Introduction to Elementary Particles, David Griffiths, John Wiley & Sons.
5. Grand Unified theories, Graham G Ross, Oxford University Press.
Mapping of COs to Syllabus

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PSNP0054: NUCLEAR AND PARTICLE PHYSICS

(4-0-0)

**COURSE OUTCOMES**

1. Explain the properties of nucleus in details. (Understanding)
2. Describe Shell model and learn to calculate the spin and parity of nuclear ground state. (Analysing)
3. Knowledge of nuclear reaction and learn the selection rules for nuclear transitions. (Analysing)
4. Classify the elementary particles and explain the quark model. (Understanding)

**Module I: General Properties of Nuclei (6 lectures)**

Nuclear size, shape and charge distribution, spin, parity and isospin of nucleon and nuclei. Determination of nuclear size and charge density, concept of magnetic dipole moment and electric quadrupole moment, Binding energy.

**Module II: Nuclear Two Body Problem and Nuclear Force (12 lectures)**

Properties of deuteron bound state and low energy n-p scattering in terms of scattering length and effective range, spin dependence, charge independence of nucleon force. Non-central part of nucleon force, exchange forces, Yukawa theory of nuclear force, magnetic moment and electric quadrupole moment of deuteron.

**Module III: Nuclear Models (10 lectures)**

Semiempirical mass formula, liquid drop model, Failure of Liquid drop model, Evidence of shell structure, magic numbers, effective single particle potentials (square well, harmonic oscillator, Wood-Saxon with spin orbit interaction), extreme single particle model and its successes and failures in predicting ground state spin, parity, Nordheim rule, rotational and vibrational model.

**Module IV: Nuclear Reactions (12 lectures)**

Kinematics governing nuclear reactions, Q-value, cross section of nuclear reactions, neutron reactions at low energies, Coulomb effects in nuclear reactions, neutron reactions, compound nucleus hypothesis, Breit Wigner one level formula for resonance reactions. Elements of direct reactions (qualitative), energies of fission and fusion, neutron induced fission, chain reaction.

**Module V: Nuclear Decay (8 lectures)**

Fermi theory of decay, selection rules, non-conservative of parity. Gamma decay, electric and magnetic multipole transitions, selection rules, examples of beta and gamma decay.

**Module VI: Particle Physics (12 lectures)**

Classification of fundamental forces, Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.), Symmetries and conservation laws, SU(2) and SU(3), CPT theorem, CP violation in K decay, Gell-Mann Nishijima relation, quark model, baryons and mesons, coloured quarks and gluons, Relativistic kinematics.

**Suggested Readings**

1. Atomic and Nuclear Physics, Vol-II, S. N. Ghosal, S. Chand and company Ltd.
2. Introductory Nuclear Physics, S. M. Wong, Prentice Hall Inc.

Mapping of COs to Syllabus

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PSMP0055: MATHEMATICAL PHYSICS-I  
(3-1-0)  
**COURSE OUTCOMES**  
1. Explain the concepts and applications of the function of complex variables. (Remembering)  
2. Apply the advanced concepts of vector spaces in solving physical problems. (Applying)  
3. Utilize the concepts and applications of some special functions. (Applying)  
4. Illustrate some of the basic concepts of residue theorem. (Understanding)  
5. Analyse physical scenarios using the concepts of vector space. (Analysing)  

**Module I: (16 lectures)**  
Functions of complex variable: Analytic functions; derivatives of an analytic function. Series of analytic functions: Taylor series, Laurent series; zeros and isolated singular points of analytic functions; the calculus of residues: theorem of residues; evaluation of integrals; Jordan’s lemma; Principal value of an integral; multi-valued functions; Riemann surfaces; evaluation of an integral involving a multi-valued function; analytic continuation; dispersion relations.  

**Module II: (16 lectures)**  
Review of vector analysis; definition of vector spaces; finite dimensional vector spaces: linear independence, basis and dimensionality, inner product of vectors and norm of vector, Schmidt's orthogonalization method, Schwarz’s and Bessel’s inequalities; matrices: orthogonal, Hermitian, unitary and normal matrices; linear operators: matrix representation of linear operators; linear transformation: similarity transformation, orthogonal and unitary transformations; eigenvectors and eigenvalues, diagonalization of matrices (or operators); infinite dimensional vector space: Hilbert space, Fock space.  

**Module III: (20 lectures)**  
Special functions: associated Legendre differential equation and functions; generating functions; orthonormality. Bessel’s equation; Bessel function; Spherical Bessel function, Neumann and Hankel functions; expansion of a plane wave into partial waves. Laguerre and associated Laguerre differential equation and functions; generating functions; recurrence relations; orthonormality. Hypergeometric and confluent hypergeometric functions.  

**Module IV: (8 lectures)**  
Integral transforms: general properties of Laplace transforms; inverse Laplace transform; application of Laplace transforms; convolution theorem; solution of differential equations using Laplace transform.  

**Suggested Readings**  

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PSMP0056: MATHEMATICAL PHYSICS-II  
(3-1-0)  
**COURSE OUTCOMES**  
1. Explain the concepts and applications of the special function (Applying)  
2. Illustrate some of the basic concepts of tensor analysis and its application to different branches of physics. (Understanding, Applying)
3. Analyse illustrate some of the basic concepts of group theory and its application to different branches of physics. (Understanding, Applying)

Module I: (20 lectures)
Special functions-II
Power series solution, Frobenius method, Sturm-Liouville theory and boundary value problems, boundary value problems on Laplace equation, Poisson equation and diffusion equation, Green’s functions and method involving Green’s function and its applications; method of separation of variables for different wave equations in Cartesian and curvilinear coordinates involving special functions like Legendre, Hermite, Laguerre and Bessel functions.

Module II: (20 lectures)
Tensor Calculus

Module III: (20 lectures)
Group Theory
Group axioms, permutation groups (S2 and S3) and symmetry operations of equilateral triangle, multiplication table, subgroup, classes and characters, finite groups (Zn), cosets, factor group, normal subgroup, point symmetry group, direct and semi direct product of groups, homomorphism and isomorphism, direct and semi-direct products, block diagonalisation - reducible and irreducible representation, group representation by matrix [unitary representation and conservation laws], Lie groups and algebras [generators, SO(2), SO(3) and SU(2)]; unitary group, special unitary group, Lorentz group, rotation group, direct product, Young Tableau, Dynkin diagrams.

Suggested Readings

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PSMY0101: MATHEMATICAL PHYSICS-I
(4-0-0)

COURSE OUTCOMES
1. Demonstrate the concept of curvilinear coordinates. (Understanding)
2. Apply some advanced topics of vectors. (Applying)
3. Develop an understanding of different types of differential equations and find their solutions. (Applying)
4. Utilize some basic concepts of probability and distribution functions. (Applying)
5. Inspect Dirac delta function and some of its properties. (Analysing)

Module I: Calculus (21 lectures)

Module II: Vector Calculus (27 lectures)

**Module III: Orthogonal Curvilinear Coordinates (6 lectures)**

**Module IV: Introduction to Probability (4 lectures)**
Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance. Dependent events: Conditional Probability. Bayes’ Theorem and the idea of hypothesis testing.

**Module V: Dirac Delta Function and its Properties (2 lectures)**

**Suggested Readings**
7. Mathematical Physics, Goswami, Cengage Learning.

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**PSMCO102: MECHANICS**
(4-0-0)

**COURSE OUTCOMES**
1. Explain the concepts of Newtonian Mechanics. (Remembering)
2. Explain the concepts of work, energy and forces. (Understanding)
3. Explain the concepts of rotational and periodic motions. (Understanding)
4. Apply the laws of motions for solving problems. (Applying)
5. Analyse the concepts of Special Theory of relativity. (Analysis)

**Module I: Fundamentals of Dynamics (13 lectures)**

**Module II: Rotational Dynamics and Elasticity (15 lectures)**
Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation

Module III: Fluid Motion, Gravitation and Central Force Motion (11 lectures)

Module IV: Oscillations and Non-Inertial Systems (11 lectures)

Module V: Special Theory of Relativity (10 lectures)

Suggested Readings
6. Introduction to Special Relativity, R. Resnick, John Wiley and Sons.

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PSEM0103: ELECTRICITY AND MAGNETISM
(4-0-6)

COURSE OUTCOMES
1. Summarize the fundamental concepts of electric and magnetic fields. (Remembering)
2. Explain the electric and magnetic properties of matter. (Understanding)
3. Explain the laws governing electromagnetic inductance. (Understanding)
4. Analyse the working of electrical circuits. (Analysing)
5. Apply the concepts of electromagnetism to physical scenarios. (Applying)

Module I: Electric Field and Electric Potential (22 lectures)
Electric field: Electric field lines. Electric flux. Gauss’ Law with applications to charge distributions with spherical, cylindrical and planar symmetry.

**Module II: Dielectric Properties of Matter (8 lectures)**

**Module III: Magnetic Field (9 lectures)**

**Module IV: Magnetic Properties of Matter (4 lectures)**

**Module V: Electromagnetic Induction (6 lectures)**

**Module VI: Electrical Circuits (4 lectures)**

**Module VII: Network theorems (4 lectures)**

**Suggested Readings**
2. Electricity and Magnetism, Edward M. Purcell, McGraw-Hill Education.
3. Introduction to Electrodynamics, D. J. Griffiths, Benjamin Cummings.

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**PSW00104: WAVES AND OPTICS**

(4-0-0)

**COURSE OUTCOMES**
1. Utilize the principle of superposition of harmonic motions and waves in different scenarios. (Analysing)
2. Summarize the principles of various wave motions. (Remembering)
3. Understand the theory of interference. (Understanding)
4. Understand the theory of diffraction. (Understanding)
5. Apply the principle of interference and diffraction in various optical instruments. (Application)

**Module I: Superposition of Harmonic oscillations (10 lectures)**
Simple harmonic motion, Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.
Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.

Module II: Wave Motion (11 lectures)

Module III: Superposition of Two Harmonic Waves (7 lectures)

Module IV: Interference (16 lectures)

Module V: Diffraction (16 lectures)
Kirchhoff’s Integral Theorem, Fresnel-Kirchhoff’s Integral formula. (Qualitative discussion only)
Fresnel’s Assumptions. Fresnel’s Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel’s Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Suggested Readings

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PSM50105: MATHEMATICAL PHYSICS-II
(4-0-0)

COURSE OUTCOMES
1. Apply the concepts of Fourier series to different physical problems. (Applying)
2. Demonstrate the power series solutions to ordinary differential equations. (Understanding)
3. Apply the concepts of errors and special integrals. (Applying)
4. Utilize partial differential equations for solving various problems of physics. (Applying)
5. Analyse various special functions and their applications. (Analysing)

Module I: Fourier Series (10 lectures)
Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier

**Module II: Frobenius Method and Special Functions (24 lectures)**

**Module III: Some Special Integrals (4 lectures)**
Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

**Module IV: Partial Differential Equations (14 lectures)**

**Module V: Theory of Errors (6 lectures)**

**Suggested Readings**

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**PSPT0106: THERMAL PHYSICS**

(4-0-0)

**COURSE OUTCOMES**
1. Explain the concept of thermodynamic potential. (Understanding)
2. Illustrate Maxwell’s thermodynamic relations (Understanding)
3. Apply different laws of thermodynamics to different physical problems. (Applying)
4. Combine the concepts of thermodynamics to those of statistical mechanics. (Creating)
5. Understand kinetic theory of gases. (Understanding)

**Module I: Zeroth and First Law of Thermodynamics (8 lectures)**

**Module II: Second Law of Thermodynamics (10 lectures)**
Module III: Entropy (7 lectures)

Module IV: Thermodynamic Potentials (14 lectures)

Module V: Distribution of Velocities (7 lectures)

Module VI: Molecular Collisions (4 lectures)

Module VII: Real Gases (10 lectures)

Suggested Readings
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears and Salinger, Narosa.

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PSDA0107: DIGITAL SYSTEMS AND APPLICATIONS
(4-0-0)

**COURSE OUTCOMES**
1. Explain the construction and working of a CRO. (Remembering)
2. Summarize the principles of various digital circuits. (Understanding)
3. Apply Boolean algebra for solving problems. (Application)
4. Analyse the functions of Timers, registers and counters. Analysing
5. Explain the organization of computers and microprocessors. (Understanding)

Module I: Introduction to CRO, Integrated Circuits and Digital Circuits (12 lectures)
Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital ICs. Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers.

Module II: Boolean Algebra and Arithmetic Circuits (11 lectures)

Module III: Data Processing Circuits and Sequential Circuits (10 lectures)

Module IV: Timers, Shift Registers and Counters (8 lectures)

Module V: Computer Organization and Microprocessor Architecture (16 lectures)

Suggested Readings
6. Logic circuit design, Shimon P. Vintron, Springer.

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PSMPO108: MATHEMATICAL PHYSICS-III
(4-0-0)

COURSE OUTCOMES
1. Explain the basics of complex analysis. (Remembering)
2. Solve physical problems using the concepts of complex analysis. (Applying)
3. Understand the concepts of integral transforms. (Understanding)
4. Apply Fourier transforms to various physical scenarios. (Applying)
5. Make use of Laplace transforms in simplifying various problems. (Applying)

Module I: Complex Analysis (30 lectures)
Brief Revision of Complex Numbers and their Graphical Representation. Euler’s formula, De Moivre’s theorem, Roots of

**Module II: Integrals Transforms (15 lectures)**

**Module III: Laplace Transforms (15 lectures)**
Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits, Coupled differential equations of 1st order. Solution of heat flow along infinite bar using Laplace transform.

**Suggested Readings**

**Mapping of COs to Syllabus**

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**PSEP0109: ELEMENTS OF MODERN PHYSICS**
(4-0-0)

**COURSE OUTCOMES**
1. Build the foundational knowledge of quantum mechanics. (Applying)
2. Develop a sound understanding of LASER. (Applying)
3. Analyse the physics of atomic nucleus. (Analysing)

**Module I: (29 lectures)**
Planck’s quantum, Planck’s constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photoelectric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions. Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle-aplication to virtual particles and range of an interaction. Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

**Module II: (10 lectures)**
One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier.
Module III: (6 lectures)
Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

Module IV: (8 lectures)
Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli’s prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron- positron pair creation by gamma photons in the vicinity of a nucleus.

Module V: (3 lectures)
Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions).

Module VI: (4 lectures)

Suggested Readings
3. Introduction to Quantum Mechanics, David J. Griffith, Pearson Education.

Mapping of COs to Syllabus

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PSAS0110: ANALOG SYSTEMS AND APPLICATIONS
(4-0-0)

COURSE OUTCOMES
1. Explain the working of diodes, transistors, amplifiers, oscillators and Op-Amps.(Understanding)
2. Illustrate the theoretical concepts of the corresponding electronic circuits. (Understanding)
3. Apply the concept of conversation. (Applying)
4. Analysing application of electronic devices for digital circuits (Application)
5. Analysing concept of analog sensors. (Analysing)

Module I: Semiconductors Diodes (10 lectures)

Module II: Two-terminal Devices and their Applications (6 lectures)
(1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.

Module III: Bipolar Junction transistors (6 lectures)

Module IV: Amplifiers (18 lectures)
Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and...
Two stage RC-coupled amplifier and its frequency response.
Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.

Module V: Operational Amplifiers (Black Box approach) and its applications (8 lectures)

Module VI: Sinusoidal Oscillators and Conversion (8 lectures)
Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation)

Suggested Readings

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PSPC0111: COMPUTATIONAL PHYSICS SKILLS
(2-0-0)

COURSE OUTCOMES
1. Explain the concept of high level language in computer programming. (Understanding)
2. Use FORTRAN programming language for solving problems in Physics. (Applying)
3. Use LaTeX for document preparation. (Applying)
4. Use Gnuplot for plotting graphs. (Applying)

Module I: Introduction (4 lectures)
Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor. Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin(x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

Module II: Scientific Programming (5 lectures)

Module III: Control Statements (6 lectures)
Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DO- WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of
Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems. Programming: 1. Exercises on syntax on usage of FORTRAN. 2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write source codes in FORTRAN. 3. To print out all natural even/ odd numbers between given limits. 4. To find maximum, minimum and range of a given set of numbers. 5. Calculating Euler number using exp(x) series evaluated at x=1.

Module IV: Scientific Word Processing (6 lectures)
Introduction to LaTeX: TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. Equation representation: Formulae an LaTeX, Computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot Hands on exercises: 1. To compile a frequency distribution and evaluate mean, standard deviation etc. 2. To evaluate sum of finite series and the area under a curve. 3. To find the product of two matrices. 4. To find a set of prime numbers and Fibonacci series. 5. To write program to open a file and generate data for plotting using Gnuplot. 6. Plotting trajectory of a projectile projected horizontally. 7. Plotting trajectory of a projectile projected making an angle with the horizontally. 8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file. 9. To find the roots of a quadratic equation. 10. Motion of a projectile using simulation and plot the output for visualization. 11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization. 12. Motion of particle in a central force field and plot the output for visualization.

Suggested Readings
1. Introduction to Numerical Analysis, S. S. Sastry, PHI Learning Pvt. Ltd.
2. Computer Programming in Fortran 77”, V. Rajaraman, PHI.
3. LaTeX–A Document Preparation System, Leslie Lamport, Addison-Wesley.

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PSEN0112: ELECTRICAL CIRCUITS AND NETWORK SKILLS
(2-0-0)

COURSE OUTCOMES
1. Explain the basics of electrical circuits. (Remembering)
2. Explain the working principle of motors, generators and transformers. (Understanding)
3. Explain the working principle of solid state devices. (Understanding)
4. Analyse the functions of various electrical protections. (Analysis)
5. Apply the various concepts of electrical wiring. (Application)

Module I: Basic Electricity Principles and Electrical Circuits (11 lectures)
Module II: Generators, Transformers and Electric Motors (7 lectures)

Module III: Solid-State Devices, Electrical Protection and Electrical Wiring (12 lectures)

Suggested Readings
1. A textbook in Electrical Technology, B. L. Theraja, S Chand & Co.

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PSBI0113: BASIC INSTRUMENTATION SKILLS
(2-0-0)

COURSE OUTCOMES
1. Explain the concepts of various performance characteristics of measuring instruments. (Remembering)
2. Explain the underlying principle of CRO and its uses. (Application)
3. Analyse the functions of signal generators, electronic voltmeter and bridges. (Analysis)
4. Explain the underlying principle of multimeter and its uses. (Understanding)
5. Understand the basic concepts behind digital instruments. (Understanding)

Module I: Basic of Measurement, Digital Instruments and Electronic Voltmeter (9 lectures)

Module II: Cathode Ray Oscilloscope (8 lectures)
Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.

Module III: Signal Generators, Analysis Instruments, Impedance Bridges & Q-Meters (7 lectures)
Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis. Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Blockdiagram & working principles of a Q- Meter. Digital LCR bridges.
Module IV: Digital Multimeter: (6 lectures)

Suggested Readings
1. A text book in Electrical Technology, B. L. Theraja, S Chand & Co.
2. Performance and design of AC machines, M. G. Say, ELBS Edn.
4. Logic circuit design, Shimon P. Vingron, Springer.
8. Electronic Devices, Thomas L. Floyd, Pearson India.

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PSRS0114: RADIATION SAFETY

(Course Outcomes)

(2-0-0)

Module I: Basics of Atomic and Nuclear Physics (6 lectures)
Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission.

Module II: Interaction of Radiation with Matter (7 lectures)

Module III: Radiation Detection and Monitoring Devices (7 lectures)
Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, mrad, rads, gy, rem, mrem, SV and mSV, absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC). Radiation detection: Basic concept and working principle of gas detectors (Ionization Chambers, Proportional Counter, Multi-Wire Proportional Counters (MWPC) and Geiger Muller Counter), Scintillation Detectors (Inorganic and Organic Scintillators), Solid States Detectors and Neutron Detectors, Thermo luminescent Dosimetry.

Module IV: Radiation Safety Management (7 lectures)

Module V: Application of Nuclear Techniques (5 lectures)
Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime
detection, Mining and oil. Industrial Uses: Tracing, Gauging, Material Modification, Sterilization, Food preservation.

**Suggested Readings**
2. Radiation detection and measurements, G. F. Knoll.
3. Thermoluminescence Dosimetry, A. F. Mcknlay, Adam Hilger Ltd.
5. Fundamentals of Radiation Dosimetry, J. R. Greening, Adam Hilger Ltd.
8. NCRP, ICRP, ICRU, IAEA, AERB Publications.

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**PSGP0115: GENERAL THERMAL PHYSICS**

(4-0-0)

**COURSE OUTCOMES**
1. Explain the concept of thermodynamic potential. (Understanding)
2. Illustrate Maxwell’s thermodynamic relations. (Understanding)
3. Apply different laws to thermodynamics to different physical problems. (Applying)
4. Combine the concepts of thermodynamics to those of statistical mechanics. (Creating)
5. Understand kinetic theory of gases and theory of radiation. (Understanding)

**Module I: Laws of Thermodynamics (22 lectures)**


**Module II: Thermodynamical Potentials (10 lectures)**

Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell’s relations and applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for (C_p – C_v), C_v/C_p, TdS equations.

**Module III: Kinetic Theory of Gases (10 lectures)**

Derivation of Maxwell’s law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

**Module IV: Theory of Radiation (6 lectures)**

Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck’s law, Deduction of Wien’s distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien’s displacement law from Planck’s law.

**Module V: Statistical Mechanics (12 lectures)**


**Suggested Readings**

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**PSGM0116: GENERAL ELEMENTS OF MODERN PHYSICS**

(4-0-0)

**COURSE OUTCOMES**

1. Build foundational knowledge of quantum mechanics and atomic physics. (Applying)
2. Analyse the concept of nuclear physics. (Analysing)

**Module I: (8 lectures)**

Planck’s quantum, Planck’s constant and light as a collection of photons; Photo- electric effect and Compton scattering. De Broglie wavelength and matter waves; Davison-Germer experiment.

**Module II: (4 lectures)**

Problems with Rutherford model - instability of atoms and observation of discrete atomic spectra; Bohr’s quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra.

**Module III: (4 lectures)**

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle; impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

**Module IV: (11 lectures)**

Two slit interference experiment with photons, atoms & particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrödinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wavefunction, probabilities and normalization; Probability and probability current densities in one dimension.

**Module V: (12 lectures)**

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier.

**Module VI: (21 lectures)**

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy. Radioactivity: stability of nucleus; Law of radioactive decay; Mean life and half-life; alpha decay; beta decay - energy released, spectrum and Pauli’s prediction of neutrino; gamma-ray emission. Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.

**Suggested Readings**


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PSQM0115: QUANTUM MECHANICS AND APPLICATIONS
(4-0-0)

COURSE OUTCOMES
1. Interpret the significance of the Schrödinger wave equation. (Understanding)
2. Solve problems involving bound states in arbitrary potential. (Applying)
3. Explain the behaviour of simple atoms using quantum theory. (Understanding)
4. Examine the quantum behaviour of atoms in external fields. (Analysing)
5. Extend fundamentals concepts from quantum theory to many-electron systems. (Understanding)

Module I: Time Dependent Schrödinger Equation (6 lectures)

Module II: Time Independent Schrödinger Equation (10 lectures)
Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle.

Module III: Bound States in an Arbitrary Potential (12 lectures)
Continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle.

Module IV: Quantum Theory of Hydrogen-like Atoms (10 lectures)
Time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wavefunctions from Frobenius method; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells.

Module V: (12 lectures)

Module VI: (10 lectures)

Suggested Readings
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, Wiley.
4. Quantum Mechanics, G. Arulduhas, PHI Learning of India.
5. Quantum Mechanics, Bruce Cameron Reed, Jones and Bartlett Learning.
8. Quantum Mechanics, Eugen Merzbacher, John Wiley and Sons, Inc.
9. Introduction to Quantum Mechanics, D. J. Griffith, Pearson Education.
10. Quantum Mechanics, Walter Greiner, Springer.

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**PSSS0116: SOLID STATE PHYSICS**

(4-0-0)

**COURSE OUTCOMES**

1. Learn about crystal structure in details. (Understanding)
2. Understand physics of phonons. (Understanding)
3. Conceptualise free electron and nearly free electron models. (Applying)
4. Know about advanced topics like superconductivity, ferroelectric properties, etc. (Analysing)

**Module I: Crystal Structure (12 lectures)**

**Module II: Elementary Lattice Dynamics (10 lectures)**

**Module III: Magnetic Properties of Matter (8 lectures)**

**Module IV: Dielectric Properties of Materials (8 lectures)**

**Module V: Ferroelectric Properties of Materials (6 lectures)**
Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop.

**Module VI: Elementary Band Theory (10 lectures)**

**Module VII: Superconductivity (6 lectures)**

**Suggested Readings**

1. Introduction to Solid State Physics, Charles Kittel, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J. P. Srivastava, Prentice-Hall of India

**Mapping of COs to Syllabus**

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PSES0117: EMBEDDED SYSTEM: INTRODUCTION TO MICROCONTROLLERS
(4-0-0)

COURSE OUTCOMES
1. Interpret the actual concept of computer hardware program. (Understanding)
2. Analyse the physics of automation. (Analysing)
3. Relate the concept of processors used in mobile and computers. (Understanding)
4. Apply the programmes to make automation and embedded systems. (Applying)
5. Apply the knowledge of timers and counters for making high precision systems. (Applying)

Module I: Embedded System Introduction and Review of Microprocessors (8 lectures)
Introduction to embedded systems and general purpose computer systems, architecture of embedded system, classifications, applications and purpose of embedded systems, challenges & design issues in embedded systems, operational and non-operational quality attributes of embedded systems, elemental description of embedded processors and microcontrollers. Organization of Microprocessor based system, 8085µp pin diagram and architecture, concept of data bus and address bus, 8085 programming model, instruction classification, subroutines, stacks and its implementation, delay subroutines, hardware and software interrupts.

Module II: 8051 Microcontroller and I/O Port Programming (16 lectures)
Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions. Introduction of I/O port programming, pin out diagram of 8051 microcontroller, I/O port pins description & their functions, I/O port programming in 8051 (using assembly language), I/O programming: Bit manipulation.

Module III: Programming (12 lectures)
8051 addressing modes and accessing memory using various addressing modes, assembly language instructions using each addressing mode, arithmetic and logic instructions, 8051 programming in C: for time delay & I/O operations and manipulation, for arithmetic and logic operations, for ASCII and BCD conversions.

Module IV: Timer and Counter Programming (3 lectures)
Programming 8051 timers, counter programming.

Module V: Serial Port Programming With and Without Interrupt and Interfacing 8051 Microcontroller to Peripherals (8 lectures)
Introduction to 8051 interrupts, programming timer interrupts, programming external hardware interrupts and serial communication interrupt, interrupt priority in the 8051. Parallel and serial ADC, DAC interfacing, LCD interfacing.

Module VI: Programming Embedded Systems, Design & Development (13 lectures)
Structure of embedded program, infinite loop, compiling, linking and locating, downloading and debugging. Embedded system development environment, file types generated after cross compilation, disassembler/ decompiler, simulator, emulator and debugging, embedded product development life-cycle, trends in embedded industry. Pin diagram and description of Arduino UNO. Basic programming.

Suggested Readings

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PSDI0118: PHYSICS OF DEVICES AND INSTRUMENTS
(4-0-0)

COURSE OUTCOMES
1. Explain the physics of semiconductor devices. (Remembering)
2. Explain the function of different components of a power supply. (Understanding)
3. Explain different techniques used in the fabrication of semiconductor devices. (Applying)
4. Explain the procedures of standard digital data communication processes. (Understanding)
5. Explain the process of digital communication. (Understanding)

Module I: Devices (14 lectures)
Characteristic and small signal equivalent circuits of UJT and JFET. Metal-semiconductor Junction. Metal oxide semiconductor (MOS) device. Ideal MOS and Flat Band voltage. SiO2-Si based MOS. MOSFET— their frequency limits. Enhancement and Depletion Mode MOSFETs, CMOS. Charge coupled devices. Tunnel diode.

Module II: Power Supply and Filters (6 lectures)
Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Short circuit protection. Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters.

Module III: Multivibrators (3 lectures)
Continuity Astable and Monostable Multivibrators using transistors.

Module IV: Phase Locked Loop (PLL) (5 lectures)
Basic Principles, Phase detector(XOR & edge triggered), Voltage Controlled Oscillator (Basics, varactor). Loop Filter— Function, Loop Filter Circuits, transient response, lock and capture. Basic idea of PLL IC (565 or 4046).

Module V: Processing of Devices (12 lectures)

Module VI: Digital Data Communication Standards (5 lectures)

Module VII: Introduction to communication systems (15 lectures)
Block diagram of electronic communication system, Need for modulation. Amplitude modulation. Modulation Index. Analysis of Amplitude Modulated wave. Sideband frequencies in AM wave. CE Amplitude Modulator. Demodulation of AM wave using Diode Detector. Basic idea of Frequency, Phase, Pulse and Digital Modulation including ASK, PSK, FSK.

Suggested Readings
4. Electronic Devices and Circuits, A. Mottershead, PHI Learning Pvt. Ltd.
5. Electronic Communication systems, G. Kennedy, Tata McGraw Hill.
8. PC based instrumentation; Concepts & Practice, N. Mathivanan, Prentice-Hall of India.

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PSCD0119: CLASSICAL DYNAMICS
(5-1-0)

**COURSE OUTCOMES**
1. Understand the motion and trajectory of a charged particle in an electromagnetic field. (Understanding)
2. Understand Lagrangian and Hamiltonian formalism of classical mechanics. (Understanding)
3. Know the importance of small oscillations. (Evaluating)
4. Distinguish between classical and relativistic particles and understand and learn the mathematical tools needed to analyse relativistic particles. (Analysing)
5. Understand the tensor analysis and four vector which will help them to write shorthand notations for different mathematical terms and expressions. (Understanding)
6. Apply the laws of fluid dynamics in their practical life as well as to build technologies. (Applying)

**Module I: Classical Mechanics of Point Particles: (22 lectures)**
Review of Newtonian Mechanics; Application to the motion of a charge particle in external electric and magnetic fields- motion in uniform electric field, magnetic field- gyroradius and gyrofrequency, motion in crossed electric and magnetic fields. Generalized coordinates and velocities, Hamilton’s principle, Lagrangian and the Euler-Lagrange equations, one- dimensional examples of the Euler-Lagrange equations- one-dimensional Simple Harmonic Oscillations and falling body in uniform gravity; applications to simple systems such as coupled oscillators Canonical momenta & Hamiltonian. Hamilton’s equations of motion. Applications: Hamiltonian for a harmonic oscillator, solution of Hamilton’s equation for Simple Harmonic Oscillations; particle in a central force field- conservation of angular momentum and energy.

**Module II: Small Amplitude Oscillations (10 lectures)**
Minima of potential energy and points of stable equilibrium, expansion of the potential energy around a minimum, small amplitude oscillations about the minimum, normal modes of oscillations example of N identical masses connected in a linear fashion to (N -1) - identical springs.

**Module III: Special Theory of Relativity (33 lectures)**

**Module IV: Fluid Dynamics (10 lectures)**
Density $\rho$ and pressure $P$ in a fluid, an element of fluid and its velocity, continuity equation and mass conservation, stream-lined motion, laminar flow, Poiseuille’s equation for flow of a liquid through a pipe, Navier-Stokes equation, qualitative description of turbulence, Reynolds number.

**Suggested Readings**
5. Introduction to Electrodynamics, D. J. Griffiths, Pearson Education.

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**PSCE0120: COMMUNICATION ELECTRONICS**

(4-0-0)

**COURSE OUTCOMES**
Module I: Electronic Communication (8 lectures)

Module II: Analog Modulation (12 lectures)
Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Emitter Modulation), Amplitude Demodulation (diode detector), Concept of Single side band generation and detection. Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector), Qualitative idea of Super heterodyne receiver.

Module III: Analog Pulse Modulation (9 lectures)
Channel capacity, Sampling theorem, Basic Principles- PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing.

Module IV: Digital Pulse Modulation (10 lectures)
Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK).

Module V: Introduction to Communication and Navigation Systems (10 lectures)
Satellite Communication— Introduction, need, Geosynchronous satellite orbits, geostationary satellite advantages of geostationary satellites. Satellite visibility, transponders (C - Band), path loss, ground station, simplified block diagram of earth station. Uplink and downlink.

Module VI: Mobile Telephony System (10 lectures)
Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data encryption, architecture (block diagram) of mobile communication network, idea of GSM, CDMA, TDMA and FDMA technologies, simplified block diagram of mobile phone handset, 2G, 3G and 4G concepts (qualitative only).

Module VII: GPS Navigation System (1 hour)
Qualitative idea of GPS navigation system.

Suggested Readings
2. Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
7. Electronic Communication system, Blake, Cengage.

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PSET0121: ELECTROMAGNETIC THEORY

(4-0-0)

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COURSE OUTCOMES
1. Apply the Maxwell's equations in solving problems related to various physical phenomena. (Applying)
2. Explain physical phenomena involving electric charges and currents from the standpoint of electromagnetic theory. (Understanding)
3. Analyse the behaviour of physical systems using electromagnetic theory. (Analysing)

Module I: Maxwell Equations (12 lectures)

Module II: EM Wave Propagation in Unbounded Media (10 lectures)
Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

Module III: EM Wave in Bounded Media (10 lectures)

Module IV: Polarization of Electromagnetic Waves (12 lectures)

Module V: Rotatory Polarization (5 lectures)

Module VI: Wave Guides (8 lectures)

Module VII: Optical Fibres (3 lectures)

Suggested Readings
1. Introduction to Electrodynamics, D. J. Griffiths, Benjamin Cummings.

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PSSM0122: STATISTICAL MECHANICS
(4-0-0)
COURSE OUTCOMES
1. Understand the connection between statistical mechanics and thermodynamics. (Understanding)
2. Differentiate between Classical and quantum theory of Radiation. (Analysing)
3. Explain the classical and quantum statistical mechanics. (Understanding)
4. Applying quantum statistics in various systems to overcome the shortcomings of classical statistics. (Applying)

Module I: Classical Statistics (18 lectures)

Module II: Classical Theory of Radiation (9 lectures)

Module III: Quantum Theory of Radiation (5 lectures)

Module IV: Bose-Einstein Statistics (13 lectures)
B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck’s law.

Module V: Fermi-Dirac Statistics (15 lectures)

Suggested Readings
2. Berkeley Physics Course, F. Reif, Statistical Physics, Tata McGraw-Hill.
6. An Introduction to Statistical Mechanics & Thermodynamics, R. H. Swendson, Oxford Univ. Press.

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PSNP0123: NUCLEAR AND PARTICLE PHYSICS
(5-1-0)

COURSE OUTCOMES
1. Understand the basic properties of nuclei, their reactions and different models to explain nuclear structure. (Understanding)
2. Explain the phenomena of radioactive decays of different nuclei. (Evaluating)
3. Illustrate the energy loss mechanism when nuclear radiation passes or interacts with matter. (Understanding)
4. Categorize the working of sophisticated nuclear detectors to detect nuclear particles or Radiations. (Analysing)
5. Analyse the physics of elementary particles. (Analysing)

Module I: General Properties of Nuclei Equation (10 lectures)
Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.
Module II: Nuclear Models (12 lectures)
Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

Module III: Radioactivity Decay (10 lectures)
a. Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy.
b. β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.
c. Gamma decay: Gamma rays emission & kinematics, internal conversion.

Module IV: Nuclear Reactions (8 lectures)
Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

Module V: Interaction of Nuclear Radiation with Matter and Detection (16 lectures)
Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.
Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

Module VI: Particle Physics (19 lectures)
Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons. Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.

Suggested Readings
1. Introductory nuclear Physics, Kenneth S. Krane, Wiley India Pvt. Ltd.
6. Quarks and Leptons, F. Halzen and A. D. Martin, Wiley India.

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PSNA0124: NANO MATERIALS AND APPLICATIONS
(4-0-0)

COURSE OUTCOMES
1. Understand and appreciate the properties of materials at nano level. (Understanding)
2. Explain different techniques used in the synthesis of nanomaterials. (Remembering)
3. Explain the theory behind different techniques and instruments used in the study of nano Materials. (Applying)
4. Explain the optical properties and phenomena of electron transport of materials at nanoscale. (Understanding)
5. Understand and appreciate few applications of nanoparticles. (Applying)
6. Understand the difference between nanotechnology and nanoscience. (Understanding)
7. Interpret the concept of characterisation for synthesis of desired materials. (Understanding)
8. Apply the nanomaterials for design and development of nano-sensors. (Applying)
Module I: Nanoscale Systems (10 lectures)
Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equation- Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences.

Module II: Synthesis of Nanostructure Materials (8 lectures)

Module III: Characterization (8 lectures)

Module IV: Optical Properties (14 lectures)

Module V: Electron Transport (6 lectures)

Module VI: Applications (14 lectures)

Suggested Readings
1. Introduction to Nanotechnology, C. P. Poole, Jr. and Frank J. Owens, Wiley India Pvt. Ltd.

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PSDP0125: DIGITAL SIGNAL PROCESSING
(4-0-0)

COURSE OUTCOMES
1. Analyse the theories of signals and systems. (Analysing)
2. Relate the different filters for better signal processing. (Remembering)
3. Understand the concept of fourier transform. (Understanding)
4. Apply the filter concept in making noise free signals. (Applying)
5. Apply the transform technique in system design. (Applying)
Module I: Discrete-Time Signals and Systems (10 lectures)
Classification of signals, Transformations of the Independent Variable, Periodic and Aperiodic Signals, Energy and Power Signals, Even and Odd Signals, Discrete-Time Systems, System Properties. Impulse Response, Convolution Sum; Graphical Method; Analytical Method, Properties of Convolution; Commutative; Associative; Distributive; Shift; Sum Property System Response to Periodic Inputs, Relationship Between LTI System Properties and the Impulse Response; Causality; Stability; Invertibility, Unit Step Response.

Module II: Discrete-Time Fourier Transform (15 lectures)
Fourier Transform Representation of Aperiodic Discrete-Time Signals, Periodicity of DTFT, Properties; Linearity; Time Shifting; Frequency Shifting; Differentiating in Time Domain; Differentiation in Frequency Domain; Convolution Property. The z-Transform: Bilateral (Two-Sided) z-Transform, Inverse z-Transform, Relationship Between z-Transform and Discrete-Time Fourier Transform, z-plane, Region-of-Convergence; Properties of ROC, Properties; Time Reversal; Differentiation in the z- Domain; Power Series Expansion Method (or Long Division Method); Analysis and Characterization of LTI Systems; Transfer Function and Difference-Equation System. Solving Difference Equations.

Module III: Filter Concepts (5 lectures)
Phase Delay and Group delay, Zero-Phase Filter, Linear-Phase Filter, Simple FIR Digital Filters, Simple IIR Digital Filters, All pass Filters, Averaging Filters, Notch Filters.

Module IV: Discrete Fourier Transform (10 lectures)
Frequency Domain Sampling (Sampling of DTFT), The Discrete Fourier Transform (DFT) and its Inverse, DFT as a Linear transformation, Properties; Periodicity; Linearity; Circular Time Shifting; Circular Frequency Shifting; Circular Time Reversal; Multiplication Property; Parseval’s Relation, Linear Convolution Using the DFT (Linear Convolution Using Circular Convolution), Circular Convolution as Linear Convolution with aliasing.

Module V: Fast Fourier Transform (5 lectures)
Direct Computation of the DFT, Symmetry and Periodicity Properties of the Twiddle factor (WN), Radix-2 FFT Algorithms; Decimation-In-Time (DIT) FFT Algorithm; Decimation-In-Frequency (DIF) FFT Algorithm, Inverse DFT Using FFT Algorithms.

Module VI: Realization of Digital Filters (15 lectures)
Non Recursive and Recursive Structures, Canonic and Non Canonic Structures, Equivalent Structures (Transposed Structure), FIR Filter structures; Direct-Form; Cascade-Form; Basic structures for IIR systems; Direct-Form I. Finite Impulse Response Digital Filter: Advantages and Disadvantages of Digital Filters, Types of Digital Filters: FIR and IIR Filters; Difference Between FIR and IIR Filters, Desirability of Linear-Phase Filters, Frequency Response of Linear-Phase FIR Filters, Impulse Responses of Ideal Filters, Windowing Method; Rectangular; Triangular; Kaiser Window, FIR Digital Differentiators. Infinite Impulse Response Digital Filter: Design of IIR Filters from Analog Filters, IIR Filter Design by Approximation of Derivatives, Backward Difference Algorithm, Impulse Invariance Method.

Suggested Readings
1. Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press.

Mapping of COs to Syllabus

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PSAA0126: ASTRONOMY AND ASTROPHYSICS
(5-1-0)

COURSE OUTCOMES
1. Define and recall fundamental concepts in astronomy. (Remembering)
2. Illustrate the working of various tools used in observational astronomy. (Understanding)
3. Explain the dynamics of the Sun and the solar system. (Understanding)
4. Classify stars based on their spectra. (Analysing)
5. Outline the astrophysics at grander scales. (Understanding)
6. Solve astrophysical problems using fundamental concepts. (Applying)

Module I: Astronomical Scales (24 lectures)

Module II: Astronomical Techniques (9 lectures)

Module III: The Sun and it’s family (7 lectures)

Module IV: Stellar Spectra and Classification Structure (4 lectures)

Module V: Galaxies (21 lectures)

Module VI: Large Scale Structure & Expanding Universe (10 lectures)
Cosmic Distance Ladder (An Example from Terrestrial Physics, Distance Measurement using Cepheid Variables), Hubble’s Law (Distance- Velocity Relation), Clusters of Galaxies (Virial theorem and Dark Matter).

Suggested Readings
5. Astro Physics a modern perspective, K. S. Krishnasamy, New Age International (p) Ltd.

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PSSL0100: ELEMENTS OF SERVICE LEARNING IN PHYSICS
(2-0-0)
COURSE OUTCOMES
1. Explain the meaning of service learning and active learning. (Understanding)
2. Illustrate engaged teaching and engaged research. (Understanding)
3. Organise service learning. (Applying)

Module I: (6 lectures)
Understanding social responsibility of educational institutes; meaning of community university engagement (CUE), engaged teaching, engaged research.

Module II: (9 lectures)
Active learning. Service learning; principles of service learning; classification of service learning models; difference between service Learning and other community experiences; historical context of University Community Partnership; service Learning for an undergraduate physics student.

Module III: (15 lectures)
Conceptualisation of the idea of service learning through any two of the following practical implementations: (i) participating in awareness programmes on scientific temper for nearby communities, (ii) taking part in demonstrations of scientific experiments for school children to eradicate the fear of pursuing higher studies in science, (iii) providing guidance to school students for understanding the topics of their physics curriculum, (iv) providing video lectures and/or demonstrations for school students.

Suggested Readings

Mapping of COs to Syllabus

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PSPS0200: PHYSICS AND SERVICE LEARNING
(2-0-0)

COURSE OUTCOMES
1. Explain the meaning of service learning and active learning. (Understanding)
2. Illustrate engaged teaching and engaged research. (Understanding)
3. Organise service learning. (Applying)
4. Illustrate CBPR. (Understanding)
5. Find the regulations of educational statutory bodies on social responsibility. (Remembering)

Module I: (6 lectures)
Understanding social responsibility of educational institutes; meaning of community university engagement (CUE), engaged teaching, engaged research. Community Based Participatory Research (CBPR). Statutory bodies of higher educational institutions and social responsibility.

Module II: (9 lectures)
Active learning. Service learning; principles of service learning; classification of service learning models; difference between service learning and other community experiences; historical context of university community partnership; physics students and service learning. Service Learning for a postgraduate physics student and its scope in research.

Module III: (15 lectures)
Conceptualisation of the idea of service learning through any two of the following practical implementations: (i) conducting awareness programmes on scientific temper for nearby communities, (ii) organising demonstrations of scientific experiments for school children to eradicate the fear of pursuing higher studies in science, (iii) surveying the need of the communities and find out various possibilities of providing the solutions from physics point of view, (iv) providing consultancy to school students for various inter school science competitions, (v) providing video lectures and/or demonstrations for school students. (vi) Radiation measurement activity and awareness campaign by students.

Suggested Readings

Mapping of COs to Syllabus
### COURSE OUTCOMES

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### LABORATORY COURSES

**PSPL6003: PHYSICS LABORATORY II**

(0-0-4)

**COURSE OUTCOMES**

1. Explain the characteristics of SCR. (Understanding)
2. Find out resistivity of a semiconductor. (Application)
3. Determine of difference in wavelengths of Na using Fabry-Perot interferometer. (Application)
4. Verify the Beer-Lambert law using UV visible spectrometer. (Analysis)
5. Use nuclear radiation detectors. (Application)
6. Understand phonon dispersion using simulator. (Understanding)
7. Have some fundamental understanding of plasma experiments. (Understanding)

**At least 10 experiments should be performed from the following:**

1. To study the characteristic of SCR using the breadboard.
2. To study resistivity of a semiconductor by probe method.
3. Determination of difference in wavelengths of Na using Fabry-Perot interferometer.
4. To verify the Beer-Lambert law using UV visible spectrometer.
5. Verification of inverse square law for gamma ray using GM counter.
6. To study attenuation of beta rays using GM counter.
7. To determine the activity of a gamma emitter.
8. To study gamma ray spectrum of Cs-137 source and determine the resolution of gamma-ray spectrometer.
9. To calibrate the scintillation spectrometer and determine the energy of gamma rays from an unknown source.
10. To study attenuation of gamma-rays from Cs-137 source by using different absorbers.
11. To study the decay curve for half-life components of irradiated 115In by a neutron source.
12. To study phonon dispersion of a monatomic chain of atoms using electronic analogue of the chain.
13. Experimental verification of Paschen law in a glow discharge system.
14. To find the floating potential of a plasma using the Langmuir probe.

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**PSPL6009: PHYSICS LABORATORY I**

(0-0-4)

**COURSE OUTCOMES**

1. Demonstrate the validity of various network theorems. (Understanding)
2. Explain the working of various circuits containing semiconductor devices. (Understanding)
3. Construct various rectifier circuits. (Applying)
4. Build various filter circuits. (Applying)
5. Illustrate the working of various transistor circuits. (Understanding)
6. Explain the behaviour of Op-Amp circuits. (Understanding)
7. Demonstrate the working of logic circuits. (Understanding)
8. Explain the transmission of electromagnetic waves through optical fibers. (Understanding)
At least 10 experiments should be performed from the following:
1. Verification of KCL and KVL using discrete components.
2. Verification of Thevenin’s theorem.
3. VI characteristics of PN junction diode.
5. Design and study the clipper circuit.
6. Design and study the clamper circuit.
7. VI characteristics of Zener diode.
8. Design of Half wave and Full wave rectifier with and without filter.
9. RC low pass and high pass filter realization.
13. Design BJT as a switch.
15. Realization of basic gates using discrete components.
16. To measure attenuation and bending losses of an optical fibre.
17. To study and verify the truth table of logic gates.
18. To realize half/full adder and half/full subtractor.

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PSCN6010: COMPUTER ORIENTED NUMERICAL METHODS LAB
(0-0-8)

**COURSE OUTCOMES**
1. Find out inverse, eigenvalues and eigenvectors of a matrix. (Application)
2. Perform numerical integration and differentiation and solution of differential equations. (Application)
3. Understand special functions and orbitals. (Understanding)
5. Numerical solutions of simultaneous equations. (Application)
6. Understand chaos. (Understanding)
7. Apply Monte-Carlo simulations. (Application)
8. Study LCR circuits. (Application)
9. Model data. (Analysing)
10. Compute Fourier transform. (Application)

At least 10 experiments should be performed from the following:
(All experiments are to be done using the Fortran, C Language)
1. Basic operations using a matrix A.
   a. To find the transpose of A.
   b. To find the inverse of A.
   c. To verify the accuracy of AA-1= I.
   d. To diagonalise a given matrix.
   e. To find the eigenvalues and eigenvectors.
   a. To find the derivative of a given function f(x) using the standard formula where h is the step size.
   b. To determine the second derivative of a given function f(x) using the standard formula.
c. Plot the case (a) as a function of x.
d. Plot the case (b) as a function of x.
e. Compare the above cases (a) and (b) with the results obtained analytically in specific cases.

   a. Obtain numerical solution for the time independent Schrödinger equation in one dimension for a given potential using Runge-Kutta Method or Fox Godwin method.
   b. To plot the wave function obtained from above versus x.
   c. Obtain numerical solution for the time independent Schrödinger equation in three dimension for a given potential using Runge-Kutta method or Fox Godwin Method.
   d. To plot the wave function obtained from above versus r.
   e. To evaluate the eigenvalues and eigenvectors for case (a).
   f. To evaluate eigenvalues and eigenvectors for case (b).
   g. To count the number of nodes of the function determined in (a) above and see if it is consistent with the theoretical expectation.
   h. To determine the boundary value problems for cases (a) and (c).

4. Spherical harmonics.
   a. To compute the Legendre polynomials.
   b. To plot spherical harmonics as a function of polar angles.
   c. To compute the spherical Bessel function (regular and irregular).
   d. To plot the case (c).

   a. To integrate a given function numerically by Simpson’s Rule.
   b. To compare the results obtained form (a) with those obtained analytically.
   c. To integrate a given function numerically by Trapezoidal rule.
   d. To compare the results obtained from (b) with those obtained analytically.
   e. To integrate a given function numerically by Gauss-Legendre integration.
   f. To compare the results obtained form (c) with those obtained analytically.

   a. Solve a given equation numerically using Newton Raphson method.
   b. Compare the result of (a) with those obtained numerically.
   c. To solve a given equation using bisection method.
   d. Comparative study of (a), (b) and (c).

7. Solution of simultaneous equations.
   b. Compare (a) with solutions obtained analytically or algebraically.

8. Logistic systems.
   To explore the regions of (a) stable fixed points (b) periodic and (c) chaotic solution.

9. Radioactivity.
   a. Use Monte-Carlo method to simulate radioactive decay.
   b. Write a program for a radioactive series, when the daughter is also radioactive and soon.
   c. Plot N (number of nuclei) Vs time t.
   d. From the slope calculate the activity at different times.

10. LCR circuits.
    a. To compute the charge and discharge of an RC circuit using DC source.
    b. To compute the charge and discharge of RC circuits using AC source.
    c. Analyse the energy in the RL circuit using the Runge-Kutta method.
    d. Study the energy dissipated in a series LCR circuit. Plot it versus time t.

11. Modelling of data.
    a. To compute for a given sample of data.
    b. To fit a given sample of data by least square method by a straight line.
    c. To fit by minimizing by straight line.
    d. To make a polynomial fit by least square method.
    e. To make a polynomial fit by minimizing.

12. Fourier transform special methods.
    a. To compute Fourier transform of discretely sampled data.
    b. To compute Fast Fourier transform of real functions and Sine and Cosine Transformations.
    c. To compute Fourier transform of a given function in two or more dimensions.

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### PSPM6013: PLASMA PHYSICS LABORATORY

(0-0-4)

**COURSE OUTCOMES**

1. Explain the breakdown mechanism of gasses. (Remembering)
2. Understand the electrical properties of a gas discharge. (Understanding)
3. Operate and conduct experiments in plasma devices. (Application)
4. Collect and analyse data from plasma devices. (Analysing)
5. Use plasma diagnostic tools. (Application)

**At least 10 experiments should be performed from the following:**

1. Experimental determination of minimum breakdown voltage in a glow discharge system.
2. To study the effect of variation in chamber pressure on different regions of a glow discharge.
3. To study the effect of variation in discharge voltage on different regions of a glow discharge.
4. To plot the I-V characteristics of a glow discharge plasma.
5. To find the variation in resistance of a glow discharge plasma with chamber pressure.
6. To find the variation in resistance of a glow discharge plasma with discharge voltage.
7. To find the variation in floating potential with discharge voltage of a plasma using Langmuir probe.
8. To find the variation in floating potential with chamber pressure of a plasma using Langmuir probe.
9. To find the plasma potential of a plasma using Langmuir.
10. To find the electron temperature of a plasma using the Langmuir probe.
11. To find the electron density of a plasma using the Langmuir probe.
12. Identification of different ions/atoms/molecules in plasma by optical emission spectroscopy (OES).
13. To find the plasma density by optical emission spectroscopy (OES) using Stark Broadening of hydrogen lines.
14. To find the plasma temperature by optical emission spectroscopy (OES) using line intensity ratio method.
15. To find the plasma temperature by optical emission spectroscopy (OES) using Boltzmann Plot method.

**Mapping of COs to Syllabus**

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### PSEL6014: ELECTRONICS LABORATORY

(0-0-4)

**COURSE OUTCOMES**

1. Explain transistor operation. (Remembering)
2. Understand amplifier design using transistor. (Understanding)
3. Operational Amplifier and Timer applications. (Application)
4. Analyse Logic Gates. (Analysis)
5. Application of gates for Digital circuits. (Application)

**At least 10 experiments should be performed from the following:**

1. Design of amplifiers: Transistor amplifiers with and without feedback.
5. 555 timer as monostable multivibrator.
6. 555 timer as astable multivibrator.
7. 555 timer as bistable multivibrator.
8. To verify the truth table of MUX and DEMUX.
10. To verify the truth table of one bit and four bit comparators using logic Gates.
11. Truth table verification of Flip-Flops: (i) RS-Type, (ii) D-Type, (iii) T-Type, (iv) J-K Master Slave
12. To study shift register in all its modes i.e. SIPO/SISO, PISO/PIPO.

**Mapping of COs to the syllabus**

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**PSNY6015: NANOPHYSICS LABORATORY**

(0-0-4)

**COURSE OUTCOMES**
1. Calculations of molarity. (Remembering)
2. Understanding hydrothermal synthesis. (Understanding)
3. Understanding characterization techniques. (Understanding)
4. Application of characterization techniques on synthesized material. (Application)
5. Analysis of characterizing results. (Analysis)

At least 10 experiments should be performed from the following:
1. Calculate molarity for different solutions. Learn to use the scientific balance (adjustments, taring, etc.).
2. Prepare stock solution of the following (100 ml):
   - 10mM Zn(NO₃)₂ · 6H₂O
   - 10mM 100ml CH₃N₄
   - 25 mM Na₂C₂H₃O₇
3. Synthesize ZnO nanoparticles using hydrothermal process.
4. Perform seeding of pre-synthesized ZnO nanoparticles on glass substrate. Also perform direct seeding of ZnO particles on glass substrate by thermal oxidation.
5. Grow ZnO nanorods on glass substrate hydrothermally.
7. Synthesize manganese doped ZnS nanoparticles using hydrothermal process.
8. Make film of ZnO nanoparticles on glass substrate using the LBL machine.
9. Use Super-hydrophobicity testing machine to find out the roll-off and contact angle of nanoparticle coated surface.
10. Synthesize CdS nanoparticles using hydrothermal process. Observe colour variations with size when illuminated with UV light.
11. Synthesize gold nanoparticles using Turkevitch process.
12. Sample preparation for different characterization techniques.
13. UV-vis spectroscopy to study optical properties of nanomaterials.
14. Tauc’s plot to determine band gap of semiconductors.
18. Analysing EDS plots.
19. Extracting information from XRD plots.
20. Measurement of WCA and ROA for different nanomaterial coated substrates.
21. PL spectroscopy on luminescent nanoparticles.

**Mapping of COs to the syllabus**

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**PSST6016: STUDY TOUR**

Study Tour is a mandatory non-credited course to be taken up in the final semester of M.Sc. (Physics) with an objective to provide students an exposure to higher studies and research in physics in other reputed institutes of the county. The study tour will not be less than 2 days and will not exceed 14 days. During the tour, the focus will be on visiting different higher educational institutes and/or research institutes. A report will be submitted and a presentation will be given at the end of the tour by each student based on which he/she will be declared “Pass”/“No Pass” in the course.

**PSPP6017: PROJECT PHASE I**

(2 credits)

During this phase the student will start a project applying the knowledge acquired during the first two semesters and also incorporating the recent trends in the chosen area. It should include phases of design, implementation and reporting. This project is to be executed individually within or outside the campus. The mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

E-resource for learning:

LaTeX

**PSPR6018: PROJECT PHASE II**

(3 credits)

During this phase the student will complete the project started in the previous semester. The final implementation of the project and report writing shall be done in this semester. The student shall be required to make a number of presentations to report on the progress of the project. There will be a viva voce examination which shall follow the final submission of the project report. The mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

**PSMY6101: MATHEMATICAL PHYSICS-I LABORATORY**

(0-0-2)

**COURSE OUTCOMES**

1. Explain the fundamentals of scientific computing. (Understanding)
2. Outline the basics of programming in C and C++ programming languages. (Understanding)
3. Organize computations efficiently using data structures. (Applying)
4. Utilize file handling for input and output of physical data. (Applying)
5. Develop computational models for physical problems. (Applying)

At least 10 experiments to be performed from the following:

<table>
<thead>
<tr>
<th>Experiments</th>
<th>Description with Applications</th>
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<tbody>
<tr>
<td>1. Introduction and Overview</td>
<td>Computer architecture and organization, memory and I/O devices</td>
</tr>
<tr>
<td>2. Basics of scientific computing</td>
<td>Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &amp; overflow: emphasize the importance of making equations in terms of dimensionless variables, Iterative methods</td>
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</table>
PSMA6102: MECHANICS LABORATORY

(0-0-2)

COURSE OUTCOMES
1. Measure distances and angles accurately. (Application)
2. Measure various properties of solid matters. (Application)
3. Measure acceleration due to gravity by different techniques. (Application)

At least 10 experiments to be performed from the following:
1. Measurements of length (or diameter) using Vernier caliper, screw gauge and travelling microscope.
2. Study the random error in observations.
3. Determine the height of a building using a Sextant.
4. Study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
5. Determine the Moment of Inertia of a Flywheel.
6. Determine g and velocity for a freely falling body using Digital Timing Technique
8. Determine the Young’s Modulus of a Wire by Optical Lever Method.
9. Determine the Modulus of Rigidity of a Wire by Maxwell’s needle.
10. Determine the elastic Constants of a wire by Searle’s method.
11. Determine the value of g using Bar Pendulum.
12. Determine the value of g using Kater’s Pendulum.

Mapping of COs to the syllabus

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PSSEM6103: ELECTRICITY AND MAGNETISM LABORATORY
(0-0-2)

COURSE OUTCOMES
1. Demonstrate the operation of electrical measuring instruments. (Understanding)
2. Measure various parameters of electrical devices and circuits. (Evaluating)
3. Measure physical quantities using established methods and apparatus. (Evaluating)
4. Measure fields using electrical apparatus. (Evaluating)
5. Demonstrate the validity of various network theorems in practical applications. (Understanding)
6. Utilize the concept of induction to study various AC circuits. (Applying)

At least 10 experiments to be performed from the following:
1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. Study the characteristics of a series RC Circuit.
4. Determine an unknown Low Resistance using Carey Foster’s Bridge.
5. Compare capacitances using De’Sauty’s bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. Verify the Thevenin and Norton theorems.
8. Verify the Superposition, and Maximum power transfer theorems.
9. Determine self inductance of a coil by Anderson’s bridge.
10. Study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Bandwidth.
11. Study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.
12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
15. Determine the mutual inductance of two coils by Absolute method.

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PSWO6104: WAVES AND OPTICS LABORATORY
(0-0-2)

COURSE OUTCOMES
1. Measure frequency of different types of oscillators. (Application)
2. Determine experimentally the properties of optical devices. (Application)
3. Measure wavelength of monochromatic light by different techniques. (Application)

**At least 10 experiments to be performed from the following:**
1. Determine the frequency of an electric tuning fork by Melde’s experiment and verify \( \lambda_2 - T \) law.
2. Investigate the motion of coupled oscillators.
3. Study Lissajous Figures.
4. Familiarization with: Schuster’s focusing; determination of angle of prism.
5. Determine refractive index of the Material of a prism using sodium source.
6. Determine the dispersive power and Cauchy constants of the material of a prism using mercurysource.
7. Determine the wavelength of sodium source using Michelson’s interferometer.
10. Determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11. Determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. Determine dispersive power and resolving power of a plane diffraction grating.

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**PSMS6105: MATHEMATICAL PHYSICS-II LABORATORY**

(0-0-2)

**COURSE OUTCOMES**
1. Outline the basics of scientific computing using Scilab. (Understanding)
2. Demonstrate the principles of curve fitting using physical applications. (Understanding)
3. Utilize concepts from linear algebra to solve physical problems. (Applying)
4. Demonstrate the solutions and plots of special functions. (Understanding)
5. Solve physical problems using ordinary and partial differential equations. (Applying)
6. Model physical scenarios using Scicos/Xcos simulations. (Applying)

**At least 10 experiments to be performed from the following.**

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<th>Topics</th>
<th>Description with Applications</th>
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<tr>
<td>1. Introduction to Numerical computation software Scilab</td>
<td>Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (2), Branching Statements and program design, Relational &amp; logical operators, the while loop, for loop, details of loop operations, break &amp; continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writinga program (2).</td>
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<td>2. Curve fitting, Least square fit, Goodness of fit, standard deviation</td>
<td>Ohms law to calculate R, Hooke’s law to calculate spring constant</td>
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3. Solution of Linear system of equations by Gauss elimination method and Gauss-Seidal method.
5. Generation of Special functions using User defined functions in Scilab
6. Solution of ODE
7. First order Differential equation Euler, modified Euler and Runge-Kutta second order methods
8. Second order differential equation Fixed difference method
9. Partial differential equations
10. Using Scicos / xcos

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PSPT6106: THERMAL PHYSICS LABORATORY

(COURSE OUTCOMES)
1. Measure mechanical equivalent of heat. (Application)
2. Determine thermal conductivity. (Application)
3. Use Platinum Resistance Thermometer. (Application)
4. Understand thermo-emf and thermocouple. (Understanding)
5. Understand the relationship between heat and mechanical work. (Understanding)

At least 5 experiments to be performed from the following:
1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne’s constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle’s Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom’s Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton’s disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
7. To calibrate a thermocouple to measure temperature in a specified range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.

Mapping of COs to the syllabus

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PSDA6107: DIGITAL SYSTEMS AND APPLICATIONS LABORATORY
(0-0-2)

COURSE OUTCOMES
1. Use of CRO and measurement of different parameters. (Remembering)
2. Understanding digital measuring equipments. (Understanding)
3. Understanding logic gates. (Understanding)
4. Analysis of Digital circuits circuits. (Analysis)
5. Execution of 8085 microprocessor programming. (Understanding)

At least 5 experiments to be performed from the following:
1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
2. To test a Diode and Transistor using a Multimeter.
3. To design a switch (NOT gate) using a transistor.
4. To verify and design AND, OR, NOT and XOR gates using NAND gates.
5. To design a combinational logic system for a specified Truth Table.
6. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
7. To minimize a given logic circuit.
8. Half Adder, Full Adder and 4-bit binary Adder.
9. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
10. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
11. To build JK Master-slave flip-flop using Flip-Flop ICs.
12. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
13. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.
14. To design an astable multivibrator of given specifications using 555 Timer.
15. To design a monostable multivibrator of given specifications using 555 Timer.
16. Write the following programs using 8085 Microprocessor.
   a. Addition and subtraction of numbers using direct addressing mode
   b. Addition and subtraction of numbers using indirect addressing mode
      c) Multiplication
         b. by repeated addition.
   a. Division by repeated subtraction.
   b. Handling of 16-bit Numbers.
   c. Use of CALL and RETURN Instruction.
   d. Block data handling.
   e. Other programs (e.g. Parity Check, using interrupts, etc.).

Mapping of COs to the syllabus

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PSMP6108: MATHEMATICAL PHYSICS-III LABORATORY
(0-0-2)

COURSE OUTCOMES
1. Develop numerical solutions of ordinary differential equations. (Applying)
2. Develop numerical solutions of definite integrals. (Applying)
3. Make use of Scilab for evaluating integral transforms. (Applying)
4. Evaluate approximations of the Dirac delta function. (Evaluating)
5. Make use of Scilab for complex analysis. (Applying)
6. Make use of Scilab for experimental error analysis. (Applying)

At least 5 experiments to be performed from the following:

1. Solve differential equations:
   a. \( \frac{dy}{dx} = e^{-x} \) with \( y = 0 \) for \( x = 0 \)
2. Dirac Delta Function:
   a. Evaluate \( \int \frac{1}{\sqrt{2\pi \sigma^2}} e^{-\frac{(x-a)^2}{2\sigma^2}} (x + 3) \) for \( \sigma = 1, 0.1, 0.01 \) and show it tends to 5.
3. Fourier Series:
   a. Program to sum \( \sum_{n=1}^{N} (0.2)^n \)
   b. Evaluate the Fourier coefficients of a given periodic function (square wave)
4. Frobenius method and Special functions:
   a. \( \int_{-1}^{1} P_n(x)P_m(x)dx = \delta_{nm} \)
   b. Plot \( P_n(x), J_n(x) \)
   c. Show recursion relation
5. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).
6. Calculation of least square fitting manually without giving weightage to error. Confirmation of a. least square fitting of data through computer program.
7. Evaluation of trigonometric functions e.g. \( \sin \theta \), Given Bessel’s function at \( N \) points find its value a. at an intermediate point. Complex analysis: Integrate \( \frac{1}{(x+2)^2} \) numerically and check with b. computer integration.
8. Compute the \( n^{th} \) roots of unity for \( n = 2, 3, \) and 4.
9. Find the two square roots of \( -5+12i \).
10. Integral transform: FFT of \( e^{-s^2} \)

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PSEP6109: ELEMENTS OF MODERN PHYSICS LABORATORY
(0-0-2)

COURSE OUTCOMES
1. Measure Planck's constant by various techniques. (Application)
2. Explain the phenomenon of photo electric effect. (Understanding)
3. Measure the e/m value of electrons. (Application)
4. Measure physical properties of certain elements and devices. (Application)
5. Measure wavelength of monochromatic light by different techniques. (Application)

At least 10 experiments to be performed from the following:
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating.

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PSAS6110: ANALOG SYSTEMS AND APPLICATIONS LABORATORY
(0-0-2)

COURSE OUTCOMES
1. Understanding analog devices. (Understanding)
2. Applications of analog devices. (Application)
3. Application of Op Amp. (Application)
4. Analysis of analog circuits. (Analysing)
5. Understanding device characteristics under different circuit condition. (Understanding)

At least 10 experiments to be performed from the following:
1. To study V-I characteristics of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To study the various biasing configurations of BJT for normal class A operation.
6. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
7. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
8. To design a Wien bridge oscillator for given frequency using an op-amp.
9. To design a phase shift oscillator of given specifications using BJT.
10. To study the Colpitt’s oscillator.
11. To design a digital to analog converter (DAC) of given specifications.
12. To study the analog to digital converter (ADC) IC.
13. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
14. To design inverting amplifier using Op-amp (741,351) and study its frequency response
15. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
16. To study the zero-crossing detector and comparator
17. To add two dc voltages using Op-amp in inverting and non-inverting mode
18. To design a precision Differential amplifier of given I/O specification using Op-amp.
19. To investigate the use of an op-amp as an Integrator.
20. To investigate the use of an op-amp as a Differentiator.
21. To design a circuit to simulate the solution of a 1st/2nd order differential equation.

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**PSGP6111: GENERAL THERMAL PHYSICS LABORATORY**

(0-0-2)

**COURSE OUTCOMES**

1. Measure mechanical equivalent of heat. (Application)
2. Determine thermal conductivity. (Application)
3. Use Platinum Resistance Thermometer. (Application)
4. Understand thermo-emf and thermocouple. (Understanding)
5. Understand the relationship between heat and mechanical work. (Understanding)
6. Determine different physical constants. (Application)
7. Calibrate Resistance Temperature Device. (Application)

At least 8 experiments to be performed from the following:

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne’s constant flow method.
3. To determine Stefan’s Constant.
4. To determine the coefficient of thermal conductivity of Cu by Searle’s Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom’s Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton’s disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and Analyse the cooling temperature of a hot object as a function of time using athermocouple and suitable data acquisition system.

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PSGM6112: GENERAL ELEMENTS OF MODERN PHYSICS LABORATORY
(0-0-2)

COURSE OUTCOMES
1. Measure Planck’s and Boltzmann constant. (Application)
2. Measure properties of various types of elements and devices. (Application)
3. Measure the e/m value of electrons. (Application)

At least 8 experiments to be performed from the following:
1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine the ionization potential of mercury.
4. To determine value of Planck’s constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of iodine vapour.
7. To study the diffraction patterns of single and double slits using laser and measure its intensity variation using Photosensor & compare with incoherent source – Na.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
9. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.

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PSQM6111: QUANTUM MECHANICS AND APPLICATIONS LABORATORY
(0-0-2)

COURSE OUTCOMES
1. Make use of Scilab to solve the s-wave radial Schrodinger wave equation for atoms (Applying)
2. Demonstrate electron spin resonance and its applications (Understanding)
3. Simulate interaction between spectral lines and external fields (Understanding)
4. Make use of Scilab to demonstrate the evolution of the wave function under a potential (Applying)
5. Demonstrate photon-matter interactions (Understanding)

At least 5 experiments should be performed from the following:
1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

\[
\frac{d^2\psi}{dr^2} = (-\frac{2m}{\hbar^2})[V(r) - E] \psi = -\frac{e^2}{r}
\]

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is \(-13.6 \text{ eV}\). Take \(e = 3.795 \text{ (eVÅ)}^{1/2}\), \(\hbar = 1973 \text{ (eVÅ)}\) and \(m = 0.511 \times 10^6 \text{ eV/c}^2\).

2. Solve the s-wave radial Schrodinger equation for an atom:

\[
\frac{d^2\psi}{dr^2} = \frac{\hbar^2}{2m}[V(r) - E] \psi
\]

where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

\[
V(r) = -\frac{e^2}{r} e^{-ar/\alpha}
\]

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take \(e = 3.795 \text{ (eVÅ)}^{1/2}\), \(m = 0.511 \times 10^6 \text{ eV/c}^2\), and \(a = 3 \text{ Å}, 5 \text{ Å}, 7 \text{ Å}\). In these units \(\hbar = 1973 \text{ (eVÅ)}\). The ground state energy is expected to be above \(-12 \text{ eV}\) in all these cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

\[
\frac{d^2\psi}{dr^2} = \frac{\hbar^2}{2m}[V(r) - E] \psi
\]
For the anharmonic oscillator potential

\[ V(r) = -\frac{1}{2}kr^2 + \frac{1}{4}br^4 \]

for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose \( m = 940 \text{ MeV}/c^2,\ k = 100 \text{ MeV} \cdot \text{fm}^{-2}, b = 0, 10, 30 \text{ MeV} \cdot \text{fm}^{-3}\). In these units, \( c_f = 197.3 \text{ MeV} \cdot \text{fm} \). The ground state energy \( E \) expected to lie between 90 and 110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

\[ \frac{d^2\psi}{dr^2} = A(r)\psi(r), A(r) = \frac{2\mu}{r^2} [V(r) - E] \]

Where \( \mu \) is the reduced mass of the two-atom system for the Morse potential

\[ \psi(r) = (\text{e}^{-\alpha r}, \text{e}^{-\alpha r}), \quad r' = \frac{r - r_0}{r} \]

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.

Take: \( m = 940 \times 10^3 \text{eV}/c^2, D = 0.755501 \text{eV}, \alpha = 1.44, r_0 = 0.131349 \text{ Å} \).

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency.
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting.
7. To show the tunneling effect in tunnel diode using I-V characteristics.
8. Quantum efficiency of CCDs.

### Mapping of COs to the syllabus

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### PSSS6112: SOLID STATE PHYSICS LABORATORY (0-0-2)

#### COURSE OUTCOMES

1. Learn about magnetic properties of matter. (Understanding)
2. Analyse dielectric properties of materials. (Applying)
3. Understand and analyse few topics related to semiconductor physics. (Analysing)

#### At least 8 experiments should be performed from the following:

1. Measurement of susceptibility of paramagnetic solution (Quinck’s Tube Method).
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency.
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR).
6. To determine the refractive index of a dielectric layer using SPR.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150 °C) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

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### PSES6113: EMBEDDED SYSTEM: INTRODUCTION TO MICROCONTROLLERS LABORATORY (0-0-2)
DEPARTMENT OF PHYSICS

**COURSE OUTCOMES**

1. Use 8051 microcontroller for various applications. (Application)
2. Use Arduino microcontroller for various applications. (Application)

**At least 10 experiments should be performed from the following:**

(8051 microcontroller based Programs and experiments)
1. To find that the given numbers are prime or not.
2. To find the factorial of a number.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED’s. Simulate binary counter (8bit) on LED’s.
5. Program to glow the first four LEDs then next four using TIMER application.
6. Program to rotate the contents of the accumulator first right and then left.
7. Program to run a countdown from 9-0 in the seven segment LED display.
8. To interface seven segment LED display with 8051 microcontroller and display ‘HELP’ in the seven segment LED display.
9. To toggle ‘1234’ as ‘1324’ in the seven segment LED display.
10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clockwise or counter clockwise direction.
11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard. (Arduino based programs and experiments)
12. Make a LED flash at different time intervals.
13. To vary the intensity of LED connected to Arduino.
14. To control speed of a stepper motor using a potential meter connected to Arduino.
15. To display "PHYSICS" on LCD/CRO.

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**PSDI6114: PHYSICS OF DEVICES AND INSTRUMENTS LABORATORY**

(0-0-2)

**COURSE OUTCOMES**

1. Design and develop rectifiers, filters, modulators etc. (Application)
2. Explain the characteristics of various electronics components. (Understanding)
3. Use SPICE/MULTISIM simulations for electrical networks and electronic circuits analysis. (Analysing)

**At least 10 experiments should be performed from the following:**

1. To design a power supply using bridge rectifier and study effect of C-filter.
2. To design the active Low pass and High pass filters with given specification.
3. To design the active filter (wide band pass and band reject) with given specification.
4. To study the output and transfer characteristics of a JFET.
5. To design a common source JFET Amplifier and study its frequency response.
6. To study the output characteristics of a MOSFET.
7. To study the characteristics of a UJT and design a simple Relaxation Oscillator.
8. To design an Amplitude Modulator using Transistor.
9. To design PWM, PPM, PAM and Pulse code modulation using ICs.
10. To design an Astable multivibrator of given specifications using transistor.
11. To study a PLL IC (Lock and capture range).
12. To study envelope detector for demodulation of AM signal.
13. Study of ASK and FSK modulator.
14. Glow an LED via USB port of PC.
15. Sense the input voltage at a pin of USB port and subsequently glow the LED connected with another pin of USB port. (The following are SPICE/MULTISIM simulations for electrical networks and electronic circuits)
16. To verify the Thevenin and Norton Theorems.
17. Design and analyse the series and parallel LCR circuits.
18. Design the inverting and non-inverting amplifier using an Op-Amp of given gain.
19. Design and Verification of op-amp as integrator and differentiator.
20. Design the 1st order active low pass and high pass filters of given cutoff frequency.
21. Design a Wein’s Bridge oscillator of given frequency.
22. Design clocked SR and JK Flip-Flop’s using NAND Gates.
23. Design 4-bit asynchronous counter using Flip-Flop ICs.
24. Design the CE amplifier of a given gain and its frequency response.
25. Design an Astable multivibrator using IC555 of given duty cycle.

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**PSC6115: COMMUNICATION ELECTRONICS LABORATORY**
(0-0-2)

**COURSE OUTCOMES**
1. Design of modulators and multiplexing technique. (Application)
2. Explain different techniques of Analog wave modulation. (Understanding)
3. Explain different techniques of pulse modulation. (Understanding)
4. Explain different techniques of digital modulation. (Understanding)

At least 8 experiments should be performed from the following:
1. To design an Amplitude Modulator using Transistor.
2. To study envelope detector for demodulation of AM signal.
3. To study FM - Generator and Detector circuit.
4. To study AM Transmitter and Receiver.
5. To study FM Transmitter and Receiver.
6. To study Time Division Multiplexing (TDM).
7. To study Pulse Amplitude Modulation (PAM).
8. To study Pulse Width Modulation (PWM).
9. To study Pulse Position Modulation (PPM).
10. To study ASK, PSK and FSK modulators.

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**PSET6116: ELECTROMAGNETIC THEORY LABORATORY**
(0-0-2)

**COURSE OUTCOMES**
1. Know about the physics of polarization of electromagnetic waves. (Understanding)
2. Build clear concept of wave properties of electromagnetic wave and its application to various systems / media. (Understanding and Applying)
3. Analyse the physics of radiation. (Analysing)

At least 8 experiments should be performed from the following:
1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyse elliptically polarized Light by using a Babinet’s compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves.
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston’s air-film.
9. To determine the refractive index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
11. To verify the Stefan’s law of radiation and to determine Stefan’s constant.
12. To determine the Boltzmann constant using V-I characteristics of PN junction diode.

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PSET6117: STATISTICAL MECHANICS LABORATORY

(0-0-2)

COURSE OUTCOMES

1. Realize numerical techniques to handle systems with large number of particles and to study their statistics. (Understanding)
2. Conceptualize numerically the classical and quantum statistical mechanics. (Understanding)
3. Analyse the knowledge of classical and quantum theory of radiation numerically. (Analysing)

At least 3 experiments should be performed from the following:

(Use C/C*+/Scilab/other numerical simulations for solving the problems)

1. Computational analysis of the behaviour of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions:
   a) Study of local number density in the equilibrium state (i) average; (ii) fluctuations.
   b) Study of transient behaviour of the system (approach to equilibrium.
   c) Relationship of large N and the arrow of time.
   d) Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity distribution.
   e) Computation and study of mean molecular speed and its dependence on particle mass.
   f) Computation of fraction of molecules in an ideal gas having speed near the most probable speed.

2. Computation of the partition function Z(β) for examples of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac and Bose- Einstein statistics:
   a) Study of how Z(β), average energy <E>, energy fluctuation ΔE, specific heat at constant volume CV, depend upon the temperature, total number of particles N and the spectrum of single particle states.
   b) Ratios of occupation numbers of various states for the systems considered above.
   c) Computation of physical quantities at large and small temperature T and comparison of various statistics at large and small temperature T.

3. Plot Planck’s law for Black Body radiation and compare it with Raleigh-Jeans Law at high temperature and low temperature.

4. Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature and low temperature and compare them for these two cases.

5. Plot the following functions with energy at different temperatures:
   a) Maxwell-Boltzmann distribution
   b) Fermi-Dirac distribution
   c) Bose-Einstein distribution

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PSNA6118: NANO MATERIALS AND APPLICATIONS LABORATORY
(0-0-2)

COURSE OUTCOMES
1. Synthesis nanoparticles. (Analysis)
2. Develop the concept of metal nanoparticle. (Understanding)
3. Study the effect of size on color of nanomaterials. (Application)
4. Learn different process of analysing nanoparticle. (Analysis)
5. Learn the concept of quantum dots. (Application)

At least 8 experiments should be performed from the following:
1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on colour of nanomaterials.
6. To prepare composite of CNTs with other materials.
8. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
9. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittancespectra in UV-Visible region.
10. Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency.
11. Fabricate a PN diode by diffusing Al over the surface of N-type Si and study its V-I characteristic.

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PSDP6119: DIGITAL SIGNAL PROCESSING LABORATORY
(0-0-2)

COURSE OUTCOMES
1. Explain Unit sample sequence, unit step sequence, ramp sequence, real valued exponential sequence. (Understanding)
2. Compute the convolution sum of a rectangle signal. (Analysis)
3. Calculate and plot the steady state response and frequency response. (Application)
4. Learn to design digital filter to eliminate the lower frequency sinusoidal. (Application)
5. Design a digital FIR differentiator. (Application)

At least 8 experiments should be performed from the following:
(Sclab based simulations based problems)
1. Write a program to generate and plot the following sequences: (a) Unit sample sequence δ(n),
   (b) unit step sequence u(n), (c) ramp sequence r(n), (d) real valued exponential sequence x(n) = 0.8^n u(n) for 0 ≤ n ≤ 50.
2. Write a program to compute the convolution sum of a rectangle signal (or gate function) with itself for N = 5
   \[ x(n) = \text{rect} \left( \frac{n}{2N} \right) = \prod_{k=1}^{N} 1 \leq n \leq N \]
   \[ \begin{cases} 1 & 0 \leq n \leq N \\ 0 & \text{otherwise} \end{cases} \]
3. An LTI system is specified by the difference equation
   \[ (n) = 0.8(n-1) + (n) \]
   (a) Determine H(e^jw)
   (b) Calculate and plot the steady state response y_n(n) to x(n) = cos(0.5πn) u(n)
   (c) Given a casual system
\[(n) = 0.9(n - 1) + (n)\]

4. Design a digital filter to eliminate the lower frequency sinusoid of
\[
\theta = \sin \sin 7t + \sin \sin 200.
\]
The sampling frequency is \(f_s = 500\ Hz\). Plot its pole zero diagram, magnitude response, input and output of the filter.

5. Let \(x(n)\) be a 4-point sequence:
\[
x(n) = \begin{cases} 
1, & 1, 1, 1, \quad 0 \leq n \leq 3 \\
0, & \text{otherwise}
\end{cases}
\]
Compute the DTFT \(X(e^{j\omega})\) and plot its magnitude
(a) Compute and plot the 4 point DFT of \(x(n)\)
(b) Compute and plot the 8 point DFT of \(x(n)\) (by appending 4 zeros)
(c) Compute and plot the 16 point DFT of \(x(n)\) (by appending 12 zeros)

6. Let \(x(n)\) and \(h(n)\) be the two 4-point sequences,
\[
x(n) = \begin{cases} 
1, & 2, 2, 1 \\
1, & -1, -1, 1 
\end{cases}
\]
Write a program to compute their linear convolution using circular convolution.

7. Using a rectangular window, design a FIR low-pass filter with a pass-band gain of unity, cut off frequency of 1000 Hz and working at a sampling frequency of 5 KHz. Take the length of the impulse response as 17.

8. Design an FIR filter to meet the following specifications: passband edge \(f_p = 2\ kHz\)
Stop band edge \(f_s = 5\ kHz\)
Passband attenuation \(A_p = 2\ dB\)
Stopband attenuation \(A_s = 42\ dB\)
Sampling frequency \(f_s = 20\ kHz\)

Using a Hamming window of length \(M = 21\), design a digital FIR differentiator. Plot the amplitude response.

### Mapping of COs to the syllabus

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**PSCP6120: COMPUTATIONAL PHYSICS USING PYTHON**

(2-0-0)

**Course Outcomes**

1. Outline the fundamental elements of Python computing. (Understanding)
2. Estimate the accuracy and speed of a Python code. (Applying)
3. Develop Python code for solving definite integrals and finding derivatives. (Applying)
4. Solve systems of equations using Python arrays. (Applying)
5. Develop optimized numerical solutions of ordinary differential equations. (Applying)
6. Make use of Monte Carlo methods in random processes for solving physical problems. (Applying)
7. Propose computational solutions to physical problems using Python. (Creating)

**Module I: Elements of Python programming (9 lectures)**

Data types, basic mathematical operations, variables; lists: indexing, slicing, altering, appending and deleting elements, concatenation; tuples and dictionaries; conditional statements; loops: while and for loops; Python libraries: installing packages, importing packages; NumPy arrays and matrices, example: eigenvalues and eigenvectors; basics of data handling using Pandas; introduction to SciPy; data visualization using Matplotlib and Seaborn.

**Module II: Accuracy and speed (2 lectures)**

Variables and data ranges; numerical error; program speed.

**Module III: Numerical integrals and derivatives (4 lectures)**

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Fundamental integral evaluation methods: trapezoidal rule, Simpson’s rule; error estimation of integrals; Romberg integration; Gaussian quadrature; numerical differentiation: forward and backward differences, central differences, second derivatives, partial derivatives, differentiation error estimation.

**Module IV: Solving linear and non-linear equations (6 lectures)**
Linear equations: Gaussian elimination, back-substitution, pivoting, LU decomposition, matrix inverse, tridiagonal and banded matrices; nonlinear equations: binary search, Newton’s method, secant method

**Module V: Numerical solutions of ordinary differential equations (4 lectures)**
First-order differential equations with one variable: Euler’s method, Heun’s method, 4th order Runge-Kutta method; differential equations with multiple variables; second-order differential equations; boundary value problems: shooting method, relaxation method; eigenvalue problems.

**Module VI: Random processes (5 lectures)**
Random numbers generators and seeds; non-uniform random numbers, Gaussian random numbers; Monte Carlo integration: mean value method, integrals in many dimensions, importance sampling; importance sampling; Markov chain methods.

**Suggested Readings**

**Mapping of COs to Syllabus**

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SCHOOL OF LIFE SCIENCES
## COURSE STRUCTURE

### SCHOOL OF LIFE SCIENCES

#### DEPARTMENT OF BIOSCIENCES

### MASTER OF SCIENCE IN BIOCHEMISTRY

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### MASTER OF SCIENCE IN BIOTECHNOLOGY

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**MASTER OF SCIENCE IN MICROBIOLOGY**

**SEMESTER II**

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- Non-credit courses (NCC) are mandatory and assess the student performance by grading their score in internal and final examinations as – satisfactory (S) or Unsatisfactory (US) based on the performance of the students. Students securing 60% or above may be considered satisfactory (S).
- NPTEL -students can select any one course from NPTEL and produce a certificate as the end of the examination.
- Industrial or laboratory visit is mandatory on the basis of applicability and mentoring of the students. A report on the experience and learning can be submitted to respective mentors.
- Remedial Teaching & NET Coaching will be one hour/week
- Skill development program; options include Fermentation technology; herbal drug formulation; mushroom cultivation; waste management; (any 1)
- Value added course will be open for all and on completion of the course the student will receive a certificate to the learning
- Students will go for internships during the semester break between – I and II semester or II and III semester or III and IV Semester and produce a certificate and report of the training.
- Semester - IV- One Core course (4 credits) + One elective (2 credits) + Dissertation (16 credit)
## DEPARTMENT OF ZOOLOGY

### BACHELOR OF SCIENCE - HONOURS IN ZOOLOGY

*Wherever there is a practical there will be no tutorial and Vice versa*

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### SEMESTER VI

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## MASTER OF SCIENCE IN ZOOLOGY

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### Value Added Course

| ZGWP6011 | Introduction to Wildlife Photography | NC | 406 |

**Total Credits**: 18

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**Total Credits**: 18

**Total Programme Credits**: 80
DEPARTMENT OF BOTANY

BACHELOR OF SCIENCE - HONOURS IN BOTANY

*Wherever there is a practical there will be no tutorial and Vice versa*

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  - T-L-P: 2-0-0
  - Credits: 457
- BOMB0114: Medicinal Botany
  - T-L-P: 2-0-0
  - Credits: 458

### Generic Elective Course 4 (Theory)
- Credits: 4-0-0/5-0-0

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- Credits: 0-0-2/0-1-0

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### Total Credits
- Semester VI: 24

### Total Programme Credits
- MSc: 142

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**MASTER OF SCIENCE IN BOTANY**

**MSc COURSE STRUCTURE**

### SEMESTER I

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### COURSE STRUCTURE

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| Total Programme Credits | 88 |

| **SEMESTER III** | |
| Core Course (Theory) | BOCP0027 | Cytogenetics and Plant Breeding | 4-0-0 | 434 |
| Core Course (Theory) | BOPE0028 | Plant Ecology and Phytogeography | 4-0-0 | 435 |
| Core Course (Theory) | BOBB0029 | Biochemicals, Molecular Techniques and Bioinformatics | 4-0-0 | 436 |
| Core Course (Theory) | BOTC0030 | Plant Cell and Tissue Culture | 4-0-0 | |
| Core Course (Lab) | BOPE6030 | Plant Ecology Lab | 0-0-3 | |
| Core Course (Lab) | BOCT6031 | Cytogenetics, Molecular Techniques and Tissue Culture Lab | 0-0-3 | 472 |
| Value added course | | Herbal Medicine | NC | |
| Value added course | | Forest Inventory and Mensuration | NC | |
| Core Course (Lab) | BODI6032 | Dissertation Phase I | 0-0-4 | 472 |
| **Total Credits** | 26 |

| **SEMESTER IV** | |
| Core Course (Theory) | BOER0031 | Environmental Management, Research Methodology and Biostatistics | 4-0-0 | 437 |
| Core Course (Lab) | BOER6033 | Environmental Management, Research Methodology and Biostatistics Lab | 0-0-2 | 473 |
| Discipline Specific Elective | BOFP0032 | Fundamentals of Plant Biotechnology | 4-0-0 | 437 |
| Discipline Specific Elective | BOAB0033 | Advances in Plant Biotechnology | 4-0-0 | 438 |
| **Plant Biotechnology** | |
| Discipline Specific Elective | BOGT0034 | Genetics, Plant Breeding and Transformation | 4-0-0 | 439 |
| Discipline Specific Elective | BOMB0035 | Molecular Genetics and Bioinformatics | 4-0-0 | 440 |
| **Plant Genetics** | |
| Discipline Specific Elective | BOMG0036 | Microbial Physiology and Genetics | 4-0-0 | 441 |
| Discipline Specific Elective | BOAM0037 | Applied Microbiology | 4-0-0 | 442 |
| **Plant Microbiology** | |
| Discipline Specific Elective | BOTS0038 | Taxonomy of Angiosperms and Biosystematics | 4-0-0 | 442 |
| Discipline Specific Elective | BOBE0039 | Economic Botany and Ethnobotany | 4-0-0 | 443 |
| **Angiosperm Taxonomy** | |
| Discipline Specific Elective | BOEG0040 | Ecology, Environment and Global concerns | 4-0-0 | 445 |
| Discipline Specific Elective | BORE0041 | Restoration Ecology | 4-0-0 | 446 |
| Service Learning | BOSL0100 | Service Learning on Ethno Botanical Practices | 4-0-0 | 442 |
| Core Course (Dissertation) | BODI6034 | Dissertation Phase II | 0-0-12 | 473 |
| **Total Credits** | 26 |
| **Total Programme Credits** | 88 |
## GENERIC ELECTIVES

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### BOTANY

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SCHOOL OF LIFE SCIENCES
DETAILED SYLLABUS

DEPARTMENT OF BIO SCIENCES

PROGRAMME: MASTER OF SCIENCE (MSC) BIOCHEMISTRY

PROGRAMME OUTCOMES

PO 1: Skill Development: Master academic, technical, managerial and crucial soft skills to qualify for careers in research, industry, education, administration and management or for higher studies where a holistic understanding of applied biosciences is required.

PO 2: Research: Develop a scientific mindset with the capacity for analytical and innovative thinking and practical knowhow to formulate, design and ethically implement scientific research in frontier areas of Biochemistry, Biotechnology and Microbiology

PO 3: Communication: Acquire effective communication and creative expression skills in the form of writing, design, presentation and networking to convincingly articulate scientific ideas in biosciences and related fields

PO 4: Employment and Entrepreneurship: Acquire the necessary knowledge and proficiencies to become employable or get self-employed and thereby create job opportunities through entrepreneurship in health, agriculture, industry, environment and allied areas of applied biosciences and thereby affirmatively contribute to scientific social responsibility.

PROGRAMME SPECIFIC OUTCOMES

PSO 1: Confidence: Demonstrate a comprehensive understanding of chemical and biological structure, principles, techniques, and applications

PSO 2: Knowledge based Skill: To develop better understanding and improve skills that would enable them to begin a career in research laboratories, industries as well as to generate self-employability

PSO 3: Scientific Social Responsibility: To develop linkages between scientific community and society to build trust, partnership and responsibility of science towards achieving social goals

PSO 4: Research and analysis: Realize the impact of science in society and plan to pursue research, and learn to work as a team as well as independently to retrieve information, carry out research investigations and result interpretations

PSO 5: Diagnostic skills: Attain a remarkable understanding of biochemical principles of bioenergetics, metabolism, physiology and disorders through diagnostic laboratory procedures.

PSO 6: Technical and analytical skills: Acquire a thorough knowledge on omics biology, high-throughput omics approaches to analyse biological samples such as genomics, transcriptomics, proteomics, metabolomics and comprehensive analysis approach.

Mapping of Courses with POs/PSOs

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DEPARTMENT OF BIOSCIENCES - BIOCHEMISTRY

DETAILED SYLLABUS
THEORY COURSES

BCBM0010: MEDICAL BIOCHEMISTRY (3-0-0)

Course Outcomes
1. Define the different disorders of the body related to carbohydrate metabolism, lipid metabolism, Nitrogen metabolism and digestive disorders (Remembering)
2. Develop an understanding of how the different metabolism are interconnected (Understanding)
3. Classify disorders of each metabolism (Understanding)
4. Compare all metabolic disorders with their symptoms and etiology (Applying)
5. Examine the normal level of glucose, glycogen, protein, amino acid, nitrogen, diagnostic enzymes (Analysing)
6. Evaluate the genetic relation of each metabolic disorder with corresponding metabolism (Evaluating)
7. Discuss the link between the metabolic disorders and genetic make of patients (Creating)
8. Gain the knowledge on the molecular diagnostic test used in various infectious diseases (Understanding)

Module I (10 Lectures)

Module II (10 Lectures)

Module III (10 Lectures)

Module IV (15 Lectures)

Suggested Readings

Mapping of COs to Syllabus

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BCPY0011: PHYSIOLOGY (3-0-0)

Course Outcomes
1. Define and have an enhanced knowledge of the fundamentals of physiology by recalling and relating (Remembering).
2. Summarize how the separate systems interact to yield integrated physiological responses (Understanding).
3. Implement the acquired knowledge of the various mechanisms in executing and constructing experiments and apply in their day to day life (Applying).
4. Analyze and report on experiments and observations in physiology (Analysing).
5. Evaluate by presenting and defending opinions by making judgments about the mechanisms and functioning of organs and organ systems (Evaluating).
6. Appreciate, compile and generate new ideas on physiology (Creating).

Part A: Plant Physiology Module I (13 lectures)
- a. Electron transport system in plants - Oxidative phosphorylation, mitochondrial respiratory complexes, order and organization of electron carriers, electrochemical gradient, chemiosmotic theory, ATP synthase and mechanism of ATP synthesis.
- b. Nitrate assimilation - Structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation.

Module II (10 lectures)
- a. Special features of secondary plant metabolism - Terpenes (classification, biosynthesis), lignin, tannins, pigments, phytochrome, waxes, alkaloids, biosynthesis of nicotine, functions of alkaloids, cell wall components.
- b. Toxins of plant origin – Mycotoxins, phytohemagglutinins, lathyrogens, nitriles, protease inhibitors, protein toxins.
- c. Stress metabolism in plants - Environmental stresses, salinity, water stress, heat, chilling, anaerobiosis, pathogenesis, heavy metals, radiations and their impact on plant growth and metabolism, criteria of stress tolerance.
- d. Antioxidative defence system in plants – Reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defense mechanism.

Part B: Human Physiology Module III (12 lectures)
- b. Digestive system – Composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids, proteins, & nucleic acids.
- c. Respiratory system– Air passages and lung structure, pulmonary volumes, alveolar surface tension, work of breathing and its regulation.

Module IV (10 lectures)
- b. Nervous system-Muscle proteins, molecular mechanisms of muscle contraction (skeletal and smooth), nerve conduction, chemical regulation of synapses, neurotransmitters, neurons, resting membrane potential and action potential.

Suggested Readings

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BCFB0013: FUNDAMENTALS OF BIOCHEMISTRY (4-0-0)

Course Outcomes
1. Relate of the structural and functional aspects of biomolecules (Remembering)
2. Compare and draw the chemical structures of different biomolecules (Understanding)
3. Identify the monomers and polymers of biomolecules (Applying)
4. Analyse the interaction and importance of equilibrium maintenance of different biomolecules for health related issues (Analysing)
5. Estimate the different concentrations of biomolecules for biological applications (Evaluating)
6. Elaborate the biological applications of different biomolecules in drug discovery (Creating)

Module I (6 lectures)
Introduction to Biochemistry, water as biological solvent, weak acids and weak bases, pH and pK, buffers, Henderson- Hasselbalch equation, physiological buffers, fitness of the aqueous environment for living organisms

Module II (14 lectures)
- a. Classification, basic chemical structure, general reactions and properties, biological significance of monosaccharide, Sugar derivatives, deoxy sugars, amino sugars, and sugar acids, Mutarotation of sugar, Anomeric effect of sugar (Methylation effect), Inversion (hydrolysis) of cane sugar
- b. Polysaccharides - occurrence, structure, isolation, properties and functions of homoglycans - starch, glycogen, cellulose, dextrin, inulin, chitins, xylans, arabinans, galactans
- c. Occurrence, structure, properties, and functions of heteroglycans - bacterial cell wall polysaccharides, glycoaminoglycans, agar, algic acid, pectins, blood group substances and sialic acids, Glycoprotein and their biological applications, Lectins structure and functions

Module III (14 lectures)
- a. Definition and Classification - (simple, complex, derived lipids - structure and example). Saturated and unsaturated fatty acids, Nomenclature of fatty acids, General chemical reactions of fatty acids – esterification, hydrogenation and halogenations
- b. Phospholipids - classification, structure and functions, Ceramides and Sphingomyelins, Eicosanoids, structure and functions of prostaglandins, thromboxanes, leukotrienes, Types and functions of plasma lipoproteins, Amphipathic lipids - membranes, micelles, emulsions and liposomes.
- c. Steroids - cholesterol structure and biological role - bile acids, bile salts.
- d. General chemical reactions of fats: Hydrolysis, Saponification number, I2 number, acetylation, acetyl number, and volatile fatty acid number, Rancidity of fat.

Module IV (4 Hours)
Porphyrs: the porphyrin ring system, chlorophyll, hemoglobin, myoglobin and cytochrome.

Module V (10 lectures)
Watson-Crick Model of DNA structure: A, B and Z – DNA. Chemical Properties: Hydrolysis (acid, alkali), enzymatic hydrolysis of DNA. Cruciform structure in DNA, formation and stability of cruciform, HDNA, palindrome, secondary and tertiary structure of RNA, hnRNA, si RNA, Cot value curve, hypochromic and hyperchromic effect, DNA-protein interactions, Viscosity, Buoyant density, Tm

Module VI (12 lectures)
- a. Definition, classification, structure, stereochemistry and reactions of amino acids;
- b. Classification of proteins on the basis of solubility and shape, structure, and biological functions. Primary structure - determination of amino acid sequences of proteins, the peptide bond, Ramachandran plot.
- d. Tertiary structure - alpha and beta domains. Quaternary structure - structure of haemoglobin, Solid state synthesis of peptides, Protein-Protein interactions, Concept of chaperones.

Suggested Readings
BCAT0014: ANALYTICAL TECHNIQUES (4-0-0)

Course Outcome
1. Define the basic principles, concepts and applications of various analytical techniques used in biological sciences (Remembering)
2. Apply the knowledge of centrifugation to separate a constituent from a complex mixture (Applying)
3. Choose a suitable microscopic, electrophoretic, and chromatographic technique to identify and purify a target molecule from a complex mixture (Applying)
4. Select an opposite spectroscopic technique to characterize a sample (Analysing)
5. Ability to appraise the various techniques and formulate an appropriate plan for research studies (Evaluating)

Module I (12 lectures)
Principle of centrifugation, concept of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation

Module II (9 lectures)
Concepts of spectroscopy; Beer-Lambert’s law, Principles and applications of colorimetry, Visible and UV spectroscopy, CD, IR and NMR

Module III (11 lectures)
Concepts of chromatography; Principles and applications of paper, thin layer, ion exchange, affinity, gel permeation, adsorption, partition and high-performance liquid chromatography

Module IV (13 lectures)
Principles of electrophoretic separation, types of electrophoresis viz. paper, cellulose, Native PAGE, SDS PAGE, Pulse field gel electrophoresis

Module V (15 lectures)
Basic concepts of microscopy, transmission electron microscopy, scanning electron microscopy, Freeze fracture technique. Principle and applications of Autoradiography

Suggested Readings
3. A Biologist’s Guide to Principles and Techniques of Practical Biochemistry Williams, B.L. and Wilson, K., 1975
5. Gel Electrophoresis of Proteins - A Practical Approach Hanes,

Mapping of COs to Syllabus

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BCMB0015: MOLECULAR BIOLOGY (4-0-0)

Course Outcomes
1. Define the principles of DNA replication, transcription and translation (Remembering)
2. Explain the structural and functional properties of biological macromolecules and to understand the role of generegulation (Understanding)
3. To recognize Central Dogma from replication of DNA till translation of protein (Applying)
4. Distinguish between replication, transcription and translation (Analysing)
5. Execute quantitative analysis to interpret biological data (Evaluating)
6. Design a scientific process, gain insight into the most significant molecular methods to expand our understanding of biology (Creating)

Module I (15 lectures)
Nucleic acid as genetic material: it’s proof; Different modes of replication (conservative, semi-conservative and dispersive); DNA replication in prokaryotes, eukaryotes and virus (rolling circle model): General features and enzymology; detailed mechanisms of initiation, elongation and termination; experiments underlying each step and role of individual factors; proofreading and processivity of DNA polymerase; telomerase: mechanism of replication, maintenance of integrity and role in cancer; effect of different inhibitors on replication.

Module II (15 lectures)
Basic concepts of promoter, operator, terminator, enhancer; RNA polymerases and its sub-Modules; different sigma factors and their relation to stress, viral infections etc; initiation, elongation and termination (rho-dependent and independent) mechanism of RNA synthesis; post transcriptional modification of RNA - capping, splicing and poly A tailing; effect of different inhibitors on prokaryotic and eukaryotic transcription.

Module III (20 lectures)
The genetic code and its nature; structure of t-RNA, ribosomal structure; activation of amino acids; initiation, elongation and termination mechanism of polypeptide chain synthesis; role of r-RNA in polypeptide chain synthesis; differences between prokaryotic and eukaryotic translational processes; post-translational modification of peptide, its transportation; non-ribosomal peptide synthesis with special reference to cyclic polypeptide antibiotics synthesis in bacteria; effect of different inhibitors on protein synthesis in both prokaryotes and eukaryotes.

Module IV (10 lectures)
Positive and negative control; catabolite regulation-definition and mechanism; effect of anti-termination and attenuation on the process of gene regulation; various protein motifs involved in DNA-protein interactions during gene regulation. Epigenetics - definition and mechanism.

Suggested Readings

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BCF10016: FUNDAMENTALS OF IMMUNOLOGY (4-0-0)

Course Outcomes
1. Course begins with general overview of immunity to get you adjusted to the basics in the field. To demonstrate comprehension of general terms associated with immunological responses and the roles of nearly every cell associated with the immune system. Understand the differentiation of hematopoietic stem cells (HSCs) into lymphoid or myeloid immune cells (Understanding)
2. To understand the immunological defense against intruders Cellular basis for innate immunity against all types of pathogens. To describe different mechanisms exist in body to recognize pathogens nonspecifically (Understanding)
3. To demonstrate comprehension of antibody structure, composition, and classes. Understand antibodies associated with particular immunological responses. Gain insights into the coordination of innate and adaptive immune response (Understanding)
4. Major Histocompatibility Complex (MHC), which determines how individuals display, present, and respond to foreign antigens. To understand the importance of MHC in determining transplant eligibility and autoimmune disease. Understand antigen transport through exogenous or endogenous location and attachment on MHC molecule on the cell surface. (Understanding)
5. Understand how T cells develop, rearrange T-cell receptor. To develop insights into key differences between rearrangements and Differential pathways that a T cell undergoes (Understanding)

Module I (10 lectures)
General overview of Immunity, Introduction to Metaphors, Pathogens and Immunity, Surveying the cells and organs of Immune system- Innate and adaptive cells, Hematopoietic Stem Cell, primary and secondary organs; Innate and Adaptive Immune response

Module II (7 lectures)
Ubiquity of Innate immune response, Anatomic Barriers-Skin, Mucosa and GI defenses; Apoptosis, Inflammation- Extravasation, Lymphocyte Extravasation, Trafficking, and Homing, Inflammatory Mediators, Inflammatory Cytokines and Chemokines, Clinical Considerations, Chronic Inflammatory Response; Innate Targeting of Pathogens- Pathogen Recognition System, PAMPs (Pathogen
Associated Molecular Patterns), TLR, Cell Types and Function

Module III (14 lectures)
Introduction to models in immune system, Immunoglobulin Superfamily, Structure of Immunoglobulin Receptors (BCR) and Antibodies, Immunoglobulin Classes, Antigen Binding, Antibody Dependent Cell Mediated Cytotoxicity (ADCC), Monoclonal Antibodies
Complement System: Overview and Terminology of the Complement System, Complement Activation, Classical, Alternative and Lectin pathway, Consequences of Complement Activation

Module IV (14 lectures)
Structure of the MHC Locus, Class I MHC, Class II MHC and Class III MHC, Haplotypes, Recombinant Haplotypes, MHC Protein Structure, Specifics of Peptide Binding, Genetic Expression and Cellular Expression, Non-Classical MHC Genes, MHC and Disease
Antigen Processing and Presentation: T Cell Antigen Recognition, Professional Antigen Presenting Cells (APCs), Self-MHC restriction, Cytosolic Pathway: Class I Processing and Presentation, Transport to the RER, Exogenous Pathway: Class II Processing and Presentation, Variations- Cross presentation, T-cell receptor-Structure and Roles, αβ versus γδ receptors, Common Elements, Functional Differences, T-Cell Receptor Genes, Gene Rearrangement- Alpha Rearrangement-, Beta Rearrangement, Delta Rearrangement

Module V (8 lectures)
Maturation in the Thymus, Double Negative Transitions, Double Positive (DP) Events Completing the Receptor, Displaying Co- Receptors, Beginning Selection; Positive and Negative Selection, CD4+ TH Cells: Types and Functions, Determination of Subclass, Superantigens, TH Cell Activation Pathway

Module VI (2 lectures)
Central and Peripheral Tolerance, Malnutrition, SCID, HIV

Module VII (5 lectures)
Types of hypersensitivity reactions 1,2,3 and 4, Autoimmunity and autoimmune diseases

Suggested Readings
2. Janeway Immunobiology, Kenneth Murphy, Casey Weaver, 9th edition, Norton & Company
4. Kuby Immunology, Judy Owen, 6th and 7th editions, W H. Freeman

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BCHD0017: HERBAL DRUG TECHNOLOGY (1 - 0 - 0)

Course Outcomes
1. To explain steps of herbal drug preparations
2. To perceive the application of herbs in formulation of herbal products
3. To design experiments for preparation various plant-based products

Module I (2 lectures)
Definition of herb, herbal medicine, herbal medicinal product and herbal drug preparation, source of herbs, selection, identification and authentication of herbal materials, processing of herbal raw material

Module II (3 lectures)
Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.

Module III (3 lectures)
Herbal Excipients – Significance of substances of natural origin as excipients, – colorants, sweeteners, binders, diluents, viscosity builders, dis-integrants, flavors & perfumes.

Module IV (2 lectures)
Stages involved in herbal formulations, Orthodox formulations and methods of delivery of herbal extracts, Novel formulations of herbal extracts

Module V (2 lectures)
General aspects, market, growth, scope and types of products available in the market, Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastrointestinal diseases.
Module VI (3 lectures)
Collection of herbs, preparation of herbal cosmetics, herbal excipients, formulations, decoctions, and nutrition-based products.

Suggested Readings

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BCBE0018: BIOENERGETICS (3-0-0)

Course Outcomes
1. Summarise the basic concepts of free energy, standard free energy, redox potential and other thermodynamic concepts about biological systems (Understanding)
2. Use principle of transmembrane transport and its various types with special emphasis to mitochondrial respiratory chain and its carriers (Applying)

Module I (15 lectures)
Concept of free energy, standard free energy, determination of G for a reaction, Relationship between equilibrium constant and standard free energy change, biological standard state & standard free energy change in coupled reactions. Biological oxidation - reduction reactions, redox potentials, relation between standard reduction potentials and free energy change (derivations included). High energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates along with reasons for high G. Energy charge.

Module II (15 lectures)
Chemotaxis and chemoreceptors chemo-osmotic theory, ion transport across energy transducing membranes, Influx and efflux mechanisms, Proton circuit and electrochemical gradient, the transport and distribution of actions, anions and ionophores, Uniport, antiport and symport mechanisms, shuttle systems.

Module III (15 lectures)
The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization, The Q cycle and the stoichiometry of proton extrusion and uptake; P/O and H/P ratios, Reversed electron transfer, respiratory controls and oxidative phosphorylation, uncouplers and inhibitors of energy transfer. Fractionation and reconstitution of respiratory chain complexes, ATP- synthetase complex, Microsomal electron transport, partial reduction of oxygen, superoxides.

Suggested Reading
1. Biochemistry, M. Berg, J. L. Tymoczko, L. Stryer, Freeman Publicatio
2. Biochemistry, Voet and Voet, John Wiley and Sons

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BCNM0019: NUTRITIONAL BIOCHEMISTRY & METABOLISM (3-0-0)

Course Outcomes
1. To acquire the knowledge of the dietary requirement of vitamins and minerals in human body (Remembering).
2. To describe the various pathways that describes the metabolism of breakdown and synthesis of carbohydrates, amino acids and lipids in a biological system (Understanding)
3. Interpret the significance of nutritional distribution of the carbohydrates, amino acids, and fats and their disturbances in the absence of its regulatory enzymes (Applying)
4. Infer the deficiency diseases and abnormalities in response to the dysfunction of enzymes associated with carbohydrates, lipids and amino acids metabolism (Analysing)
5. Compare the linkage of carbohydrate, amino acids and lipid metabolism in in a biological system (Evaluating)

Module I (11 lectures)
Brief account on carbohydrates; Glycolysis; Fates of pyruvate under aerobic and anaerobic conditions; Regulation of glycolysis; Pentose phosphate pathway; Oxidative and Non-oxidative phases of PEP; Citric acid cycle; Production of acetyl CoA, Pyruvate
dehydrogenase complex, Regulations of the Citric Acid Cycle; Gluconeogenesis pathway and its regulation; Glycogen biosynthesis and its regulation.

**Module II (11 lectures)**
Brief account of amino acids; essential and non-essential amino acids; metabolic fates of amino acids; amino acid metabolism: transamination, deamination; amino acid pathway and its degradation; nitrogen excretion and urea cycle; linkage of urea cycle and citric acid cycle

**Module III (10 lectures)**
Brief account of lipids, Synthesis and storage of triacylglycerol, Transport and mobilization, Essential fatty acids, Fatty acid oxidation, Biosynthesis of cholesterol and steroids.

**Module IV (8 lectures)**
Importance of carbohydrates, lipids and amino acids in our daily diet; essential and non essential amino acids; dietary input of carbohydrates, lipids and amino acids; deficiency diseases associated with carbohydrates, lipids and amino acids; distribution process of carbohydrates, fats and proteins in the human body once ingested.

**Module V (5 lectures)**
Importance of vitamins in our diet; nutritional significance of minerals and trace elements; dietary sources of vitamins and minerals; requirements and deficiency diseases associated with Vitamins (fat soluble and water soluble vitamins) and minerals

**Suggested Readings**

**Mapping of COs to Syllabus**

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**BCOB0020: OMICS BIOLOGY AND ITS TOOLS (4-0-0)**

**Course Outcomes**
1. Recall mapping and sequencing of genomes, transcriptome, proteome and metabolome (Remembering)
2. Illustrate the different sequencing techniques (Understanding)
3. Apply the tools of bioinformatics to analyze biological data (Applying)
4. Analyze the data with biostatistics software (Analysing)
5. Decide the type of spectroscopic method for sample analysis (Evaluating)
6. Construct phylogenetic tree after analysis of biological samples (Creating)

**Module I (15 Lectures)**

a. Mapping and sequencing genomes: Genetic and physical mapping, Sequencing genomes different strategies, High- throughput sequencing, next-generation sequencing technologies, comparative genomics, population genomics, epigenetics.

b. Human genome project, pharmacogenomics, genomic medicine, genome editing, applications of genomics to improve public health, drug discovery and agriculture, metagenomics.

**Module II (15 Lectures)**

a. Transcriptome, analysis of gene expression - ESTs, SAGE, recent developments in RNA sequencing; metatranscriptomics, applications in gene regulation: alternative splicing, non-coding RNA.

b. Introduction to proteomics, techniques to study proteomics such as 1D and 2D PAGE, X-ray crystallography, Mass spectrometry including MALDI-TOF, protein microarrays, protein database analysis, comprehensive analysis of protein-protein interactions in different cell types.

**Module III (10 Lectures)**

a. Metabolomics, metabolome and metabolite, Structural diversity, number of metabolites in biological system, basic concept of metabolic channeling or metabolons, new approaches to analyze metabolic pathways.

b. Sample preparation, strategy and techniques used for metabolomic studies viz. GC-MS, LC-MS, NMR; data analysis (PDA,PLSDA), Lipidomics, Glycomics, Phenomics, etc.
Module IV (20 Lectures)
a. Technical writing: Preparation of scientific report. Thinking and planning, information, ideas, order of paragraph writing; Presentation of a review; Objective and its importance; design of the experiment; parameters used; data interpretation; compilation of experimental record.
b. Case studies derived from scientific literature (genomics, transcriptomics, proteomics and metabolomics) including comparisons between healthy and diseased tissues.
d. Biostatistics tools: Data analysis with excel and software (SPSS).

Suggested Readings

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BCBM0021: BIORESOURCE MANAGEMENT (2-0-0)

Course Outcomes
1. Define and have an enhanced knowledge of the fundamentals of bioresources by recalling and relating with the surrounding environment (Remembering).
2. Summarize how nature works regarding the climate, biodiversity and the flow of natural resources, and realize the impact of human activity on the environment (Understanding).
3. Implement the acquired knowledge of bioresources through different conservation methods (Applying).
4. Analyze, observe and recognize how their sustainability will safeguard the future of humans and the ecosystem on the planet (Analysis).
5. Evaluate by presenting and defending opinions by making judgments about the human activities and assess the benefits, opportunities, and challenges of bioresources in today’s economy (Evaluating)

Module I (12 lectures)
Basics of Bioresources: Concept, kinds, importance, economy- environment nexus. Management, scope and importance of human resource management (HRM) and personnel management; employment and utilization of natural resources; measures of rural poverty and human development; human development index (HDI); sustainable rural development, Community based management of Bioresources

Module II (18 lectures)
Bioresource Management, and their utilisation: Sustainable agriculture, Climate change and its impact on crop productivity, Bioresource management through land use planning, Post harvest management of agricultural produce, Significance and methods of biodiversity conservation; concepts of hot spots, red data book; traditional knowledge and biodiversity conservation; Earthworm technology: a tool for sustainable agriculture, Integrated farming, Induced breeding, Captive breeding, Sericulture, Integrated pest management, Conservation of biodiversity in seed banks, gene banks and germplasm reserves, Habitat restoration. Application of remote sensing technology for bioresource management, Bio prospecting and bio piracy issues with particular reference to India’s biodiversity

Concept and hands on training on formulation of biopesticides, bioinsecticides, bio weedicides, bio manure, bio cosmetics, bioplastics, biofuel generation from natural sources. Field visit and Report Writing: Conservation Centres / small scale industry etc.

Suggested Readings
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**BCSL0200: SERVICE LEARNING IN BIOSCIENCES (2-0-0)**

**Course Outcomes**
1. To understand the essence of learning through community service
2. To realise and identify the needs of community
3. To apply subject related knowledge for service to the community

**Module I (8 lectures)**
Service learning: Definitions; Principles of Service Learning; Awareness of Community; Involvement with Community; Commitment to service

**Module II (12 hours)**
Fermentation and food microbiology; Herbal Drug Technology; Waste Management; Mushroom cultivation; Principles of Floriculture and Horticulture; Health -hygiene and disease awareness
LABORATORY COURSES

BCIM6004: MEDICAL BIOCHEMISTRY LAB

Course Outcomes
1. Practically estimate lipoprotein, bilirubin, blood urea, creatine phosphokinase from a serum sample (Applying)
2. Perform glucose tolerance tests and understand the normal and abnormal constituents of urine (Applying)

List of Experiments
1. Estimation of lipoproteins
2. Glucose tolerance test
3. Estimation of bilirubin
4. Estimation of blood urea
5. Estimation of creatine phosphokinase
6. Normal and abnormal constituents of urine

Suggested Readings

Mapping of COs to Syllabus

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BCPY6005: PHYSIOLOGY LAB

Course Outcome
1. To be able to understand and master the conceptual and practical physiological functions of systems (Understanding)
2. To acquire basic knowledge and perform experiments in physiology (Applying)
3. To be able to determine, estimate and report on experiments and observations in physiology (Evaluating)
4. To be able to perform an assay, analyse and report on experiments and observations in physiology (Analysing)
5. To equip students with skills and techniques related to physiology to design experiments necessary for careers in research (Creating)

List of Experiments
1. Estimation of urea in serum
2. Estimation of cholesterol in serum.
3. Estimation of calcium in serum.
4. Assay of Serum glutamate oxaloacetate transaminase (SGOT) and serum glutamate pyruvate transaminase (SGPT)
5. Assay of alkaline phosphatase
6. Assay of amylase in serum
7. Estimation of glucose in serum by glucose oxidase-peroxidase method.
8. Assay of LDH activity in serum
9. Separation of plasma proteins by electrophoresis
10. Estimation of glycosylated hemoglobin
11. Counting white blood cells, red blood cells, platelets

Suggested Readings

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*P: Practical

BCBM6006: BIOENERGETICS LAB

Course outcomes
1. Interpret how cells manufacture energy-ATP generation (Evaluating)
2. Illustrate the mechanism of cellular respiration in yeast, plants and mitochondria (Understanding)

**List of Experiments**
1. Numerical solving related to determination of free energy, free energy determination from equilibrium constants and standard reduction potentials
2. Demonstration of cellular respiration in yeast
3. Isolation of chloroplast from plant cells
4. Isolation of mitochondria from mouse liver tissue

**Suggested Readings**

**Mapping of Course outcomes to Syllabus**

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*P: Practical

**BCD16007: DISSERTATION PHASE I (0-0-2)**

**Course Outcomes**
1. Develop a scientific mindset with the capacity for analytical and innovative thinking (Creating).
2. Develop writing skill, referencing and citations for effective communication (Applying).
3. Improve communication and creative expression skills to articulate scientific ideas (Creating).
4. Examine the research gap in the related field and formulate strategies to address the same (Analysing).

**Syllabus**
1. Familiarization with research topic and methodologies by a thorough literature review.
2. Writing of review of literature to brush up already existing knowledge on a given area.
3. Formulate a research hypothesis and a proposed work plan.
4. Presentation of the research topic at department level and submission of literature review.

**Suggested Readings**
1. Scientific review and research articles published in respective specialized area of research.

**Mapping of Course outcomes to Syllabus**

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*P: Practical

**BCD16008: DISSERTATION PHASE II (0-0-16)**

**Course Outcomes**
1. Support the research hypothesis with experiments executed ethically (Evaluating).
2. Develop skill to independently carry out research in the laboratory (Creating).
3. Examine the methodology, analyse results, and defend the research work (Analysing).

**Syllabus**
1. Execute a scientific dissertation based on the proposed plan in Phase 1 through bench work.
2. Present and report data at various stages of the research work to the assigned supervisor.
3. Analysing the results, correlating it with different experiment performed during the dissertation.
4. Present the findings in a department level to internal and external examiners, and submission of completed thesis.

**Suggested Readings**
1. Scientific review and research articles published in respective specialized area of research.

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BCFB6009: FUNDAMENTALS OF BIOCHEMISTRY LAB

Course Outcomes
1. Estimate and prepare buffer solutions for different experiments
2. Quantify various biomolecules at different concentrations for future research experiments
3. Apply the technique based on spectrophotometer for analysis of various biomolecules

List of Experiments
1. Preparation of buffers
2. Determination of pKa and pl of acidic, basic, and neutral amino acids
3. Estimation of amino acids by Ninhydrin method
4. Estimation of DNA by DPA method
5. Estimation of RNA by Orcinol method
6. Estimation of proteins by Bradford method
7. Estimation of proteins by Lowry method
8. Isolation and estimation of lipids from seeds
9. TLC of plant pigments
10. TLC of lipids

Suggested Readings

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BCAT6010: ANALYTICAL TECHNIQUES LAB

Course Outcome
1. Recall and perform the laboratory analysis in accordance with Good Laboratory Practices, in conditions of hygiene and safety (Remembering)
2. Describe the principles and the theoretical concepts of the instruments (Understanding)
3. Choose an appropriate separation technique for analysis of the samples (Applying)
4. Ability to undergo a comparative analysis of different identification and purification protocols that can best suit a particular experiment (Analysing)
5. To evaluate the spectrophotometric parameter for understanding the nature of the biological sample (Evaluating)
6. Design an analytical work flow to characterize a biological sample (Creating)

List of Experiments
1. Study of UV absorption spectra of biological macromolecules-proteins, nucleic acids
2. Separation of bacterial lipids/amino acids/sugars/organic acids by TLC
4. Study of nucleic acids using Agarose gel electrophoresis.
5. Study of serum proteins by vertical gel electrophoresis
6. Separation of haemoglobin or blue dextran by gel filtration
7. Quantitative estimation of hydrocarbons/pesticides/organic solvents/methane by gas chromatography
8. Demonstration of PCR and its application

Suggested Readings

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BCRT6012: REMEDIAL TEACHING & NET COACHING
BCNM6013: NUTRITIONAL BIOCHEMISTRY & METABOLISM LAB

Course Outcomes
1. To discuss the effect of pH and temperature on enzyme activity (Understanding).
2. To analyze the saponification value (Analysing)
3. To measure the content of vitamins in food sample (Evaluating)
4. To estimate the acidity in milk and evaluate its causes (Evaluating)
5. Design a protocol to study how pH and temperature effects the regulation of enzymes (Creating)

List of Experiments
1. Determination of saponification value of fats/oils
2. Estimation of acidity in milk
3. Estimation of vitamin C from biological sources
4. Effect of pH on amylase activity.
5. Effect of temperature on amylase activity

Suggested Readings

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BCMB6013: MOLECULAR BIOLOGY LAB

Course Outcomes
1. Define the principles for isolation of DNA from bacteria, plant and animal (Remembering)
2. Demonstrate the knowledge of laboratory practices in molecular biology and conduct independent work in laboratory (Understanding)
3. Apply practical knowledge to perform isolation of genomic and chromosomal DNA from bacteria (Applying)
4. Test for DNA amplification by PCR and observe the amplicons of gel electrophoresis (Analysing)
5. Execute quantitative analysis to interpret clear and concise communication of biological data and evaluate student progress with guided enquiries (Evaluating)
6. Design a scientific process, think critically and employ the scientific method in the formal practices of observation and experimentation (Creating)

List of Experiments
1. Isolation of genomic DNA from bacteria/plant/animal
2. Isolation of chromosomal DNA from bacteria.
3. DNA amplification by PCR and visualization of DNA by gel electrophoresis
4. Restriction digestion of DNA

Suggested Reading

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*P: Practical
Course Outcomes
1. Visualize the types of cells present in the blood and understand their normal and abnormal percentage as a sign of infection
2. Analyze the basic difference between serum and blood plasma
3. Determine antigen antibody interaction
4. Determine immunodiagnostic application
5. Understand the type and detection of antibodies present in body secretions
6. Understand the principles for isolation of various blood cell types

List of Experiments
1. Microscopic examination of blood cells
2. Isolation of serum and plasma from blood
3. Antibody capture ELISA
4. Antigen capture ELISA
5. Blood grouping through agglutination
6. Antibody IgG purification
7. Detection of secretory IgA from saliva
8. Apoptosis determination using standard kits
9. Separation of peripheral blood mononuclear cells by Ficoll-Hypaque

Mapping of COs to syllabus

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*P: Practical

BCRT6015: REMEDIAL TEACHING & NET COACHING

BCSC6017: SCIENTIFIC WRITINGS AND COMMUNICATIONS (0-0-1)

Course Outcomes
1. Assess published data, critically read, interpret, and present it (Analysing)
2. Compare the strengths and weaknesses of publications (Evaluating)
3. Develop skills in interpreting and evaluating scientific data (Creating)
4. Demonstrate ethics in research and related good laboratory practices (Understanding)
5. Relate the relevance of personality for boosting overall confidence (Understanding)
6. Design paper writing based on advanced fields of research (Creating)

Activities-Lecture/Talk by students/Faculty/Outsourcing
1. Introduction to Good Laboratory practices
2. Development of personality skills and refinement of communication skills for scientific presentation and interviews
3. Presentation of research articles/classical papers by 3rd Semester
4. Problem solving and critical thinking session by giving the research problem and allow them to present strategy
5. Scientific communication and its ethics
6. Invited Talk

Mapping of COs to Syllabus

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*P: Practical
PROGRAMME: MASTER OF SCIENCE (MSC) BIOTECHNOLOGY

PROGRAMME OUTCOMES
PO 1: **Skill Development**: Master academic, technical, managerial and crucial soft skills to qualify for careers in research, industry, education, administration and management or for higher studies where a holistic understanding of applied biosciences is required.

PO 2: **Research**: Develop a scientific mindset with the capacity for analytical and innovative thinking and practical knowhow to formulate, design and ethically implement scientific research in frontier areas of Biochemistry, Biotechnology and Microbiology.

PO 3: **Communication**: Acquire effective communication and creative expression skills in the form of writing, design, presentation and networking to convincingly articulate scientific ideas in biosciences and related fields.

PO 4: **Employment and Entrepreneurship**: Acquire the necessary knowledge and proficiencies to become employable or get self-employed and thereby create job opportunities through entrepreneurship in heath, agriculture, industry, environment and allied areas of applied biosciences and thereby affirmatively contribute to scientific social responsibility.

PROGRAMME SPECIFIC OUTCOMES
PO 1: **PSO1: Confidence**: Demonstrate a comprehensive understanding of chemical and biological structure, principles, techniques, and applications.

PO 2: **PSO2: Knowledge based Skill**: To develop better understanding and improve skills that would enable them to begin a career in research laboratories, industries as well as to generate self-employability.

PO 3: **PSO3: Scientific Social Responsibility**: To develop linkages between scientific community and society to build trust, partnership and responsibility of science towards achieving social goals.

PO 4: **PSO4: Cell culture handling and transgenic technology**: The programme will help in gaining knowledge on *in vitro* culture techniques for plant and animal cells which contributes in the development of transgenic plants and animals.

PO 5: **PSO5: Grasp of industrial and environmental aspects of Biotechnology**: The programme will help in the understanding the application and working of pharmaceutical, and fermentation industry for healthcare and food products. It will also emphasise on environment protection and its long-term sustainability.

PO 6: **PSO6: Scale-up and connect to advanced and modern concepts**: The programme will update students about the most recent developments in the fields of OMICS, genome editing, systems biology, nano-biotechnology and nano-materials to stimulate scaling up to advanced learning.

MAPPING OF COURSES WITH POS/PSOS

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Module III (15 lectures)

- Waste Management (Skill Development course)
- Fermentation and Food Micorbiology (Skill Development course)
- Mushroom Cultivation (Skill Development course)
- Herbal Drug Technology (Skill Development course)
- Research Methodology & Biostatistics-common
- Bioprocess Engineering
- Plant Biotechnology
- Animal Biotechnology
- Pharmaceutical &Environmental Biotechnology
- Lab I- Animal Biotechnology
- Lab II- Bioprocess Engineering
- Lab III- Plant Biotechnology
- Lab IV-Pharmaceutical & Environmental Biotechnology
- Dissertation Phase I
- PR &Entrepreneurship
- Scientific Writings and Communications
- Value Added Course- Clinical Laboratory Techniques
- Trends in Biotechnology
- Agriculture Technology (Elective )
- Nanobiology (Elective)
- Bioresource Management (Elective)
- Dissertation Phase II

BTRM0003: RESEARCH METHODOLOGY AND BIOSTATISTICS (4-0-0)

Course Outcomes
1. Recall and classify the different forms of research – basic, applied, interdisciplinary, etc. Scientific literatures (Remembering)
2. Summarize an understanding of various kinds of research, objectives of doing research, research process, researchdesign and sampling, scientific problems (Understanding)
3. Apply statistical methods of data analysis and interpretation. (Applying)
4. Explain ethical conduct of research and its communication. (Analysing)
5. Recommend adequate knowledge of hypothesis testing procedures, measurement, scaling techniques and quantitative data analysis (Evaluating)
6. Produce a manuscript by conducting research work on original ideas, formulating research synopsis, research report, data analysis and meaningful interpretation of data (Creating)

Module I (15 lectures)

- Scientific research- Definition, types: basic and applied research, interdisciplinary research, Steps involved in scientific research
- Scientific literature primary and secondary literature, biological abstract, current content, review, monograph, peer-reviewed journals, e-resources; research and review articles; scientific communication- scientific paper, scientific posters
- Scientific problems: What is scientific problem? Methods and techniques, research conditions, data types, techniques, repeatability, reproducibility and reliability, validity, effect measure and choice of statistical test, experimental protocol, experimental routine
- Research design: Meaning, need for research design, features of a good design, Types of research design

Module II (5 lectures)
Brief introduction to ethics, scientific conduct and misconduct-plagiarism, authorship issues, investigation and punishment of scientific misconduct, ethics of animal and human research

Module III (15 lectures)

- Introduction to Biostatistics: definition and applications of biostatistics;
Module IV (6 lectures)
  a. Permutations and combinations, sets
  b. Probability: Introduction, counting possible outcomes, probability of an event, adding and multiplying probabilities
  c. Probability distributions: Binomial, Poisson and Normal distribution

Module V (19 lectures)
  a. Testing of hypothesis and goodness of fit: Null hypothesis, level of significance, errors of influence, Student’s t-test, paired t-test, Fischer’s test, Chi-square test, linear correlation and linear regression
  b. Analysis of variance: variances of samples and their means, F distribution, partitioning of the total sum of square degrees of freedom, models and types of ANOVA

Suggested Readings

Mapping of COs to Syllabus

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BTGE0005: GENETIC ENGINEERING (3-0-1)

Course Outcomes
1. To understand the properties and function of different enzymes used in genetic engineering (Understanding)
2. To compare the different types of cloning and expression vector used in genetic engineering and its limitations (Analyzing)
3. To understand the concepts regarding different hybridization techniques and applications (Understanding)
4. To acquire theoretical knowledge of tools, techniques, and application of genetic engineering (Remembering)
5. To develop an ability to design and conduct genetic engineering experiments, as well as to analyse and interpret data (Applying)

Module I (10 lectures)
Restriction nucleases: Exo and Endonucleases: History, Restriction endonuclease nomenclature, classification of restriction endonuclease—typeI, II, III, and VI, cleavage patterns—sticky ends, blunt ends, applications; Modifying enzymes—ligases, kinases, RNAse, polymerases, phosphatasas and methylases, RNA dependent DNA polymerase, Terminal Deoxynucleotidyl transferase

Module II (13 lectures)
Cloning vectors: Plasmids and plasmid vectors, phagens, cosmids, artificial chromosome vectors, YAC, BAC. E. Coli plasmid vectors—pBR322, pUC18, pET21, Bacterio-phage vectors—λ and M13, Cosmids, phagemids and Phasmids, Shuttle vectors–Yeast vectors, Baculo virus vector. Intran-based vectors; Inclusion bodies; Plant based vectors, Ti and Ri as vectors, Yeast vectors, Insertion and Replacement vectors, Expression vectors; Strategies for production of foreign proteins in E.coli, Yeast, animalcell, pMal; GST, pET-basedvectors; Proteinpurification; His-tag, GST-tag, MBP-tag

Module III (12 lectures)
Isolation of genomic and plasmid DNA, DNA cloning; Strategies for construction of genomic and cDNA libraries, chromosome walking; screening of libraries; Oligonucleotide, cDNA and antibody probes; The Southern, Northern, Western, North-Western, Zoo blots, Southwestern, Farwestern blotting and Colony hybridization, yeast-two hybrid system, c-DNA synthesis and cloning: mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis; Cloning interacting genes two- hybrid systems, cloning
differentially expressed genes. Site directed mutagenesis and protein engineering

Module IV (10 lectures)
Maxam and Gilbert method and Sanger’s method, Next generation sequencing, Applications of genetic engineering: Transgenic animals and plants, production of recombinant pharmaceuticals, gene therapy, disease diagnosis, Transgenic and gene knockout technologies: Vector engineering, strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing

Suggested Readings

Mapping of COs to Syllabus

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BTBE0007: BIOPROCESS ENGINEERING (3-0-1)

Course Outcomes
1. Outline the principles of fermentation, design and operation of bioreactors for production of biomass and products (Understanding)
2. Compare strategies of bioprocess development for industrial production of bioproducts and specialized applications (Analysing)
3. Relate fermentation and related bioprocess development in food, industry and environment (Understanding)
4. Estimate the contribution and prospect of bioprocess engineering in commercial biotechnology (Evaluating)

Module I (8 lectures)
Introduction to bioprocess engineering; Isolation, preservation and maintenance of industrial microorganisms, strain improvement strategies media formulation for industrial fermentation, air and media sterilization; kinetics of microbial growth, Fermenter/bioreactor-types and classes, Designing of a fermenter/Bioreactor.

Module II (10 lectures)
Kinetics of operation of bioreactors - batch, fed batch and continuous bioreactor; Measurement and control of bioprocess parameters in a bioreactor – heat and mass transfer, aeration and agitation, scale up ans scale down; Biotransformation, Mixed microbial cultures, immobilized cells, Specialized bioreactors (pulsed, fluidized, photo bioreactors); Advanced and non-conventional bioprocesses (animal and plant cell culture, genetic engineering, tissue engineering)

Module III (12 lectures)
Downstream processing: Product recovery and purification, removal of microbial cells and solid matters, precipitation, filtration, centrifugation, cell disruption, extraction and purification-, chromatography, drying and crystallization, ; Industrial production of chemicals using biological aid: alcohols, acids (citric, acetic and gluconic), solvents (glycerol, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline) amino acids (lysine, glutamic acid), biotransformation of steroids and non-steroid compounds.

Module IV (15 lectures)
Food: Bakery and dairy products, wine, beer and other alcoholic beverages and formulated bio-products, Conventional and molecular breeding of plants for food production; Mushroom production; Single cell proteins; Probiotics; Food spoilage and preservation process Environment: Techniques of bioremediation of industrial and medical effluent disposal; Phyto- remediation and myco- remediation; Bioremediation of heavy metals, oil spills, dyes and plastics.

Suggested Readings

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BTTE0009: THERMODYNAMICS AND ENZYMOLGY (3-0-1)

Course Outcomes
1. To relate the entropy to law of thermodynamics and Free energy and its relation to chemical equilibria (Evaluating)
2. To understand the fundamentals of enzyme structure, properties and function (Understanding)
3. To compare the different types of methods for protein purification (Analysing)
4. To understand the rate of reactions and order of reactions, and inhibitions and their kinetics (Understanding)
5. To describe the structure, functions and the mechanism of different enzymes (Evaluating)
6. To understand the application of enzymes (Understanding)

Module I (5 lectures)
Laws of thermodynamics, reversible and irreversible processes, entropy, enthalpy, internal energy, free energy and equilibrium constant, Gibbs free energy equation, determination of free energy change of under standard and non-standard conditions, high energy compounds, coupled reactions, determination of feasibility of reactions.

Module II (5 lectures)
Classification, nomenclature and general properties like effects of pH, substrate and temperature on enzyme catalyzed reactions. Isolation and purification of enzymes, Salting out of protiens, Isoelectric point, Electrophoresis of protein.

Module III (7 lectures)
Kinetics of enzyme catalyzed reaction: Single substrate reactions, bi-substrate reactions, concept of Michaelis-Menten, Determination and significance of kinetic constants, Limitations of Michaelis-Menten Kinetics, Briggs Haldane relationship

Module IV (10 lectures)
Activation energy and Arrhenius concept, Binding energy, Enzyme catalysis: enzyme specificity and the concept of active site, determination of active site. Stereospecificity of enzymes, Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, concerted acid – base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Theories on mechanism of catalysis, Inhibition of enzyme activity: Competitive-cite: succinate on Malonate dehydrogenase a s e x a m p t l e , n o n - c o m p e t i t i v e and irreversible covalent modification of enzymes, cascade processes, immobilised enzymes and their industrial applications, Ribozyme (catalytic RNA) and Abzyme (use of antibody as enzyme) - definition only.

Module V (9 lectures)

Module VI (9 lectures)
Enzyme regulation: Allosteric enzymes, Feedback Regulation, Sigmoideal kinetics and their physiological significance, Symmetric and sequential modes for action of Allosteric enzymes. Reversible and irreversible covalent modification of enzymes, cascade systems, immobilised enzymes and their industrial applications, Ribozyme (catalytic RNA) and Abzyme (use of antibody as enzyme) - definition only.

Suggested Readings

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BTCA0010: COMPUTER APPLICATIONS AND BIOINFORMATICS (3-0-2)

Course Outcomes
1. To recall the basics of operation of computer and its related softwares, languages (Remembering)
2. To utilize concepts of C- programming language for preparing application based programs.(Applying)
3. To demonstrate the working principle of the World Wide Web and the internet protocols involved (Understanding)
4. To inspect the role of the biological resources in sequence alignment, methods of gene prediction, phylo-genetic treeconstruction and other tools (analysing)
5. To perceive the importance of methodologies involved in protein structure prediction, structure analysis tools and drugdesigning (evaluating)

Module I (10 lectures)
Basic computer organization, Processor and memory, secondary storage devices, Input-Output devices, Computer software, Computer language; Basic Ideas in Programming in C: Variables, data types, Constants, Keywords, Input/output, Control Statements, Functions, Structures; Operating system—Basic commands in Linux.

Module II (5 lectures)
Introduction to Spreadsheet, presentation software, document and word processing. WorldWideWeb, Client-server organization; Internet Protocols-FTP, HTTP, Telnet; Search engines- search concepts

Module III (12 lectures)
Concept of databases: Biological Databases-Primary, secondary, composite databases; Databases for Literature, Sequence and structure; Searching and their retrieval. DNA and Protein sequence alignments- Pairwise alignment, dot plot, global and local alignment algorithms- Needleman and Wunsch algorithm, Smith-Waterman algorithm; Multiple sequence alignment —progressive alignment and alterative alignment algorithms; PAM and Blosum scoring matrices; Multiple sequence alignment-based database searching— PSI-Blast

Module IV (9 lectures)
Gene prediction approaches in prokaryotic and eukaryotic genomes, Methods of gene prediction, Introduction to gene prediction tools, Regulatory sequence analysis, Oligo design and analysis tool. Bioinformatics for phylogenetic analysis. Character based and distance based phylogenetics tree, interpretation of phylogenetic tree, Construction of phylogenetic tree from distance matrix Human genome project; concept of microarray and principles of microarray data analysis

Module V (9 lectures)
Structural biology and Protein structure prediction, Methods of protein structure prediction: Homology modeling, Threading andAb initio methods, Molecular visualization tools- Rasmol, Pymol and Swiss pdb viewer. Structure analysis tools -VAST and DALI. Stages of Drug development , Definition of drug, target and its properties Steps in Drug Designing, Lead identification, Types of drug designing, ADME along with concept of Lipinski rule of five and drug likeliness, Molecular docking, QSAR

Suggested Readings
2. Essential Bioinformatics. Xiong J, Cambridge University Press
3. Introduction to Bioinformatics, Attwood TK and Parry-Smith DJ, Pearson Education

Mapping of COs to Syllabus

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BTPB0011: PLANT BIOTECHNOLOGY (3-0-2)

Course Outcome
1. To inspect the relevance of plant tissue culture and their application in in vitro propagation of indigenous as wellgenetically manipulated plants (Analysing)
2. To perceive the techniques of gene transfer by biological and non-biological methods in developing transgenic plants (Evaluating)
3. To examine the role of transgenic plants in developing plants carrying desirable traits and its related advancedtechniques (Analysing)

Module I (15 lectures)
Definition, brief history, principle and significance of tissue culture; Cellular totipotency: Cytodifferentiation: Organogenetic Differentiation: induction, factors affecting shoot bud differentiation; Cell suspension Culture, Callus Culture, Embryo Culture, Haploid Culture: microspore and macrospore culture. Triploid culture: Endosperm Culture, Protoplast: isolation, Culture and Fusion; Somatic hybridization and cybridization; Somatic Embryogenesis and Synthetic Seed Production; Androgenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation.
Module II (15 lectures)
Introduction to transgenic plants, methods of gene transfer – Agrobacterium tumefaciens mediated, Agrobacterium rhizogenes mediated; Direct gene transfer methods – Chemical, Physical and alternative methods. Selectable markers, reporter gene and promoter in plant vectors

Module III (15 lectures)
Transgenic plants, characterization of transgensics; chloroplast transformation; marker-free methodologies; advanced methodologies-cisgenesis, intragenesis and genome editing. Strategies for Introducing genes of biotic and abiotic stress resistance in plants (Herbicide resistance; drought, Salinity, thermal stress, flooding and submergence tolerance, insect resistance, virus resistance) longer shelf life (including strategies for suppression of endogenous genes), male sterility, enhanced nutrition (golden rice), edible vaccines molecular pharming - concept of plants as biofactories, production for industrial enzymes and pharmaceutically important compounds.

Suggested Readings
1. Plant tissue and Organ culture fundamental methods. Gamburg OL, Philips GC., Narosa publications
2. Text book of Biotechnology Singh BD., Kalyani publishers

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BTAB0012: ANIMAL BIOTECHNOLOGY (3-0-1)

Course Outcomes
1. Have a basic understanding on different types of media composition, different cell culture and its characteristics (Understanding)
2. Applications of various techniques involved in improvement of animal (Applying)
3. Application of Genetic engineering methods for production of important compounds and treating diseases (Applying)

Module I (10 lectures)
General considerations of cell culture: Aseptic condition, Media, Balanced salt solution, Carbon dioxide incubator, feeder layer, serum, growth factors; Types of culture media (defined and undefined media), culture media composition; role of different media. Types of cell culture –organ, Organotypic, single cell, Histotypic/3D, primary cells, cell lines, adherent, suspension cell cultures, stem cell culture, embryonic stem cell culture; Characteristics of cells in culture; measurement of cell viability, apoptosis, senescence; Scaling up of animal cell culture.

Module II (8 lectures)
Embryology: Collection and preservation of embryos; culturing of embryos; micromanipulation technology and fertilization in animals; Equipment used in micromanipulation; Sperm sorting; Enrichment of semen for x (female) or y (male) sperm; Biotechnology Techniques in Animal Breeding: Artificial Insemination, In Vitro Fertilization and embryo transfer.

Module III (12 lectures)
Transgenic animal: methods of production and application; transgenic animals as models for human diseases; transgenic animals in livestock improvement; industry, biomedicine chimera mice production; Gene knockouts, production of human antibodies in animals; gene therapy for animal diseases; Animal cloning and ethical issues.

Suggested Readings
3. Plant tissue and Organ culture fundamental methods, Gamburg OL, Philips GC, 2005, Narosa publications

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BTFF0013: FERMENTATION AND FOOD MICROBIOLOGY (1-0-0)

Course Outcomes
1. Demonstrate the understanding of the principles of fermentation and food microbiology in skill development (Understanding)
2. Construct experimental platforms with fermentation systems to learn the making of commercial food products (Applying)
3. Analyze experimental data interpret results to arrive at credible conclusions (Analysing)
Module I (2 lectures)
Production of wine from fruit juice (Monitoring of sugar reduction during wine production; Estimation of alcohol concentration in wine)

Module II (2 lectures)
Production of traditional rice beer of ethnic communities of NE region (microbial isolation; growth monitoring, alcohol concentration)

Module III (1 lecture)
Estimation of vicinal diketone in beer

Module IV (1 lecture)
Microbial production of curd (assay milk quality by MBRT test; Isolation and identification of Lactobacillus from fermented dairy products; lactic acid estimation

Module V (2 lectures)
Making of bread and other bakery products by fermentation

Module VI (1 lecture)
Pickled products: Making of traditional pickles of India (NE region); production of Sauerkraut; fermented fish and other products

Module VII (2 lectures)
Fermentation in flavour and fragrance (tea processing; essential oil)

Module VIII (2 lectures)
Microbial enzyme production via liquid and solid-state fermentation

Module IX (1 lecture)
Sterility testing in food products (microbial examination of food)

Suggested Readings

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BTIE0014: IPR AND ENTREPRENEURSHIP (1-0-0)

Course Outcomes
1. Interpret different IPR, laws governing IPR and their management in biosciences (Understanding)
2. Relate the fundamentals of business and entrepreneurship to biosciences (Understanding)
3. Apply the understanding of IPR and entrepreneurship in innovation management and start-up (Applying)

Module I (9 lectures)
Concept of Intellectual Property; introduction to intellectual property rights and its types: patents, trademarks, copyright and related rights, industrial design, geographical indications, Protection of new varieties of plants and plant breeder’s rights; World Intellectual Property Organization (WIPO) and its role, PCT; Indian Patent Act 1970 relevant sections and amendments thereof; Drafting and filing patent applications; management and practical use of IP rights, including licensing, enforcement and ethics.

Module II (6 lectures)
Entrepreneurship essentials: opportunities, ideas and innovation; feasibility and market research; business plan; Building a business: business models, teams, pitching and investment, finance; Start-up ecosystem; Technology and bio-entrepreneurship – case studies.

Suggested Readings

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BTPE0015: PHARMACEUTICAL & ENVIRONMENTAL BIOTECHNOLOGY (3-0-0)

Course Outcomes
1. Choose suitable methods to distinguish the sources, types and composition of waste with methods of handling and sampling strategies (Remembering)
2. Demonstrate the concepts of environment, regulation of population and associated factors (Understanding)
3. Explain the basic concepts of pharmacology used in drug formulation (Understanding)
4. Inspect the working structure of pharmaceutical industries and role of regulatory bodies (Analyzing)
5. Plan the management of the environmental pollution load with respect to its physical properties and associated critical considerations in view of emerging technologies (Applying)
6. Appraise the various steps involved in clinical trials and various approaches for toxicity studies (Evaluating)
7. Interpret and infer the relationships among the different constituents of the environment (Analyzing)

Module I (9 lectures)

Module II (7 lectures)
Hit to lead optimization by Preclinical studies and clinical trials, Approaches to screen lead molecules, source of lead molecules, Clinical trials- Ethical considerations, regulatory requirements of clinical trials and phases of clinical trials. Preclinical Toxicology- Acute, subacute and chronic toxicity, Anima tests, prodrug, Formulation and drug delivery systems.

Module III (7 lectures)

Module IV (10 lectures)
Basic concepts of environment viz. atmosphere, hydrosphere, lithosphere; biotic environment; biotic and abiotic interactions; energy flow and nutrient cycling (C, N, P); Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement; Population-environment relationship modules viz. Characteristics of a population; Survivorship graph curves; population dynamics; population density curves; population regulation strategies (r and K selection); meta population; age structured population.

Module V Environmental monitoring and pollution treatment (12 lectures)
Pollution types and monitoring approaches: Environmental pollution; sources (air, water, soil); pollutants and its types; standard criteria of pollution monitoring; biotechnological approaches of environmental monitoring viz. plant based, animal based, cell biology based, molecular biology-based approaches; pollution management.
Pollution treatment methodologies: sewage/waste water treatment; primary, secondary and tertiary methods of treatment; sources and characteristics of solid waste; Solid waste stabilization (aerobic and anaerobic treatment); Bioremediation strategies (in-situ and ex situ bioremediation); role of microorganisms in bioremediation; Significance of genetic engineering in degradation of toxic compounds

Suggested Readings

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DEPARTMENT OF BIOSCIENCES - BIOTECHNOLOGY

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BTTB0016: TRENDS IN BIOTECHNOLOGY (4-0-0)

Course Outcomes
1. Recall the fundamentals of biotechnology, biochemistry, molecular biology to better comprehend the recent topics in biotechnology (Remembering)
2. Relate with developments in Omic, particularly Genomics, Transcriptomics, Proteomics, Metabolomics and other emerging fields of study (Understanding)
3. Assess the global and Indian scenario of innovation and commercial biotechnology and their impact on human life and environment (Evaluating)
4. Examine the new and emerging frontiers in biotechnology at an interdisciplinary level (Analyzing)

Module I (30 lectures)
Genomics: Genome sequencing, History of sequencing, Next Generation Sequencing (NGS), whole genome sequencing, model organisms, genome projects, microarrays; epigenomics, pharmacogenomics, comparative genomics, metagenomics, and their applications
Transcriptomics ESTs, SAGE, NGS(RNASeq); metatranscriptomics, alternative splicing, non- coding RNA
Proteomics: 2D PAGE, X-ray crystallography, Mass spectrometry including MALDI-TOF, protein microarrays, recent developments in secretomics, interactomics; applications of proteomics in drug discovery
Metabolomics: Metabolome diversity, Metabolite profiling; High throughput analytical techniques for metabolome analysis (GC- MS, LC-MS, NMR), applications
Other emerging Omics – Lipidomics, Glycomics, Phenomics, etc.
Bioinformatics and statistical analysis in Omics (PCA, HCA, PLSDA, Heatmap and other tools of analysis and data representation)

Module II (10 lectures)
Genome editing, synthetic biology, molecular evolution, nanobiotechnology and advanced biomaterials, structural and computational biology, gene ontology, systems biology

Module III (10 lectures)
Global and Indian biotech sector, Segments of biotech market, Bioprospecting in biotechnology, ethical concerns; Commercial production of industrial bio-molecules; bio-products from both natural and synthetic source and their commercialization, vaccines and therapeutics, diagnostics; commercial plant tissue culture including automation, strategies for environment cleanup and their commercialization.

Module IV (10 lectures)
New colors of biotechnology: Blue (aquatic and marine life); Yellow (food and nutrition), White (gene-based bio-industry) Gold (bioinformatics and nanobiotechnology), Brown (extreme environments), Violet (bioethics and laws) Purple (Inventions and IPR), Dark (bio-terrorism, bio-weapons)

Suggested Readings

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BTAT0017: AGRICULTURE TECHNOLOGY (2-0-0)

Course Outcomes
1. Relate with agriculture as a multidisciplinary field of scientific study (Understanding)
2. Analyze the concepts of farming and agricultural technology and their impact on agriculture. (Analysing)
3. Apply principles of agriculture in farm and agribusiness management (Applying)

Module I (9 lectures)
Scope of agriculture and agro-economy of India, History of Indian agriculture, Green Revolution, Food security, Agencies involved in agricultural development (India and Global)

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Introduction to disciplines of agricultural sciences: Agronomy, Horticulture, Plant Breeding and Genetics, Agricultural Biotechnology, Biochemistry and Microbiology, Physiology, Plant Pathology, Entomology, Soil Science, Water technology, Agricultural extension, Agricultural engineering, Agricultural economics and statistics, Meteorology, Seed technology, Plantation crops, Animal husbandry and Fishery

Module II (14 lectures)
Nature of soil, Soil chemistry, biology and biochemistry, Soil fertility and nutrient management, Soil analysis techniques, bio-fertiliser, organic farming, soil conservation
Principles of irrigation and water management, Water analysis techniques, Water stress, Dryland agriculture and watershed management; Flood stress, Salinity stress
Nutrition, Food testing, Crop varietal improvement, Crop breeding techniques, Seed technology, Crop production and protection techniques including biotech, post-harvest management, Farm machinery and equipment; Innovation in agriculture

Module III (7 lectures)
Farm management principles, integrated farming systems, agricultural market, agro-based industry, agribusiness and local farmeconomy, Government schemes, Credit, Crop insurance, Soil health cards.

Suggested Readings

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LABORATORY COURSES

BTAP6003: ANIMAL BIOTECHNOLOGY LAB

Course Outcomes
1. To understand the principle of the techniques (Understanding)
2. To prepare culture media and cell cultures (Analysis)
3. Analysis of the data (Analysis)
4. To develop research aptitude (Applying)
5. To develop writing skill (Applying)
6. To develop technical skills (Applying)

List of Experiments
1. Isolation of lymphocytes
2. Cell viability by using tryphan blue.
3. Isolation of genomic DNA from animal cells
4. Preparation of animal cell culture media and Filter sterilization
5. Preparation of single cell suspension from spleen/liver/thymus
6. Quantitation of animals cells using hemocytometer

Suggested Readings
2. Hirenkumar Sherathiya (Author), 2012, Practical manual for Plant Tissue Culture, Munich, GRIN Verlag

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BTGE6004: GENETIC ENGINEERING LAB

Course Outcomes
1. To understand the different types of techniques used in genetic engineering experiments (Understanding)
2. To develop technical skills (Applying)
3. To interpret experimental data (Evaluating)
4. To develop research aptitude (Applying)
5. To develop writing skill (Applying)

List of Experiments
1. Transformation
2. Cloning in plasmid/ Phagemid vectors
3. Gene expression in E. coli and analysis of gene product
4. Silver staining of gels (protein)
5. RFLP (Restriction fragment length polymorphisms)
6. RAPD (Random Amplification of Polymorphic DNA)

Suggested Readings

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BTBE6006: BIOPROCESS ENGINEERING LAB

Course Outcomes
1. Recall the theoretical topics in bioprocess engineering (Remembering)
2. Experiment with fermentation systems for estimation of biomass and product formation (Applying)
3. Analysing data from the scientific experiments and interpret results (Analysing)

Syllabus
1. Parts and design of fermenter
2. Media for Industrial Fermentation
3. Isolation, preservation and maintenance of industrial microorganisms
4. Solid state fermentation
5. Submerged fermentation
6. Production and estimation of protease
7. Production and estimation of amylase
8. Growth kinetics for batch culture
9. Production and quantification of alcohol using yeast
10. Lactic acid fermentation process

Suggested Readings

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BTDI6007: DISSERTATION PHASE I (0-0-2)

Course Outcomes
1. Develop a scientific mindset with the capacity for analytical and innovative thinking (Creating).
2. Develop writing skill, referencing and citations for effective communication (Applying).
3. Improve communication and creative expression skills to articulate scientific ideas (Creating).
4. Examine the research gap in the related field and formulate strategies to address the same (Analysing).

Syllabus
1. Familiarization with research topic and methodologies by a thorough literature review.
2. Writing of review of literature to brush up already existing knowledge on a given area.
3. Formulate a research hypothesis and a proposed workplan.
4. Presentation of the research topic at department level and submission of literature review.

Suggested Readings
Scientific review and research articles published in respective specialized area of research.

Mapping of Course outcomes to Syllabus

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BTDI6008: DISSERTATION PHASE II (0-0-16)

Course Outcomes
1. Support the research hypothesis with experiments executed ethically (Evaluating).
2. Develop skill to independently carry out a research in the laboratory (Creating).
3. Examine the methodology, analyse results, and defend the research work (Analysing).

Syllabus
1. Execute a scientific dissertation based on the proposed plan in Phase 1 through bench work.
2. Present and report data at various stages of the research work to the assigned supervisor.
3. Analysing the results, correlating it with different experiment performed during the dissertation.
4. Present the findings in a department level to internal and external examiners, and submission of completed thesis.

Suggested Readings
Scientific review and research articles published in respective specialized area of research.

Mapping of COs to Syllabus

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BTTE6009: THERMODYNAMICS AND ENZYMEOLOGY LAB

Course Outcomes
1. To understand the principle of the experiments on enzyme activity (Understanding)
2. To conduct an experiment on enzyme activity (Applying)
3. To analyse the effect of different physicochemical condition on enzyme activity (Analysing)
4. To interpret experimental datas (Evaluating)
5. To develop research aptitude (Applying)
6. To develop writing skill (Applying)

Syllabus
1. Effect of pH on amylase enzyme activity
2. Effect of temperature on amylase enzyme activity
3. Determination of K_m and V_max of salivary amylase enzyme
4. Assessment of inhibitor on enzyme activity.
5. Assessment of activatoron enzyme activity.
Suggested Readings
1. Introductory Practical Biochemistry, Sawhney SK and Singh R, 2001, Narosa Publishing

Mapping of COs to Syllabus

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**BTCA6010: COMPUTER APPLICATIONS AND BIOINFORMATICS LAB**

Course Outcomes
1. To construct various application program by using the concepts of C programming (Applying)
2. To demonstrate the usage of basic commands for operation in LINUX systems (Understanding)
3. To execute sequence alignment, primer designing, gene prediction phylogenetic tree construction by utilizing biological database and tools (Evaluating)
4. To build the 3D protein structures by homology modeling methods, visualize it to subject to molecular docking experiments (Creating)

**Syllabus**
1. Programs of C language
2. Introduction to basic commands used in LINUX operating systems
3. Introduction to various databases available, their usage in sequence searching, retrieval available in databases
4. Sequence alignment
5. Introduction to Gene prediction tools
6. Primer designing and analysis
7. Phylogenetic Analysis based on sequence alignment data and RAPD/protein profile data
8. Visualization of structures of protein, ligands in databases and their molecular docking
9. Homology modeling

**Suggested Readings**
Bioinformatics. A Practical Approach. Shui Qing Ye, Chapman and Hall/CRC

**Mapping of COs to Syllabus**

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**BTIV6011: INDUSTRIAL/LABORATORY VISIT**

**BTBP6011: PLANT BIOTECHNOLOGY LAB**

Course Outcome
1. To design the composition of plant media and solution (Creating)
2. To develop various techniques of plant tissue culture. (Applying)
3. To determine the application of the various techniques used in plant tissue culture (Analysing)

**Syllabus**
1. Preparation of Plant tissue culture media and Stock solutions
2. Callus induction, Shoot/Root induction – organogenesis
3. Cell suspension culture
4. Haploid production – Anther and ovule culture
5. Artificial seed production
6. Protoplast fusion by PEG

**Suggested Readings**
Mapping of CoS to Syllabus

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BTPE6012: PHARMACEUTICAL & ENVIRONMENTAL BIOTECHNOLOGY LAB

Course Outcomes
1. Experiment with handling animals and the routes of injections (Applying).
2. Determine the techniques of evaluation of sterility of pharmaceutical products(Evaluating)
3. Design experiments for testing cyto-toxicity of pharmaceutical products (Creating)
4. Test for the physical properties of wastewater and solid waste (Analyzing)
5. Design protocol to estimate the level of pollution in water and solid (Creating)

Syllabus
- Demonstration of method of injecting drugs by various routes.
- Sterility testing methods for pharmaceutical products
- Assessment of cyto-toxicity of drug by mitotic index
- Assay of vitaminB12 in commercially available capsules/tablets.
- Determination of pH and conductivity of wastewater.
- Determination of pH and conductivity of solid waste.
- Determination of BOD of wastewater samples.
- Determination of COD of wastewater samples.

Suggested Readings

Mapping of CoS to Syllabus

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BTCL6014: CLINICAL LABORATORY TECHNIQUES (0-0-1)

Course Outcome
1. Perform the experiments necessary for careers in research and diagnostic laboratories. (Applying)
2. Detect Inflammation which could help them in diagnoses of underlying health condition (Analyzing)
3. These diagnostic tests will help learner to analyze the presence of pathogenic agents and guide them for further screening (Analyzing)
4. Analyze and correlate hemoglobin with different health conditions and can guide the patient for further diagnostic test (Analyzing)
5. Developing methods of identification of clinically important microorganisms and study response to antibiotics (Applying).

Syllabus
1. Good Laboratory practices
2. Determination of blood groups (A, B, O and Rh system)
3. Determination of total erythrocyte count, total leucocyte count and determination of platelet count
4. Estimation of sugar by DNS Assay
5. CRP estimation in blood
6. Antigen and antibody detection ELISA
7. Haemoglobin estimation in blood
8. Preparation of microbiological media
9. Isolation of microorganisms from a clinical sample.
10. Staining techniques and microscopic examination of microbial cells.
11. Antibiotic susceptibility testing

Suggested Readings

Mapping of COs to syllabus

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BTBB6015: BASIC BIOINFORMATICS (0-0-1)

Course Outcome
1. To recognize the importance of various types of biological databases (Remembering)
2. To apply the bioinformatics tools for performing the different types of sequence alignments (applying)
3. To construct the phylogenetic tree by using various strategies (Creating)

Module I
Definition of Bioinformatics and introduction to Biological databases, classification, Concept of nucleotide sequence, protein sequence and sequence alignments, types

Module II
Features of Phylogenetic tree, types of trees, interpretation of tree.

Module III
Nucleic acid databases, Protein databases, Small molecules/ Ligand databases and literature databases, Searching of sequences and retrieval of sequences, Pairwise sequence alignment and multiple sequence alignment using BLAST, Introduction to MEGA sequence alignment tool

Module IV
Sequence based phylogenetic tree construction using BLAST, Phylogenetic tree construction from chromatogram of sequencing results using MEGA & BIOEDIT tool and tree construction from RFLP profile and protein profile using DendroUPGMA

Suggested Readings
1. Introduction to Bioinformatics, Attwood T K and Parry-Smith DJ, Pearson Education.

Mapping of COs to syllabus

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PROGRAMME: MASTER OF SCIENCE (MSC) MICROBIOLOGY

PROGRAMME OUTCOMES
PO 1: **Skill Development**: Master academic, technical, managerial and crucial soft skills to qualify for careers in research, industry, education, administration and management or for higher studies where a holistic understanding of applied biosciences is required.

PO 2: **Research**: Develop a scientific mindset with the capacity for analytical and innovative thinking and practical knowhow to formulate, design and ethically implement scientific research in frontier areas of Biochemistry, Biotechnology and Microbiology.

PO 3: **Communication**: Acquire effective communication and creative expression skills in the form of writing, design, presentation and networking to convincingly articulate scientific ideas in biosciences and related fields.

PO 4: **Employment and Entrepreneurship**: Acquire the necessary knowledge and proficiencies to become employable or get self-employed and thereby create job opportunities through entrepreneurship in health, agriculture, industry, environment and allied areas of applied biosciences and thereby affirmatively contribute to scientific social responsibility.

PROGRAMME SPECIFIC OUTCOMES
PSO 1: **Confidence**: Demonstrate a comprehensive understanding of chemical and biological structure, principles, techniques, and applications.

PSO 2: **Knowledge based Skill**: To develop better understanding and improve skills that would enable them to begin a career in research laboratories, industries as well as to generate self-employability.

PSO 3: **Scientific Social Responsibility**: To develop linkages between scientific community and society to build trust, partnership and responsibility of science towards achieving social goals.

PSO 4: **Research and analysis**: Realize the impact of science in society and plan to pursue research, and learn to work as a team as well as independently to retrieve information, carry out research investigations and result interpretations.

PSO 5: **Diagnostic skills**: Attain a remarkable understanding of biochemical principles of bioenergetics, metabolism, physiology and disorders through diagnostic laboratory procedures.

PSO 6: **Technical and analytical skills**: Acquire a thorough knowledge on omics biology, high-throughput omics approaches to analyse biological samples such as genomics, transcriptomics, proteomics, metabolomics and comprehensive analysis approach.

MAPPING OF COURSES WITH POS/PSOS

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DEPARTMENT OF BIOSCIENCES - MICROBIOLOGY

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MBVM0003: VIROLOGY AND MYCOLOGY (3-0-1)

Course Outcomes
1. To develop a comprehensive understanding about viruses in general
2. To gain insights on the infection pattern of viruses and to detect viral infection in vitro
3. Understand the in vitro models of viral infection (Understanding)
4. To gain deep insights into various types of viruses on the basis of its genetic material
5. To understand the mechanism of different types of viral diseases prevalent across the globe
6. To understand about bacteriophages and how they play the role in the transmission of infections (understanding)
7. To understand basic principle behind how vaccine works and trace the history of vaccines
8. Understand diseases successfully recovered due to vaccination (Understanding)
9. Understand the risk and benefits of vaccination and develop vaccine schedule
10. To understand general overview and characteristics of fungi
11. To differentiate fungi on the basis of nutritional types and how fungi are important in plant growth (Understanding)
12. Fungi as a model to understand some of the human diseases
13. Understand how biotechnology helped in the exploitation of fungi industrially
14. Develop knowledge on various aspects of fungi from medicine to food security
15. Gain insights into the drug targets and antifungal agents (Analysing)

Module I (10 lectures)
Introduction to virology: Virus history, Diversity, shapes, sizes and components of genomes, Baltimore classification of Viruses Infectious cycle: Attachment and entry into the cells, entry of non-enveloped virions, Assay of virus infectivity, modes of transmission of viral diseases
Isolation and purification of viruses: animal cell culture, multiplicity of infection, virus preservation

Module II (20 lectures)
Animal Viruses: + Stranded RNA viruses: Picornaviruses, Flaviviruses- West Nile virus and Dengue virus, Coronavirus- SARS pathogenesis
–ve strand RNA viruses: Paramyxoviruses, Orthomyxoviruses: Influenza pathogenesis and Bird flu, Rhabdoviruses: Rabiespathogenesis
Retroviruses: structure, classification, life cycle; reverse transcription. Retroviruses: HIV, viral pathogenesis and AIDS Bacteriophages: Phage basics, Infectious cycle: Lytic and lysogenic, regulation of switch between lytic and lysogenic cycle, assay of bacteriophages, Phage therapy

Module III (5 lectures)
Basic principles, Small pox and polio vaccine, subunit vaccine, Flu vaccination, how toxic are vaccines, Vaccine schedule

Module IV (10 lectures)
Introduction: Overview of fungi, general characteristics of fungi, fungal structure, Fungal Cell wall – architecture and biosynthesis, reproduction in fungi-vegetative, asexual and sexual, homothallism and heterothallism
Nutrition classification of fungi: fungi, saprophytic, parasitic, obligatory and facultative, biotrophic
Fungal-plant interactions: symbiotic and antagonistic interactions, ecto-mycorrhizae, endomycorrhizae and vesicular arbusculumycorrhizae, Yeast as model for human diseases

Module V (5 lectures)
Importance of Fungi in biotechnology, industrially important enzymes from fungi, Fungal metabolites and their economic significance - mycotoxins, medicinal uses of fungi (antibiotics), Antifungal agents and their mode of actions, drug targets, Fungi as food - mushrooms,

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mushroom poisoning

Suggested Readings
5. Radical Mycology, 1st edition, Peter McCoy’s, 2016, Chthaeus Press

Mapping of COs to Syllabus

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MBEM0009: ENVIRONMENT MICROBIOLOGY (3-0-1)

Course Outcomes
1. Outline the traditional and modern approaches of microbial biodiversity analysis (Understanding).
2. Relate the role of a habitat in natural selection of diverse microbial forms (Remembering).
3. Classify the different modes of microbial interaction in a micro- and macro-habitat (Understanding).
4. Apply the properties of microbes in agriculture and in wastewater remediation (Applying).

Module I (10 lectures)
- b. Biodiversity: structure and function of a microbial community, estimates of total number of species, measures, and indices of diversity (diversity, dominance, and species richness indices), culture dependent and culture independent methods, microbial biodiversity analysis and documentation.

Module II (10 lectures)
- a. Ecology: Microbial ecology vs. macroecology, concept of habitat and niche, fundamental and realized niche, resource partitioning and character displacement, characteristics of microbial population growth curves, microbial population regulation, r and K selected strategies, microbial community succession.
- b. Extremophiles: Molecular and physiological adaptation of acidophiles, alkalophiles, halophiles, thermophiles and hyperthermophiles, psychrophiles and barophiles.

Module III (15 lectures)
- a. Microbial interaction: Brief account of the interactions - rhizosphere, phyllosphere, microbial interactions within community - mycorhiza, epiphytic and endophytic microorganisms and their functional capability, microbial biofilm: definition, development, and importance.
  Application of bacteria in agriculture: nitrogen fixing organisms – nitrogenase system and nif genes. Bio fertilizers – Bacterial, Azotobacter and vermicform compost

Module IV (10 lectures)
Waste treatment: Types of waste – solid and liquid waste characterization, bioremediation - several sustainable approaches for remediation of xenobiotic compounds and hydrocarbons, Physical, chemical and biological treatment methods, wastewater remediation – trickling, activated sludge, oxidation pond. Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN tests, tests for faecal coliforms (b) Membrane filter technique.

Suggested Readings

Mapping of Course outcomes to Syllabus

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MBMM0010: MEDICAL MICROBIOLOGY (3-0-1)

Course Outcomes
1. Define the role of microflora in human body and its mode of transmission (Remembering).
2. Explain the mode of microbial pathogenesis in disease causation (Understanding).
3. Illustrate the differences in bacterial and fungal diseases (Understanding).
4. Examining different diagnostics methods and treatment options for microbial infections (Analysing).

Module I (5 lectures)
a. Human Microflora: Normal microorganisms in human body, role of resident microbial flora.
b. Transmission: Routes of transmission, community and nosocomial infections, opportunistic infections.
c. Detection strategies and protocol: Collection, transportation and processing of clinical samples, Quality control of a medical microbiology laboratory.

Module II (15 lectures)
b. Mechanisms of pathogenesis: adhesion, colonization and invasion of host tissue – mucous membrane of respiratory, enteric and urogenital tracts; role of aggressins, depolymerizing enzymes, organotropisms, pathogenicity, and cytotoxicity modulation of host cell.

Module III (15 lectures)
a. Bacterial diseases: Clinical features, transmission, characteristics of causative organism, pathogenesis, laboratory diagnosis, prevention and control of bacterial diseases and clinical syndromes – typhoid fever, cholera, diphtheria, tetanus, meningitis, septic arthritis, conjunctivitis, otis media, pneumonia, gastroenteritis, urinary tract infections, wound infections, skin and soft tissue infections.

Module IV (10 lectures)
a. Antibiotic therapy: antibiotic sensitivity assays - Stokes method, Agar dilution method, Broth dilution method, E-strip method, efficacy; pharmacokinetics and side-effects, prophylaxis.

Suggested Readings

Mapping of Cos to Syllabus

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MBCG0011: CELL BIOLOGY AND GENETICS (4-0-1)

Course Outcomes
1. Recall the fundamental concepts of cell biology and genetics (Remembering).
2. Relate cellular structure to function, physiology and communication (Understanding).
3. Examine the principles of genetics, mutation and recombination (Analysing).
4. Compare concepts in cell, developmental biology and genetics (Evaluating).

Module I (9 lectures)

Module II (12 lectures)
Organization of genes and chromosomes: Structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin,
euchromatin; Concept of gene, operons, gene families; Cell division and cell cycle and its regulation, Uncontrolled cell growth – cell cycle in cancer; oncogenes, tumor suppressor genes; Programmed cell death; Basic concepts of development: stages and mechanisms of early and late development; differentiation, Stem cells.

**Module III (15 lectures)**

Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Cell signaling: Hormones and their receptors, cell surface receptor, signal transduction pathways, second messengers and their roles in signal transduction, regulation of signaling pathways.

**Module IV (15 lectures)**

Mendelian principles: Mendel’s laws, concept of allele, multiple alleles, pseudoallele, codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance, expressivity.

Linkage and crossing over, sex linkage, sex limited and sex influenced characters. Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance; Genetic disorders, Pedigree analysis; Gene Mapping: linkage maps, molecular markers; Basic principles of population and evolutionary genetics, Quantitative genetics- polygenic inheritance and biostatistics.

**Module V (9 lectures)**

Fine structure of a gene: Cistron, muton and recon; Basic genome organization (prokaryotic and eukaryotic); Bacterial genetics (transformation, transduction, conjugation)

Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Transposable genetic elements;

Recombination: Homologous and non-homologous recombination, including transposition, site-specific recombination.

**Suggested Readings**


**Mapping of COs to Syllabus**

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**MBWM0012: WASTE MANAGEMENT (1-0-0)**

**Course Outcomes**

1. Understand the waste management systems with respect to its physical properties and associated critical considerations in view of emerging technology (Remembering)
2. To prepare an outline with methods of sample handling, storage and disposal of various waste (Understanding)
3. To apply the concepts of zero waste (Applying)
4. To select an appropriate method for disposal of hazardous solid waste (Applying)
5. To choose an appropriate method to recycle waste (Evaluate)
6. To synthesize the recycling approaches towards economic growth (Creating)

**Module I (4 lectures)**

Overview of waste management: Basic concepts and principle of waste management; sources of waste; waste management hierarchy; management strategies; challenges and opportunities; contribution to economic growth.

**Module II (2 lectures)**

Training on sustainable approaches to solid waste management

**Module III (3 lectures)**

Training on Waste water processing treatment

**Module IV (2 lectures)**

Training on Reuse and Recycling Techniques to convert trash to thrive

**Module V (2 lectures)**

Field visits to explore waste management processing.

**Module VI (2 lectures)**

Waste management awareness program
Mapping of COs to Syllabus

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MBMC0013: MUSHROOM CULTIVATION (1-0-0)

Course Outcomes
1. To develop comprehensive understanding basics of mushroom and their importance to humans and environment (Remembering)
2. To develop skills on techniques of mushroom cultivation and understand global market and demand of mushrooms (Understanding)
3. To develop skills on preservation techniques for mushrooms, risk and benefits associated (Analysing)

Module I (5 lectures)
Definition of a Mushroom, Mushroom Hunting, Ecological Classification of Mushrooms, Food Supply through Mushroom, Enhance Human Health through Mushroom Derivatives, Benefit the Environment through Mushroom Mycelia

Module II (7 lectures)
Mushroom Cultivation: Both a Science and an Art, World Mushroom Production, Differences in Mushroom Production Patterns, World Mushroom Market, Nutritive value of mushrooms, Poisonous Mushrooms
Phases of Mushroom Cultivation: Sterilization: Knowledge of General Safety, health and hygiene, Optimum growing condition Substrate: Preparation of beds for cultivation of various mushrooms and its maintenance, Problems in mushroom cultivation & its remedies Cultivation of selected mushrooms: Oyster Mushroom Cultivation, Milky Mushroom Cultivation, Button Mushroom cultivation
Practical aspects: Sterilization process practice, morphological and microscopic identification of mushroom mycelium, Molecular identification of mushrooms, Spore printing technique, Growing and Identification of viable Spawn, microbial analysis of substrate and optimization,

Module III (3 lectures)
Economics of Mushroom cultivation, Post Harvesting care and processing, Packaging and storage
Practical aspects: Visits and trainings to research laboratories and Mushroom farms, mushroom trainings to community people

Suggested Readings

Mapping of Course outcomes

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MBBM0014: BASIC MICROBIOLOGY (2-0-1)

Course Outcomes
1. Differentiate and classify a significant number of common bacteria by their salient properties (Understanding).
2. Compare the nutritional needs of bacteria for growth and their metabolism (Understanding).
3. Identify key factors of the microbial growth curve and growth kinetics (Applying).
4. Define the physical and chemical methods of microbial growth control (Remembering).

Module I (5 lectures)
- Historical perspective: Discovery of microbial world, Landmark discoveries relevant to the field of microbiology, controversy over spontaneous generation
- Microbial taxonomy and diversity: Basis of microbial classification, Haeckel’s 3 Kingdom concept, Whittaker’s 5 Kingdom concept, three Domain of Carl Woese, Archael taxonomy.
- Staining techniques: Basic and acidic dyes, simple and differential staining, negative and positive staining, Grams’ staining, acid fast staining, flagella and spore staining

Module II (10 lectures)
- Nutritional classification: nutritional groups of bacteria - photoautotroph, photoorganotroph, chemolithotroph (ammonia, nitrite,
Module II
b. Microbial growth: Definition of growth and bacterial reproduction, microbial growth curve, mathematical expression of exponential growth phase, measurement of growth and growth yields - spectrophotometric method, microscopic counting, serial dilution and viable cell count, most probable number, synchronous and continuous culture
c. Microbial cultures: Concept of pure culture, methods of pure culture isolation, enrichment culturing techniques, single cell isolation, and pure culture development.
d. Culture media: chemically defined, complex, differential, and special selective media.
e. Transport of nutrients: Microbial nutrient uptake – diffusion, active transport (periplasmic binding protein and ABC transporters), group translocation and protein export system

Module III (10 lectures)
a. Photosynthesis: characteristics and metabolism of autotrophs, an-oxygenic photosynthetic bacteria and cyanobacteria, CO2fixation and mechanism of photosynthesis
b. Metabolism: An overview of metabolism, Glycolysis, Pentose-phosphate pathway, Entner- Doudoroff pathway, Citric acid cycle; electron transport system, aerobic and anaerobic respiration.
c. Endospore – Structure, properties, and germination.

Module IV (5 lectures)
a. Sterilization: physical and chemical control of bacteria.
b. Antimicrobials: General characteristics of antimicrobial drugs – antibiotics, antifungals and antivirals, classification and mode of action, antibiotic susceptibility testing - Kirby-Bauer’s disc diffusion method; antiseptics and disinfectants

Suggested Readings

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MBIM0015: INFECTION AND MOLECULAR DIAGNOSTICS (3-0-0)

Course Outcomes
1. Develop understanding on basic terminology associated with infection and diseases
2. Understand how far vaccines are effective in reducing the burden of infectious diseases
3. To understand various challenges faced in the developing world to reduce the burden of infectious disease (Analysing)
4. To gain knowledge on various types of infectious agents as a means of infection
5. To understand different mechanism for the transmission, pathology and control of infectious diseases (Understanding)
6. To understand changing paradigm of global health and strategies towards their control
7. To understand novel emerging infectious diseases which are constant threat to public health
8. To understand the problem multidrug resistance and solutions
9. Gain insights into the role of IPC in control of infections
10. To develop an understanding on how human-induced environmental changes, such as global warming, deforestation and land-use conversion, urbanization, international commerce, and human migration, are altering the ecology of infectious disease transmission (Evaluating)
11. To gain knowledge on antigen antibody based immunodiagnostics test as a primary screening for detection of infection
12. To understand the mechanisms and advancement in the techniques for screening of infectious diseases(Understanding)
13. To understand problems associated with traditional approaches for detection and how advancement in nucleic acid- based detection method decreased time and increased specificity
14. To understand the currently available molecular diagnostic approaches for detection of infectious diseases(Understanding)

Module I (10 lectures)
a. Acute infections, chronic infections, outbreak, epidemic and pandemic, epidemiology, endemcity, reproductive number, Age dependent pattern of infection, herd immunity
b. Vaccines-Impact, questions, safety and challenges, disease eradication, Nutrition and infection in developing world

Module II (10 lectures)
a. Principles of the transmission of the infectious agents (viruses, bacteria, rickettsiae, mycoplasma, fungi, and protozoan), The role of vectors, reservoirs, and environmental factors
b. Epidemiology of diarrheal diseases, TB, Hepatitis B,A, C and E, epidemiology and control of Malaria, meningococcal diseases: global
DEPARTMENT OF BIO SCIENCES - MICROBIOLOGY

problem and solutions, bioterrorism

Module III (15 lectures)
Nipah virus, SARS, COVID-19, Ebola, Plague, Diphtheria, Acute encephalitis syndrome (AES), Hantavirus Pulmonary Syndrome - causes, spread and control; Case studies, endemic, pandemic and epidemic diseases, Zoonotic diseases, Combating emerging infections, Viral mediated cancers, current issues of MDR/XDR microbial strains, concept of DOTS, emergence of antibiotic resistance, gut microbiota in health and disease, Role of Infection prevention and control (IPC)

Module IV (10 lectures)
Immunoelectrophoresis, agglutination, ELISA, immunofluorescence, Immunohistochemistry; Fluorescent Activated Cell Sorter (FACS); Single and double immunodiffusion, Immunofluorescence, RIA, ELISA, Western blot, FACS

Module V (10 lectures)
Non nucleic acid-based methods: Biotyping, Antimicrobial susceptibility testing, serotyping, bacteriophage typing, Nucleic acid- based methods - Agarose gel electrophoresis, RFLP, PFGE, PCR

Suggested Readings
5. The elements of Immunology, 1st Edition, Fahim Halim Khan, 2009, Pearson Education India

Mapping of COs to Syllabus

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MBNB0016: NANOBIOLOGY (2-0-0)

Course Outcomes
1. To understand the history and concept of nanotechnology (Understanding)
2. To explain the different types of nanomaterials (Applying)
3. To compare the different types of methods involved in the synthesis of nanoparticles (Evaluating)
4. To analyse the properties of nanoparticles by using different instruments (Analysing)
5. Application of nanotechnology in different fields (Applying)

Module I (5 lectures)
Introduction to nanobiotechnology; History of nanotechnology; Types of nanomaterials- Quantum dots, Carbon based, Metal based, Dendrimer, Composite; Properties of nanomaterials

Module II (13 lectures)
Synthesis of Nanomaterials- Physical, Chemical, Biological (Bacteria, Fungus, Plants); Characterization of nanomaterials- UV-Vis Spectroscopy, Electron microscope- Energy Dispersive X-ray Spectroscopy, Mass Spectroscopy-Types-Nuclear Magnetic Resonance (NMR) Spectroscopy, FT-IR Spectroscopy- X-Ray Diffraction (XRD)

Module III (12 lectures)
Application of Nanotechnology- Drug delivery system; Disease treatment; Agriculture; Food industry; Detection system; Nanotechnology - Environmental and health effects

Suggested Readings

Mapping of COs to Syllabus

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MBIF0018: INDUSTRIAL AND FOOD MICROBIOLOGY (4-0-0)

Course Outcomes
1. Recall methods of isolation and screening methods for industrially important microorganisms (Remembering).
2. Illustrate techniques for scaling of microbial fermentation for food and product formation (Understanding)
3. Develop methods for production of economically important products and its preservation (Applying).
4. Categorize important preservation and safety measures for food production in North-east India (Analysing)
5. Compare the diverse fermented food products and its mode of preparation in tribal population of North-East India (Understanding)

Module I (15 hours)
a. Microbes: Isolation and Screening of industrially important microorganisms, improvement of microbial strains, qualities of an industrially important microbe, preservation and maintenance of industrial strains.
b. Fermentation basics: Fermentation medium and sterility, types of fermentation process - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (e.g. baker’s yeast) and continuous fermentations, fermentation kinetics.
c. Industrial design: Bioreactor – design and components, bioreactor types - Laboratory, pilot-scale and production fermenters, constantly stirred tank and air-lift fermenters, fermentation process control. Post production techniques and down-stream processing.

Module II (15 hours)
a. Production: Microbial production of industrial products, micro-organisms involved, media formulation, fermentation conditions, upstream and downstream processing and uses - Citric acid, ethanol, penicillin, streptomycin, glutamic acid, Vitamin B12, Enzymes (amylase, protease, lipase), wine, beer.
c. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).

Module III (15 hours)
a. Food preservation: Food as a substrate for microbes, microbial growth in food, characteristics of micro-organisms in food, food preservation – physical methods (dehydration, freeze drying, heat and irradiation), chemical methods (chemical preservatives and additives), canning.
b. Food Spoilage: characterization of contamination and spoilage of cereals, sugar products, vegetables, fruits, meat and meat products, milk and milk products, fish and sea foods, poultry, beer and wines; Spoilage of fermented foods and canned foods. Laboratory testing protocols and biosensors in food industry.

Module IV (15 hours)
a. Food safety: Microbiological quality standards of food, Food control agencies and their regulations – FDA, EPA, CDC and ISI. ISO and Hazard analysis and Critical Control point (HACCP) system, Food Safety Act and Trade Regulations.
b. Fermented food: Cultures for food fermentation, fermented foods and their production – bread, cheese, fermented vegetables, dairy products –acidophilus milk, yoghurt, single cell proteins, pickles, oriental foods and beverages, locally fermented alcoholic beverages, probiotics, prebiotics and symbiotic.

Suggested Readings

Mapping of COs to Syllabus

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# LABORATORY COURSES

## MBCB6011: CELL BIOLOGY AND GENETICS LAB

**Course Outcomes**
1. Recall the theoretical topics in cell biology and genetics (Remembering)
2. Apply the fundamental concepts of cell biology and genetics in laboratory (Applying)
3. Analyze data and numerical problems from experiments and interpret results (Analysing)

**Syllabus**
1. Method s of cell lysis and staining
2. Cell imaging and documentation
3. Study of mitosis and meiosis in plants/cultured cells
4. Isolation of DNA from animal and plant sources
5. Agarose gel electrophoresis of isolated genomic DNA
6. Determination of Tm of DNA
7. Isolation of auxotrophic mutants by replica plating
8. Numerical problems in genetics(Mendelian, population and bacterial genetics, mutation, recombination, etc.

**Suggested Readings**

**Mapping of COs to Syllabus**

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*P: Practical

## MBBM6012: BASIC MICROBIOLOGY LAB

**Course Outcomes**
1. Experiment with different microbial isolation techniques (Applying)
2. Examine cell structure through microscopy and microbial colonies for identification (Analysing).
3. Determine the factors that affect microbial growth (Evaluating).

**Syllabus**
1. Preparation of various routine laboratory media - differential, selective and enriched.
2. Isolation of microorganisms by serial dilution method
3. Isolation of pure cultures by streak plate method
4. Staining techniques and microscopic examination of bacteria – Gram’s staining, negative staining, capsule staining, spore staining, acid fast staining of bacteria
5. Staining techniques and microscopic examination of fungi – Lactophenol cotton blue
6. Measurement of microbial growth curve by direct cell count method/turbidity method
7. Measurement of fungal growth by colony diameter method/biomass method
8. Preservation of bacterial cells by various techniques
9. Antibiotic susceptibility testing (disc diffusion/broth microdilution)

**Suggested Readings**

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MBVM6008: VIROLOGY AND MYCOLOGY LAB

Course Outcomes
1. Apply the knowledge on bacteriophages to isolate and quantify (Applying)
2. Learn the technical skills to isolate DNA from phages (Analysing)
3. Apply the knowledge on fungi to isolate, and identify (Applying)
4. Learn the technical skills to isolate DNA from fungi (Analysing)
5. Analyse different nutrients in macro fungi (Analysing)

Syllabus
1. Isolation of bacteriophage from natural sources
2. Cultivation and quantification of phages
3. Isolation of DNA from bacteriophage
4. Phage identification by PCR
5. Isolation of fungi from soil
6. Staining of fungus
7. Nucleic acid isolation of fungi
8. Spore printing of fungi
9. Detection of protein, minerals and vitamins in fungi

Suggested Readings

Mapping of outcomes:

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MBEM6009: ENVIRONMENT MICROBIOLOGY LAB

Course Outcomes
1. Experiment with different protocols for isolation of microbes from natural habitats (Applying)
2. Examine microbial interactions in soil, water, and plant systems (Analysing)
3. Evaluate the roles of microbes for its medicinal, plant growth promoting, and degradation properties (Evaluating).

Syllabus
1. Isolation of microbes (bacteria & fungi) from soil (28ºC&45ºC)
2. Isolation of Cyanobacteria from natural sample
3. Isolation of antibiotic producing microbes from soil sample.
4. Determination of antimicrobial spectrum of isolate
5. Isolation of anaerobic microorganisms
6. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane
7. Isolation of protease secreting bacteria from soil
8. Isolation of xenobiotic compound degrading bacteria by enrichment culture technique
9. Assessment of microbiological quality of water
10. Microbial biofilm detection
11. Isolation and identification of symbiotic bacteroids of Rhizobium sp. from root nodules of leguminous plants
12. Isolation of phosphate solubilizing bacteria from soil and quantitative measurement of the phosphate solubilisation

Suggested Readings
Mapping of COs to Syllabus

### MBMM6010: MEDICAL MICROBIOLOGY LAB

**Course Outcomes:**
1. Developing methods of identification of clinically important microorganisms (Applying).
2. Categorize microbes based on their physiology to develop methods for diagnosis (Analyzing).
3. Assess the response of bacteria to antibiotics by in vitro assays (Evaluating).

**Syllabus:**
1. Biochemical tests – IMViC tests – of enteric bacteria
2. Isolation and biochemical characterization of pathogenic bacteria from any clinical sample
3. Isolation and biochemical characterization of normal micro flora of skin, throat or oral cavity
4. Isolation and identification of fungal pathogens from clinical specimens
5. Isolation of hemolytic bacteria using blood agar media.
6. Minimum inhibitory concentration (MIC) determination of antimicrobial compound against microorganism
7. Isolation and screening of bacterial and fungal cultures for enzyme production – amylase or gelatinase
8. Determination of presence of catalase and oxidase activity in bacteria
9. Determination of the ability of bacteria to utilize sugars by oxidative or fermentative mode
10. Demonstration of sugar fermentation – sucrose, lactose and glucose

**Suggested Readings:**

### MBIM6015: INFECTION AND MOLECULAR DIAGNOSTICS LAB

**Course Outcomes:**
1. Analyse antibodies by different types of ELISA generated due to microbial infection (Analyzing)
2. Standardization of Indirect Immunofluorescence assay (Evaluating)
3. Demonstrate practical knowledge on Single radial immune diffusion (Analyzing)
4. Demonstrate practical knowledge on Double immune diffusion method (Analyzing)
5. Demonstrate practical knowledge on Immuno electrophoresis (Analyzing)
6. Standardize antimicrobial susceptibility test and learn analysing its result (Evaluating)

**Syllabus:**
1. Detection of antimicrobial antibodies by ELISA
2. Indirect Immunofluorescence assay
3. Single radial immune diffusion
4. Double diffusion method of Ouchterlony
5. Immuno electrophoresis
6. Rocket electrophoresis
7. DOT ELISA for the presence of specific antigen.
8. Antimicrobial susceptibility testing

**Suggested Readings:**
Mapping of Course outcomes:

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**MBDI6006: DISSERTATION PHASE I (0-0-2)**

Course Outcomes
1. Develop a scientific mindset with the capacity for analytical and innovative thinking (Creating).
2. Develop writing skill, referencing and citations for effective communication (Applying).
3. Improve communication and creative expression skills to articulate scientific ideas (Creating).
4. Examine the research gap in the related field and formulate strategies to address the same (Analysing).

Syllabus
1. Familiarization with research topic and methodologies by a thorough literature review.
2. Writing of review of literature to brush up already existing knowledge on a given area.
3. Formulate a research hypothesis and a proposed workplan.
4. Presentation of the research topic at department level and submission of literature review.

Suggested Readings
1. Scientific review and research articles published in respective specialized area of research.

Mapping of Course outcomes to Syllabus

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**MBDI6007: DISSERTATION PHASE II (0-0-16)**

Course Outcomes
1. Support the research hypothesis with experiments executed ethically (Evaluating).
2. Develop skill to independently carry out a research in the laboratory (Creating).
3. Examine the methodology, analyse results, and defend the research work (Analysing).

Syllabus
1. Execute a scientific dissertation based on the proposed plan in Phase 1 through bench work.
2. Present and report data at various stages of the research work to the assigned supervisor.
3. Analysing the results, correlating it with different experiment performed during the dissertation.
4. Present the findings in a department level to internal and external examiners, and submission of completed thesis.

Suggested Readings
Scientific review and research articles published in respective specialized area of research.

Mapping of COs to Syllabus

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*P: Practical
DEPARTMENT OF ZOOLOGY

DETAILED SYLLABUS

VISION:

- To develop the Department as an interdisciplinary centre for learning, research, and innovation
- To develop the Department into a hub of biodiversity research while making the surrounding a natural laboratory

MISSION:

- To provide a better understanding of Zoological Sciences through interaction with the natural environment and sensitizing the students about their social responsibilities
- To expose the learners to recent advances in Zoology and to provide high quality education with an emphasis on learning and research.

PROGRAMME: BSC ZOOLOGY (HONOURS)

PROGRAM OUTCOMES (PO) - BSC PROGRAMME

PO 1: **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspective.

PO 2: **Effective Communication:** Speak, read, write and listen clearly in person and through electronic media, and make meaning of the world by connecting people, ideas, books, media and technology.

PO 3: **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO 4: **Effective Citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO 5: **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO 6: **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

PO 7: **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PROGRAMME SPECIFIC OUTCOMES (PSOs) - Bsc (Honours) Zoology

PSO 1: **Knowledge and Concept:** Acquire detailed knowledge on the extensive diversity of organisms inhabiting varied ecological niches of the earth as well as understand the complexity of the various life-systems operating in these organisms.

PSO 2: **Applying knowledge for self-sustenance:** Build foundations for novel thinking through application-based studies such as sericulture and aquarium fish keeping, thus ensuring better opportunities for self-sustenance in future.

PSO 3: **Skills in handling scientific instruments:** Develop interest as well as proficiency in handling scientific instruments introduced as part of practical courses, thereby warranting all-around growth.

PSO 4: **Conservation strategies:** Recognize the importance of conservation and encourage designing of effective strategies to address present conservation issues with preference to sustainable development.

COURSES OFFERED IN BSC (HONOURS) ZOOLOGY

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PROGRAMME: MSC ZOOLOGY

PROGRAM OUTCOMES (PO)- MSC ZOOLOGY

PO 1: Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspective.

PO 2: Effective Communication: Speak, read, write and listen clearly in person and through electronic media, and make meaning of the world by connecting people, ideas, books, media and technology.

PO 3: Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO 4: Effective Citizenship: Demonstrate empathetic social concern and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO 5: Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO 6: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO 7: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PO 8: Skill Development: Acquire and develop skills in handling scientific instruments, planning and executing biological research for employability and social service.

PO 9: Entrepreneurship: Inculcate a holistic approach towards amalgamating and applying the acquired knowledge, ideas and views towards formulating a model that would not only encourage financial stability of the person concerned but also generate employability and strengthen the socio-economic aspect of a region or locality as a whole.

PO 10: Creative Thinking: Promote creative thinking and innovative ideas for the welfare of the society.

PROGRAMME SPECIFIC OUTCOMES (PSOs)- MSc ZOOLOGY

PSO 1: Knowledge and concept: To acquire in-depth knowledge about the complexity of life systems at the molecular level.

PSO 2: Research-inclined mindset: To apply and analyze the various research techniques through minor dissertation projects, thus inculcating the fundamentals for future scientific studies.

PSO 3: Applied Zoology and Entrepreneurship: To apply the acquired knowledge to invigorate the existing areas of application-based zoological studies for creating productive models for self-sustenance.

PSO 4: Conservation Models: To specifically recognize the existing conservation issues with regards to both animal and environment and develop strategies to address these issues through ecologically sustainable methods.

COURSES OFFERED IN MSC ZOOLOGY

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DEPARTMENT OF BIOSCIENCES - BOTANY

DETAILED SYLLABUS THEORY COURSES

BTRM0003: RESEARCH METHODOLOGY AND BIOSTATISTICS (4 CREDITS – 60 HOURS) [L-T-P: 4-0-0]

Course Outcomes
At the end of the course students will be able to:
1. Identify the forms of research – basic, applied, interdisciplinary, etc. (Analysing)
2. Explain Ethical conduct of research and its communication (Understanding)
3. Determination of Statistical methods of data analysis and interpretation (Evaluating)

Module I: Introduction to Scientific Research (15 hours)
- Definition, basic and applied research, interdisciplinary research,
- Discriminative reading, reading and reviewing scientific literature – consulting source material, primary and secondary literature, biological abstract, current content, review, monograph, peer- reviewed journals, e-resources; research and review articles
- Introduction on scientific problems, your scientific problem, methods and techniques, research conditions, data types, repeatability, reproducibility and reliability, validity, effect measure and choice of statistical test, experimental protocol, experimental routine
- Scientific communication - scientific paper, scientific posters

Module II: Ethics and Scientific Conduct (5 hours)
Brief introduction to ethics, scientific conduct and misconduct-plagiarism, authorship issues, investigation and punishment of scientific misconduct, ethics of animal and human research

Module III: (15 hours)
- Introduction to Biostatistics: definition and applications of biostatistics;
- Data-types and presentation: types of biological data, accuracy and significant figures;
- Populations and samples: populations, samples from populations, random sampling, variables and attributes, statistical errors
- Frequency distributions
- Graphical representation of data: line diagram, bar diagram, pie chart, histogram
- Measures of central tendency: the arithmetic mean, median and mode
- Measures of dispersion: range, mean deviation, variance, standard deviation, standard error of mean, standard score

Module IV: (6 hours)
- Permutations and combinations, sets
- Probability: introduction, counting possible outcomes, probability of an event, adding and multiplying probabilities
- Probability distributions: Binomial, Poisson and Normal distribution

Module V: (19 hours)
- Testing of hypothesis and goodness of fit: Null hypothesis, level of significance, errors of influence, Student’s t-test, paired t-test, Fischer’s test, Chi-square test, linear correlation and linear regression
- Analysis of variance: variances of samples and their means, F-distribution, partitioning of the total sum of squares and degrees of freedom, models and types of ANOVA

Mapping of COs to Syllabus

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ZGDB0005: DEVELOPMENTAL BIOLOGY (4 CREDITS–60 HOURS) [L-T-P: 4-0-0]

Course Outcomes
1. Summarize the mechanisms underlying the process of development. (Remembering)
2. Distinguish different mechanisms of cellular dynamics through experimental embryology. (Analyzing)
3. Apply the concepts of stem cells in relation to health sciences. (Applying)
4. Analyze the various teratogenic agents and environmental estrogens. (Analyzing)
5. Evaluate the interactions of maternal effect of gene, gap gene, pair-rule gene, and hox-gene in development with respect to Drosophila. (Evaluating)
6. Discuss the various methods of assisted reproductive technology. (Creating)

**Module I (14 hours)**

**a)** Fertilization-pre and post fertilization events, activation of eggs, gamete fusion and prevention of phylogeny

**b)** General concept of Induction: mesoderm development, Determination: Imaginal disc of insects, Differentiation: Formation of fruiting bodies in Dictyostelium

**c)** Neo-cytoplasmic interaction in development of unicellular organisms and in early development and differentiations of multicellular organisms, importance and role of cytoplasm, hybridization experiments, nature of changes in nuclei, cell hybridization, nuclear transplantation experiments.

**Module II (10 hours)**

**a)** Principles of experimental embryology: the developmental dynamics of cell specification, stem cells and developmental commitment, totipotency and pluripotency.

**b)** Morphogenesis and cell adhesion- the thermodynamic model of cell interactions, concept of morphogen gradient and morphogenetic field, cell adhesion molecules.

**Module III (10 hours)**

Role of maternal contribution in early embryonic development in Drosophila: maternal effect genes, gap genes, pair rule genes and hox genes in development.

**Module IV (10 hours)**

Organogenesis: Vulva formation in *Caenorhabditis elegans*; Regeneration of Salamander limbs; Lens regeneration in amphibia; Bone and neural regeneration-Medical Advances in regeneration.

**Module V (16 hours)**

**a)** Medical implications of Developmental Biology - Genetic error of human development; Environmental assault on human development, Teratogenic agents (Retinoic acid, pathogens, alcohol, drugs and chemicals, heavy metals); Environmental estrogens.

**b)** Infertility- In vitro fertilization and embryo transfer. Cloning experiments- Amphibians and Mammals. Embryonic stem cells and their applications; ethical issues

**c)** Sex determination-Timing and gene expression in mammalian sex determination, Brain sex determination pathways in invertebrates and flies, Hormone disruptors and sex determination problems, Temperature-dependent sex determination in turtles, Evolution of sex from invertebrate to vertebrate; ethical issues.

**Suggested Readings**

7. Oppenheimer, S.B. Introduction to Embryonic Development. Allyn and Bacon, Inc.
17. Chester-Jones I: Fundamentals of Comparative vertebrate Endocrinology (Pleum Press: NY)

**Mapping COs to syllabus**

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SPECIALISATION I: ENTOMOLOGY

ZGIF0008: INSECTS- STRUCTURE AND FUNCTION (4 CREDITS-60 HOURS; L-T-P: 4-0-0)

Course/Learning Outcomes (CO)
At the end of this course students will be able to:
1. Recall the basics of insect classification of different insect orders up to family level. (Remembering)
2. Identify details of insects’ morphology, origin and locomotion and the different receptor organs. (Applying)
3. Discuss the basic concepts of insect-plant interactions. (Creating)

Module I (20 hours)
a) Origin and evolution of insects
b) Segmentation of insect: head, thorax and abdomen: body tagmata, sclerites and segmentation, Type of mouthparts, antennae, legs, their modifications and functional significance; model Genitalia and their modifications; Embryonic and post-embryonic development; Types of metamorphosis in insects.
c) Wings: wing structure, venation and wing coupling; Insect flight taking Drosophila as a model.

Module II (20 hours)
Basic concept of surveillance and sampling of insect.

Classification of insect up to family with example : a) Coleoptera, Diptera, Hymenoptera; b) Lepidoptera, Odonata; c) Orthoptera, Hemiptera and; Insect molecular taxonomy-DNA as a new tool for insect identification

Module III (8 hours)
Insect integument: Structure, chemical composition, bio-composition of chitin, function of integument

Module IV (12 hours)
a) Receptor organ in insects (Chemoreceptors,
b) mechano receptors and photoreceptors);
c) Sound and Light producing organs in insects;
d) Locomotion in insects,
e) Insect Muscle,
f) Insect eye.

Suggested Readings
2. D.B. Tembhare, Modern Entomology, Himalaya Publishing House
5. H. Maxwel-Lefroy & F.M. Howlett, Indian insect Pests, Astral International (P) Ltd.

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ZGIP0009: INSECT PHYSIOLOGY (4 CREDITS-60 HOURS; L-T-P: 4-0-0)

Course/Learning Outcomes
1. Explain the development and physiology of different systems; hormones and pheromones. (Understanding)
2. Compare the morphology of insect organ systems. (Analysing)
3. Examine how the morphology of an organ is related to its function and how these systems help the insects to adapt to the environment. (Analysing)
4. Develop a sound knowledge on the insect metabolism, muscle and the physiology of insect vision (Applying)

Module I (25 hours)
a) Digestive System: Different types of alimentary canal, salivary glands, physiology of digestion and absorption.
b) **Respiratory System**: General organization of respiratory system, classification of respiratory system, respiration in terrestrial insects-different types of spiracles and their structure, opening and closing mechanism of spiracle, trachea and tracheoles, air sac, ventilation of tracheal system, mechanism of gaseous exchange, respiration in aquatic insects, physiology of gill and plastron respiration, respiration in parasitic insects.

c) **Circulatory system**: Diaphragm and sinuses, dorsal vessels, accessory pulsatory organs, blood circulation, chemical composition of haemolymph, different types of haemocytes and their functions.

Module II (18 hours)

a) **Nervous system**: Structure and types of neurons, central nervous system basic plan, gross anatomy and microanatomy of brain and ganglion, sympathetic nervous system, nerve impulse transmission.

b) **Excretory System**: Basic and cryptonephridial system, malpighian tubules-anatomy and histology, Accessory organs of excretion, metabolic pathways of formation of uric acid and ammonia, elimination of Uric acid by malpighian tubules;

c) **Diapause**: Hormonal control of embryonic, larva, pupal and reproductive diapause

Module III (17 hours)

a) **Reproductive System**: male and female reproductive system, spermatogenesis, oogenesis; Hormonal control of reproduction in male and female insects;

b) **Neuroendocrine System**: Neuroendocrine organs, hormones produced by neurosecretory cells, corpus allatum, corpus cardiacum and prothoracic gland, their chemical nature and functions; Insect immunity; Growth and metamorphosis of insects; Insect Pheromones.

**Suggested Readings**

1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press
4. Introduction to General and Applied Entomology, Abhishek Shukla and Sushil kumar Saxena, Astral International (P)Ltd.

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**SPECIALIZATION II: CELL AND MOLECULAR BIOLOGY SPECIALIZATION**

**ZGC80010: CELL AND MOLECULAR BIOLOGY-I (4 CREDITS; 60 HRS; 4-0-0)**

**Course Outcomes**

1. Define the structure and working of various components of the cell such as biomembrane structure and organization; genes and gene regulation and protein hierarchical structure. (Remembering).
2. Describe the various types of protein in the cell organization. (Understanding)
3. Study the positive and negative control of gene expression and also the molecular structure of chromosomes. (Analysing)
4. Recommend the use, Ramachandran plot for the prediction of secondary structure of protein. (Evaluating, creating)

**Module I (10 hrs)**

**Transport across cell membrane**: Mechanism of diffusion, Facilitated diffusion; Osmosis and water channels, movement, Fick’s law, Donnan equilibrium; Uniporter-catalyzed transport, difference between uniport-catalyzed transport and passive diffusion, GLUT- 1 transport & its kinetics; Intracellular ion environment and membrane electric potential; Active transport - P-class ion pumps, F-class and V-class ion pumps and ABC superfamily, Plasma Membrane Ca++ ATPase pump, Muscle Ca++ ATPase pump and Na+/K+ ATPase pump; Cotransport by symporters and antiporters; Transport across epithelia, Receptor mediated endocytosis.

**Module II (15 hrs/hr)**

**Cytoskeleton**: Microfilaments: Actin cytoskeleton, G-actin and F-actin; structural and functional polarity. Cortical actin network, erythrocyte and platelet cytoskeleton; Actin bundle support projecting fingers of membrane; Dynamics of actin assembly, actin polymerization; Toxins effect on actin monomer - polymer equilibrium, stabilization of actin filaments by actin capping proteins; Movement with actin polymerization (a) Intracellular bacterial and viral movements (b) Actin polymerization at the leading edge of moving cells; Myosin: (a) Structure and mechanism of movement with actin (b) Conformational changes in myosin during movement. Microtubules: Microtubules structure and microtubule assembly from organizing centers, Microtubule dynamics, Microtubule associated proteins (MAP’s) and crosslinking of microtubules.
Microtubules and mitosis (a) Centrosome duplication (b) Kinetochore and force for poleward chromosome movement (c) Organization of spindle pole and orientation of assembly (d) Formation of poles and capture of chromosomes (e) Kinetochore and force of poleward chromosome movement (f) Astral microtubule and cytokinesis (g) Microtubules and plant cell formation.

**Module III (20 hrs)**

**Molecular structure of genes and chromosomes**: Definition of gene; Chromosomal organization of genes- coding and non-coding DNA; Functional re-arrangements in chromosomal DNA; Organizing cellular DNA into chromosomes; Morphological and functional elements of eukaryotic chromosomes.

**Regulation of Gene expression**: Operon concept; Positive and Negative regulation; Inducers and corepressors; Regulation by attenuation-his and trp operons.

**Module IV (15 hrs)**

**Protein structure and function**: Structure and chemistry of amino acids; Hierarchical structure of proteins-Secondary structure: α-helix, β-pleated sheets and bends; Prediction of secondary structure, Ramachandran plot; Tertiary structure, forces stabilizing tertiary structure; Domains and Motifs; Quaternary structure of proteins

**DNA binding proteins and gene regulation**: DNA binding domain; Homeodomain proteins; Zinc finger proteins; Winged-helix (Forked head) proteins; Leucine-Zipper proteins; Helix Loop helix proteins.

**Suggested Readings**

1. Cooper, G. M., Cell (A Molecular Approach)
2. DeRobertis&DeRobertis: Cell and Molecular Biology
3. Lodish et al: Molecular Cell Biology
4. Karp: Cell and Molecular Biology
6. T.A. Brown: Genome
7. Griffith et al: Modern Genetic Analysis
8. Hartl& Jones: Essential Genetics: A Genome Perspective
9. Ram Mahabal, Fundamental of Cytogenetics and Genetics
10. Lewin, Genes VIII

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**ZGIY0011: IMMUNOLOGY-I (CREDIT 4; 60 HRS; 4-0-0)**

**Course Outcomes**

1. Define the basic concepts of the immune system and its components. (Remembering)
2. Analyze the antigen-antibody reactions. (Analyzing)
3. Demonstrating the general organization and inheritance of major histocompatibility complex. (Understanding)
4. Recommend the list of various agents responsible for hypersensitivity reaction Develop a network of various components and complexes of the immune system and make a checklist of organ specific and systemic autoimmunediseases. (Evaluating)

**Module I (15 hrs)**

**Cells and organs of immune system**: Hematopoiesis- B-Lymphocytes, T-lymphocytes and Null cells; Mononuclear cells (antimicrobial and cytotoxic activities, secretion of factors); Granulocytic cells (Neutrophils, Eosinophils and Basophils); Mast cells; Dendritic cells and Langerhans cells; Organs of immune system: Primary lymphoid organs (Thymus and bone marrow), Secondary lymphoid organs (Lymph nodes, spleen, mucosal associated lymphoid tissue and cutaneous associated lymphoid tissue, tonsils and Peyer’s patches; Lymphatic system.

**Molecular Immunology**: Components of immunity; Innate (nonspecific) immunity- Anatomic barriers, Chemical barriers, Phagocytic barriers, Inflammatory barriers; Adaptive (specific) immunity-Humoral and cell-mediated immunity (CMI): (a) Recognition of antigen by B- and T-lymphocytes and antigen presenting cell (APC) (b) Clonal selection of lymphocytes; Cellular interactions required for generation of immune responses (a) Activation and proliferation of B and T cells (b) Generation of humoral immune responses (c) Generation of Cell mediated immune responses.

**Module II (15 hrs)**

**Antigens**: Immunogenicity versus antigenicity; Factors that influence immunogenicity, Contribution of the immunogens (foreignness, molecular size, chemical composition and heterogeneity, susceptibility to antigen processing and presentation); Haptens and epitopes; Immunogen dosage and route of administration and adjuvants.

**Immunoglobulins structure and function**: Molecular structure of Ig; Immunoglobulin classes (IgG, IgM, IgE and IgD and their biological activities; Immunoglobulin - mediated effector functions (Opsonization, activation of complement, antibody dependent cell- mediated interactions).
cytotoxicity, neutralization; Antigenic determinants on immunoglobulin (isotype, allotype and idiotype); Monoclonal antibodies: Formation and selection of hybrid cells, Production of monoclonal antibodies, Clinical uses of monoclonal antibodies, Catalytic monoclonal antibodies (abzymes).

**Antigen - Antibody Interaction:** Antibody affinity and activity; Cross reactivity; Agglutination reactions; Precipitation reaction.

**Module III (20 hrs)**

**Major Histocompatibility complex:** General organization and inheritance of MHC; Location and function of MHC; MHC haplotypes; MHC molecules and gene: Structure of class I molecules; Structure of class II molecules; Organization of class I and II genes; Peptide binding by MHC molecules; Class III molecules; Regulation of MHC expression; MHC and immune responsiveness; MHC and disease susceptibility.

**Antigen processing and presentation:** Role of antigen presenting cell, Early evidence for the necessity of antigen processing; Cells that function in antigen presentation; Evidence for two processing and presentation pathways; Endogenous antigens (The cytosolic pathway): (a) Peptide generation by proteasomes (b) Peptide transport from the cytosol to rER (c) Assembly of peptide with class I MHC molecules; Exogenous antigens (The endocytic pathway)(a) Peptide generation in endocytic vesicles(b) Transport of class II MHC molecules to endocytic vesicles.(c) Assembly of peptide with class II MHC molecules.

**Module IV (10 hrs)**

**Hypersensitivity:** Type I, II, III and IV; *in vivo and in vitro*

**Autoimmunity:** Organ specific autoimmune disease; Systemic autoimmune disease.

**Suggested Readings**
1. Kuby et al.: Kuby Immunology
2. Abbas A.K., Lichtman A.K. and Pober J.S. Cellular and Molecular Immunology
3. Roitt et al, Essential Immunology
5. Kindt T.J., Osborne B.A., Goldsby R., Immunology

**Mapping of COs to Syllabus**

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**SPECIALIZATION III: FISHERY SCIENCE**

**ZGTF0012: TAXONOMY AND FUNCTIONAL ANATOMY (4 CREDITS- 60 HOURS/L-T-P: 4-0-0)**

**Course Outcomes**
1. Demonstrate the knowledge of non-piscine fishery resources and their importance in fisheries. (Understanding)
2. Apply the knowledge of fish biology and its importance in fishery practices for the development of futureentrepreneurship. (Applying)
3. Develop fundamental skill to identify and classify various groups of fishes, their relationship with morphi-anatomicaland molecular techniques. (Creating)

**Module I (10 hours)**

a) **Fin fish taxonomy:** General characters and classification, major fish groups (extant & extinct), phylogeny of fishes;
b) **Gross external anatomy of fishes:** skin and its derivatives, scales and their significance; Significance of fish osteology in taxonomy.
c) Fish barcoding.

**Module II (30 hours)**

a) **Fin fish functional biology:** Food and feeding habits: Food– Kinds and varieties, abundance of food and its availability, structural adaptation, search for food, classification based on food and feeding habits;
b) **Respiratory organs in fishes** – Modification of gills and Tracheae in relation to habit – Structural adaptations of air breathing fishes;
c) **Age and growth:** Growth, length weight relationships, condition factors, morphometric indices and bioenergetics index, variation in growth rate, age determination;
d) **Fin fish reproductive biology:** Modes of reproduction, reproductive cycle, gonad maturity stages, Hormonal regulation of gonadal development, activity of Gonadotropin-releasing hormone, modes of spawning; Environmental factors controlling reproduction and factors affecting development.

**Module III (20 hours)**

a) **Shellfish taxonomy:** General characters and classification of major groups of crustacean and molluscs.
b) **Food and feeding biology of Shellfish:**
   - Food, feeding habits and adaptations of cultured prawn and shrimps.
   - Food, feeding habits and adaptations of cultured Molluscs.

c) **Shellfish reproductive biology:**
   - Reproductive patterns in prawn and shrimp, reproductive organs, gonad maturity, spawning and fertilization.
   - Endocrine organs in crustaceans and their role in reproduction.
   - Reproductive patterns in Molluscs, reproductive organs, gonad maturity, spawning and fertilization.

**Suggested Readings**
12. Jhingran V. G. Fish and Fisheries of India.
16. Kumar S and Thembre M Anatomy and Physiology of Fishes (Vikas Publishing House)
20. Biswas K P A Text Book of Fish, Fisheries and Technology, (Narendra Publishing House)
22. Daniels R J R Freshwater fishes of Peninsular India (Universities press)

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**ZGAF0013: AQUACULTURE AND FISH GENETICS (4 CREDITS-60 HOURS/ L-T-P: 4-0-0)**

**Course Outcomes**
1. Compare various freshwater fish culture methodologies and their significance. (Understanding)
2. Utilize the knowledge on the process of fishery and aquaculture management for development of futureentrepreneurship. (Applying)
3. Utilize the knowledge of nutritional requirements in fishery and development of skill on fish feed formulation for a profitable fish farming system. (Applying)
4. Apply the knowledge of the application of modern biotechnological tools and their role in the development of fishery. (Applying)

**Module I (15 hours)**

a) **Fishery Management:** Construction of fish farm and reclamation of swamps; Selection of species for culture – Biological principles, Preparation and management of nursery ponds, rearing ponds and stocking ponds along with control of weeds, pests and predators, Construction of hatcheries and their management.

b) **Aquaculture Management:** Feed, health and water quality management.

**Module II (15 hours)**

**Freshwater fish culture:** Indian Major carps and exotic carps - Composite Fish Culture; Air breathing fishes; Integrated Fish Farming – Paddy cum Fish Culture and Fish cum Livestock Culture, Monoculture, Monosex culture; Sewage fed fisheries, Catfish culture, Trout culture, Freshwater prawn culture; shrimps and Crab culture; cage culture and pen culture, Lobster culture, Mussel culture; Pearl oyster
Module III (15 hours)
a) **Fish nutrition**: Nutritional requirements, formulation and preparation of fish feeds Food & Feeding habits of commercially important fishes. Larval nutrition — Importance of live feed and artificial feed, Different types of feed available for larvae.
b) **Fish seed resources**: Procurement and transportation of seed from natural resources.

Module IV (15 hours)
a) **Fishery Genetics and Biotechnology**: Inheritance in fishes, sex determination, hybridization
b) **Cytogenetics and molecular techniques in fisheries**: Comet Assay, Micronuclei Test, Fish cell lines and cell culture. Application of biotechnological tools: Recombinant DNA, Transgenesis, Gynogenesis and Androgenesis, Jellyfish Green Fluorescent Proteins and their applications; Cryopreservation.

Suggested Readings
1. Arumugam, N. Aquaculture & Fisheries, Saras Publication
3. Beaven C R Handbook of the freshwater fishes of India (Narendra Publishing House)
4. Boris, Gomelsky. Fish Genetics. VDMVerlag
5. C.I.F.R.I., Prawn Fisheries Bulletin
6. Chakroff,M., Freshwater Fish Pond Culture and Management, Scientific Publishers
8. Daniels R J R Freshwater fishes of Peninsular India (Universities press)
15. Hall, C. B., Ponds and Fish Culture, Agro Botanical Publishers
17. Hora, S. L. and Pillay, T.V. R. Handbook on Fish Culture in the Indo-Pacific Region, Fisheries Division, Biology Branch, FAO,
18. Huet, M., Textbook of Fish Culture, Breeding and Cultivation of Fish, Fishing News (Books) Ltd..
19. CAR. Handbook of Fisheries and Aquaculture Reddy,
25. Lucas, J.S. Aquaculture: Farming aquatic animals and plants (Fishing News Books)
27. Michael Bernard New (Editor), Wagner Cotton iValenti(Editor), James H. Tidwell(Editor). Freshwater Prawns: Biology and Farming Wiley-Blackwell
29. Nigel Preston (Editor), Dean R. Jerry (Editor)Biology and Culture of Farmed Marine Shrimps. CRC Press
30. Pandian, T.J. (Editor), C.A. Strüssmann (Editor), M.P. Marian (Editor). Fish Genetics and Aquaculture Biotechnology,CRC Press
31. Pandian, T.J. Genetic Sex Differentiation in Fish. CRC Press
35. Rath, R.K. Freshwater Aquaculture Scientific Publishers Journals Dept
38. Selvamani B.R & Mahadevan R.K 2008 Freshwater fish farming (Campus Books International)
41. Turner, Bruce. Evolutionary Genetics of Fishes (Monographs in Evolutionary Biology).Springer

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SPECIALIZATION IV: ANIMAL ECOLOGY AND WILDLIFE BIOLOGY

ZGEB0014: ANIMAL ECOLOGY AND BIOGEOGRAPHY (4 CREDITS: 60 HOURS, L-T-P: 4-0-0)

Course Outcomes (CO)
1. Define basic ecological concepts and have a deep understanding of the theories of ecology. (Remembering)
2. Explain the concepts of landscape ecology, its importance in designing protected areas, reasons of difference in species diversity across different habitats, role of humans in fragmented habitats of wildlife. (Understanding)
3. Examine the quality of wildlife habitat, document and monitor different biodiversity around themselves and to identify different types of animal signs through animal mark and sign analysis. (Applying, Analysing)
4. Outline the different theories and processes of Biogeography, dispersal of species and barriers to their dispersal and Case studies which would provide them a deep insight to Indian biogeography. (Understanding)

Module I: Basic Ecological concept (15 hours)
- Habitat & Niche, Ecological Versatility & Niche dimension.
- Species diversity, Species richness, Global patterns in species richness, Theories of species richness, Invasive species and its effect on species richness.
- Ecosystem model

Module II: Habitat and landscape ecology (25 hours)
- Introduction to Landscape Ecology: Edge, ecotones, Edge effect interspersion and juxtaposition. Habitat fragmentation and its effect on the resident community.
- Metapopulation concept and its application in designing Nature reserve; Theory of Island Biogeography.
- Measuring Wildlife habitat: Inventory, evaluation and monitoring of wildlife habitat - availability, quality, palatability of graze and browse. Inventory of unique habitats, their distribution and need for conservation, Animals signs as indicators of habitat use.

Module III: Principles of Biogeography (10 hours)
History of biogeography. Ecology of dispersal and faunal exchange, barriers, mode of dispersal, origins and radiation; island biogeography: endemism, refugia. Continental drift; dispersal and vicariance biogeography; dispersal mechanisms and dispersal barriers.

Module IV: Indian biogeography (10 hours)
India’s biogeographic classification. Case studies of Indian fauna explaining Biogeographic Theories. Biogeographic affinities of the fauna and flora of the Indian sub-continent.

Suggested Readings

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ZGWM0015: WILDLIFE CONSERVATION AND MANAGEMENT (4 CREDITS: 60 HOURS, L-T-P: 4-0-0)

Course outcome (CO)
1. Relate different principles and practices of wildlife management and make use the concepts of conservation (Understanding,
2. Explain the concepts of wildlife management and applying theories on habitat management (Understanding, Applying)
3. Explain about different plant diversity, phytoresource utilization and their importance, threatened plants of India with respect to Northeast India. (Understanding)

Module I: Conservation Biology (20 hours)

a) Introduction to conservation biology: Values of biodiversity and conservation ethics, Patterns and process of biodiversity, losses and threats to biodiversity. Geological and present extinctions, changes in species composition and problem of climate change.

b) Strategies for conservation –
   • In situ conservation: International efforts and Indian initiatives; protected areas in India – sanctuaries, national parks, biosphere reserves, sacred grove and Community Reserve. Ecological restoration and its significance
   • Ex situ conservation: Principles and practices; botanical gardens, fields gene banks, seed banks, cryobanks; non-formal conservation efforts.

Module II: Wildlife Management (25 hours)

a) Principles and practices of wildlife management; Management of special habitats: riparian zones, Grasslands, wetlands.

b) Species conservation projects: Tiger, Lion, Rhino, Crocodile, Turtle, Adjutant stork.

c) Management plan for Protected Areas: Principles of planning, objectives, resource surveys, analysis of surrounding region, management zones, theme plans, communications, staff and visitor amenities, monitoring. Financing protected areas; Need for wildlife management planning

Module III: Plant diversity and Phytoresources (15 hours)

a) Plant Biodiversity: Concept, status in India, utilization and concerns.

b) Forest products: Important timber yielding planting. Timber types,

c) Non-Timber Forest products

d) Plants used as avenue trees for shade, pollution control and aesthetics. e) Threatened plants of India with special reference to NE India

Suggested Readings
2. Gopal, R. Wildlife Management, Allied International
3. Saharia, V. Wildlife conservation
4. Primack- Essentials of Conservation Biology
5. Dyke- Conservation Biology- Foundation, Concepts, Applications
6. Primack- A primer of Conservation Biology
7. Singh- Textbook of Wildlife Management
11. Kibue- Wildlife Conservation and Utilization
12. Trivedi and Sharma- Plant Resource Utilization and Conservation

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SPECIALISATION I: ENTOMOLOGY

ZGIG0017: INSECT ECOLOGY (4 CREDITS-60 HOURS, L-T-P: 4-0-0)

Course Outcomes
1. Apply the basics of insect ecology to the development of their research (Applying)
2. Acquire knowledge on behavioural ecology, insect association, interactions and population ecology (Applying)
3. Outline and interpret the concepts of ecology, basic principles of distribution and abundance of organisms and their causes and the impact of climate change on insect diversity (Understanding)
4. Explain the life history of some insects (Understanding)
5. Estimate the diversity of insects using different diversity indices (Creating)

Module I (15 hours)

a) Dynamics of insect life system-determinants of insect abundance, population change, birth rate, Death rate, movements; Law of minimum, law of tolerance
b) Population growth models, Exponential and logistic model, discrete and continuous growth model, concept of carrying capacity, life tables and their application to insect biology, survivorship curves, case study of insect life tables.

Module II (9 hours)

a) Regulation of insect populations, Population dynamics - Factors affecting abundance - Environmental factors, dispersal and migration, Seasonality in insects. Diapause (Quiescence) - aestivation, hibernation.

b) Dominance of insect- cause of success; Adaptation of insect - aquatic, terrestrial, soil, boring wood

Module III (18 hours)

c) Calculation of some diversity indices: Shannon, Simpson Problem solving in ecology

d) Insect biodiversity, threats to insect biodiversity, impact of climate change on insect communities;

e) Insect plant interaction Pollination Biology with special reference to Bees

Module IV (18 hours)

a) Insect behavior: chemotropism, thigmotropism, hydrotropism, rheotropism, anemotropism, phototropism, geotropism, instinct. Protective behavior: mimicry cryptis, warning coloration. Behavioral defense, chemical defense; Breeding behavior.

Suggested Readings

1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press


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ZGPM0035: APPLIED ENTOMOLOGY AND PRINCIPLES OF PEST MANAGEMENT (4 CREDITS-60 HOURS, L-T-P: 4-0-0)

Course Outcomes

At the end of this course students will be able to:

1. Illustrate the classification and life histories of the important household and agricultural and forest pests. (Understanding)

2. Apply the latest knowledge of pesticides application equipment. (Applying)

3. Determine latest concepts of the principles of biological control, rearing, screening, and conservation of natural enemies and their problems in biological control. (Evaluating)

Module I (10 hours)

Definition of Insect Pest; Classification of Insect Pest; Major pest of rice, wheat, cotton, vegetables, tea, jute, pulses, stored grain pest-life history, nature of damage and control.

Module II Pest Control (24 hours)

a) Primary control measures: Physical, mechanical, traditional and legislative measure.

b) Chemical Control Measures: Nomenclature and Classification of Insecticides; Mode of action of Insecticides; Advantage and Hazards of Insecticides; LD_{50} and LC_{50}.

c) Biological control measures

d) Autocidal control measures

e) Integrated Pest Management (IPM)

Module III Industrial Entomology and Pest of Medical Importance (16 hours)

a) Apiculture, Sericulture (Muga, Eri, Mulberry and Tasar), Lac culture.

b) Insects of medical importance: Mode of Transmission; Common Vector Insects (Mosquitoes, House flies, Sand flies, Human louse and Tsetse flies); Morphology with role in disease transmission and control

Module IV Forest Entomology and Forensic Entomology (10 hours)

a) Insect common to forest and their damage, defoliators, borers and sap suckers.

b) Insects of Forensic importance; Carcass condition and incidental attack by insects; Investigation methodology by forensic insects.

Suggested Readings
1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press
4. Introduction to General and Applied Entomology, Abhishek Shukla and Sushil Kumar Saxena, Astral International (P) Ltd.
8. Indian Pest Aphids, T.V. Sathe & B.V. Jadhav, Astral International (P) Ltd.

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**SPECIALIZATION II: CELL AND MOLECULAR BIOLOGY**

**ZGMB0019: CELL AND MOLECULAR BIOLOGY-II (4 CREDIT; 60 HRS; 4-0-0)**

** COURSE OUTCOMES**

1. Define the cell adhesion molecules and their role in cell junctions. (Remembering)
2. Demonstrating the concept of protein targeting. (Understanding)
3. Make use of various theory of aging for understanding its process. (Applying)
4. Analyze the genetics and physical mapping of mutation. (Analyzing)
5. Estimate the effect of Cyclins and cyclin - dependent kinases in cell cycle regulation. (Evaluating)

**Module I (15 hours)**

Cell-Cell Signaling: Endocrine, paracrine and autocrine signaling; Receptor Proteins- Cell Surface receptors and intracellular receptors; Cell Surface receptors-G-protein coupled receptors, ion channel receptors, tyrosine kinase-linked receptors and receptors with intrinsic enzymatic Activity; Second messenger System - cAMP and IP3, DAG; MAP kinase cascade, JAK/STAT and TGF –β / Smad signaling; Signaling from plasma membrane to nucleus (a) CREB links cAMP signals to transcription (b) MAP kinase. Wnt pathway, Hedgehog pathway and Notch pathway

**Module II (10 hours)**

Protein sorting and targeting to organelles: Protein traffic through the endomembrane system; Targeting of proteins to the Rough Endoplasmic Reticulum and Golgi complex; Anterograde and retrograde transport; Signal-mediated protein transport to organelles (i) Nucleus (ii) Mitochondria (iii) Peroxisome

**Module III (10 hours)**

Genetic analysis in Cell Biology: Mutation: type and causes; Isolation and analysis of mutants; Physical and Genetic mapping of mutations; Molecular cloning of genes defined by mutations.

**Module IV (15 hours)**

a) Cell Cycle: Bacterial cell cycle (Helmstetier - Cooper or I+C+D model); Partition and cytokinesis; Eukaryotic cell cycle – G1, S, G2 and M phases; Cell cycle checkpoints; Molecular basis of cell cycle regulation(a) Cyclins and cyclin - dependent kinases(b) Regulation of CDK cyclin activity.

b) Cell Death: Apoptosis and necrosis; Apoptosis-its characteristics; Genes involved in apoptosis.

**Module V (10 hours)**

a) Aging, the biology of senescence: Maximum life span and life expectancy; Causes of aging: (i) General wear and tear andgenetic instability (ii) Free radicals, oxidative damage and antioxidants (iii) Telomerases and aging.

b) Cancer: Tumor cells and onset of cancer; Proto-oncogenesis and tumor suppressor genes; Mutation causing loss of cell cycle; Mutations affecting genuine stability.

**Suggested Readings**

1. Cooper, G.M., Cell (A Molecular Approach)
2. Sadava, D.E., Cell Biology
3. Karp, G., Cell and Molecular Approach
4. Kish, V.M. and Kleinsmith L.J., Cell and Molecular Biology
5. Gardener, Principles of Genetics
6. Strickberger, Genetics

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7. Ram mahabal, Fundamental of Cytogenetics and Genetics

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ZGIM0020: IMMUNOLOGY II (4 CREDIT; 60HRS; 4-0-0)

Course Outcomes
1. Define the basic organization and expression of the immunoglobulin genes. (Remembering)
2. Understanding the role of various cytokines related to diseases. (Understanding)
3. Make use of avirulent strain of microorganism for the development of vaccine and Analyzing the role of immonereresponses to various infectious diseases. (Analysing)
4. Recommend the use of various tumor suppressive drugs for preventing the graft rejection and also to develop various methods for immunization. (Creating)

Module I (20 hours)
Organization and expression of Ig genes: Multigene organization of Ig genes; Light-chain multigene family; Heavy chain multigene family; Variable region gene rearrangement, V-J rearrangements in light chain DNA, V-D-J rearrangements in heavy chain DNA, Mechanism of gene rearrangement, Allelic exclusion; Generation of antibody diversity, Multiple germline V, D and J gene segments; Combinatorial V-J and V-D-J joining; Functional diversity; Association of heavy and light chain; Expression of Ig genes, Differential RNA processing of heavy chain primary transcripts, Expression of membrane secreted Ig, Simultaneous assembly and secretion of IgM and IgD, Synthesis, assembly and secretion of Ig; Class switching of constant regions

Module II (15 hours)
(a) Cytokines: Properties of cytokines, General structure of cytokines, Function of cytokines, Cytokines related diseases, Bacterial septic shock, Bacterial toxic shock and similar diseases, Lymphoid and myeloid cancers, Chagas disease
(b) Immune system in health and disease: Immune response to infectious disease; Viral infections (i) Viral neutralization by humoral antibody (ii) Cell-mediated antiviral mechanisms (iii) Viral evasion of host defense mechanisms; Bacterial infections (i) Immune responses to extracellular and intracellular bacteria (ii) Bacterial evasion of host defense mechanism; Protozoan diseases; Diseases caused by helminths.

Module III (15 hours)
(a) Vaccines: Active and passive immunization; Designing vaccines for active immunization; Whole organism vaccine (i) Attenuated viral or bacterial vaccines (ii) Inactivated viral or bacterial vaccines; Polysaccharide vaccines; Recombinant vector vaccines; DNA vaccines; Synthetic peptide vaccines; Multivalent peptide vaccines
(b) Immune deficiencies: Primary and Secondary Immune deficiencies, lymphoid and myeloid lineage; AIDS: Structure and types, Genome organization, replication, opportunistic agents and therapeutic agents

Module IV (10 hours)
(a) Tumor immunology: Tumor antigen; Tumor evasion; Immune system against tumors; Therapies.
(b) Transplantation immunology: Acute, hyperacute and chronic rejection; Tissue matching (HLA typing); Graft Vs host (GVH) reaction; Xenotransplantation; Immunosuppressive drugs; role of monoclonal antibodies in transplantation.

Suggested Readings
1. Kindt, T.J., Osborne, B.A., Kuby, J., Kuby Immunology
2. Kasper, D.I., Fauci, A.S., Harrison’s Infectious Diseases
3. Abbas, A.K., Lichtman, A.H.H., Pillai, S., Cellular and Molecular Immunology
4. Sell, S., Berkower, I., Immunology and Immunopathology and immunity

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SPECIALIZATION III: FISHERY SCIENCE
ZGCP0021: CAPTURE FISHERY AND POST-HARVEST TECHNOLOGY (4 CREDITS-60 HOURS/ L-T-P: 4-0-0)

Course Outcomes
1. Explain about the capture fishery resources of the country and the managerial practices for sustainable utilization of these aquatic resources. (Understanding)
2. Develop the knowledge of cold water fishery resources of the country and their applicability in the development of future entrepreneurs in the fishery sector of the region. (Creating)
3. Explain about the various fishing gears and crafts used in various water bodies of the country. (Understanding)
4. Develop new ideas on the development of efficient fishing tools and the skill to predict the possible fish stock in the water bodies and management for sustainable utilization of the resources. (Creating)
5. Develop the skill of fish preservation and processing for long term utilization. (Creating)

Module I (20 hours)
Capture fishery: Fish catch statistics of the world with special reference to India; Riverine Fisheries River Systems in India, their ecology and fisheries (Ganga & Brahmaputra); Reservoir Fisheries: Development, Exploitation and management of Reservoirs with special reference to India–Dams and their effect On fish migration; Beel fisheries of Assam: Fish resources, problems and management;

Module II (10 hours)
Cold water fisheries: Hill stream fisheries of North East India; Mahseer fisheries: prospects and problems with special reference to NE India; Major Estuaries of India and their fisheries; Brackish water Fisheries: Chilika lake. Hilsa fishery–causes of decline and efforts for revival

Module III (10 hours)
a) Craft and Gear used in Fisheries: Traditional and mechanized boats and nets used in catching fish; Population Dynamics: Fish populations and factors affecting the population structures; Estimation of fish yield and control of overfishing, Yield and optimum catch; Fishing crafts and gears used in Inland capture fisheries; Destructive fishing– its impact on fish diversity.
b) Fish oils, Fish Proteins, Fish manure, Fish glue, Fish flour, Isinglass, Fishmeal, Fish Silage, Fish guano, Bone meal; Production of fish sauce by lactic acid fermentation.

Module IV (20 hours)
Post-harvest technology and fish by-products: Preservation and processing: Methods of preservation Of both finfish and shellfish preservation (Refrigeration and freezing, Drying, Salting, Smoking, Canning, Pickling, pasting and spicing) and associated problems; Rigor mortis and post-mortem changes. Handling and packaging of fish for marketing; product stability and shelf-life. Fish by-products

Suggested Readings
3. Beaven C R Handbook of the freshwater fishes of India (Narendra Publishing House)
4. Biswas K P A Text Book of Fish, Fisheries and Technology, (Narendra Publishing House)
5. Brody , Fishery by-products technology., AVI, Westport
6. Chandy, M. Fishes, National Book Trust, India;
7. EIRI Board.Book Of Fish Farming & Fishery Products
8. Gopakumar, K., Singh, B.N. and Chitranshni, V.R. Fifty Years of Fisheries Research in India, Fisheries Division Indian Council of Agricultural Research, New Delhi.
11. Jhingran V. G. Fish and Fisheries of India.
12. Jobling M Environmental Biology of Fishes (Chapmen and Hall)
15. Krishnaveni, G., N.Veerabhadra Rao and K.Veeranjaneyulu Recent Technologies in Fish and Fisheries, Rigi Publication
18. Pandey.Fish and Fisheries.Rastogi Publications
22. Rounsfell, G.A. and Everhart, W.H. Fishery Science: it 's Methods and Applications John Wiley & Sons,
23. Sachindra, N.M. & N.S. Mahendrakar. Fish Processing Byproducts: Quality Assessment And Application Studium press
# Course Outcomes (CO)

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## ZGLF0022: LIMNOLOGY, FISHERY ECONOMICS, ORNAMENTAL FISHERY AND FISH PATHOLOGY (4 CREDITS-60 HOURS/ L-T-P: 4-0-0)

### COURSE OUTCOMES (CO)

1. Explain the needs of physico-chemical factors in maintaining a proper productive aquatic ecosystem, an essential element in aquaculture and fishery management. (Understanding)
2. Utilize the understanding of fishery economics and laws of the country, various fishery training institutions and their roles and extension program in fishery development. (Applying)
3. Develop the skill on ornamental fish culture and aquarium preparation and maintenance. (Creating)
4. Apply the knowledge acquired on fish pathology and their prophylactic control measures. (Applying)

#### Module I (15 hours)
**Limnology:** Physico-chemical factors of fresh water habitat; Nutrients – Availability, Seasonal distribution and availability of phosphorus, Nitrogen and Silicon; Ecological classification of freshwater organisms; Plankton – Distribution, seasonal variation in space and time, planktonic migration, cyclomorphosis

#### Module II (15 hours)
**Fishery economics and law:** Larvivorous fishes in relation to public health; Exclusive Economic Zone (EFZ) and its strategy; Fisheries cooperatives and their role in fish production and marketing; Aquaculture and rural development in India; Fishery education, training and extension; Fishery research institutes in India; Fishery legislation and their role in fishery development.

#### Module III (15 hours)
**Ornamental fishery:** Ornamental fish culture: Ornamental aquarium fishes, Breeding and care of Freshwater aquarium fishes; Aquarium keeping—Design and construction of tanks; species-wise tank size requirement; heating, lighting, aeration and filtration arrangements; decorations; common aquarium plants and their propagation; Maintenance of Natural Colour of fishes in Aquarium.

#### Module IV (15 hours)
**Fish pathology:** Fish and Prawn/Shrimp Diseases: Types of Diseases—viral, bacterial, fungal, protozoan and other parasitic diseases; symptoms & control measures; Diagnosis—Histopathological methods; Immunoassay; Biochemical assay; Serological techniques; Role of biopesticides; Application of Monoclonal antibodies; Vaccines and immune stimulants; Drug resistance.

### Suggested Readings

1. Agarwal, S.C. Limnology
5. Edward, J. Noga. Fish Disease: Diagnosis & Treatment
12. Sharma Shailendra & Pawan Kumar Bharti. Limnology and Aquatic Science. Discovery publishing house
15. Untergasser, D. Handbook of Fish Diseases. TFH Publications

### Mapping of COs to Syllabus

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SPECIALIZATION IV: ANIMAL ECOLOGY AND WILDLIFE BIOLOGY

ZGRE0025: WILDLIFE RESOURCE MANAGEMENT, LAWS AND TECHNIQUES IN POPULATION STUDY (4 CREDITS: 60 HOURS, L-T-P: 4-0-0)

Course Outcome
1. Explain different threatened categories and conservation history in India. (Understanding)
2. Define forestry and explain different conservation movements (Remembering)
3. Analyse the threats on different species and identify different laws for their protection (Analyzing)
4. Identify the structure and demography of wildlife population and apply different sampling techniques. (Applying)

Module I Species conservation (20 hours)
IUCN categories, criteria for allocation into different categories. Threatened animal species of India with special reference to NE India. Role of Iconic species designation in conservation. Concept and significance of conservation of Flagship (Target) species; overview of conservation problems and issues of fauna of Indian sub-continent.

Module II Natural resource management and conservation (15 hours)
a) Introduction to forestry, principles of forest management, Importance and performance of joint forest management (JFM) Role of Non-Government Organizations (NGO).
c) Project Grants for Wildlife Conservation

Module III Forest and Wildlife laws of India (5 hours)
Wildlife Protection Act, 1972; The Biological Diversity Act, 2002; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of forest Rights) Act, 2006.

Module IV Population ecology and Sampling Techniques (20 hours)
a) Demographic and life history parameters, evolution of life history parameters: r & K selection, allometry, aging and sexing, life tables, age and stage structures models, methods of estimation of life history and demographic parameters
b) Sampling designs for population estimation, population estimation methods: Mark-Recapture for Closed Population, Collection Techniques used in wildlife study.

Suggested Readings
7. Patro, L. Biodiversity Conservation and Management
8. Misra, H.N. – Managing Natural Resources- Focus on Land and Water
11. Kumar, R. Environmental Laws
12. Muthukrishna- Natural Resource Economics
13. Field, B.C. Economics of Environment
15. Rockwood- Introduction to population Ecology

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ZGWC0026: TECHNIQUES IN WILDLIFE STUDY WILDLIFE HEALTH, FORENSICS AND CONFLICT (4 CREDITS: 60 HOURS, L-T-P: 4-0-0)
Course Outcomes
1. Define wildlife disease, identify major parasitic diseases in wild animals and assess animal health condition. (Remembering, Applying)
2. Apply different techniques of wildlife study. (Applying)
3. Discuss about wildlife forensic, various protocols for species identification and trade of wildlife products. (Creating)
4. Develop the prospects of ecotourism in Northeast India, its importance and consequences and recommend mitigation plans to reduce human animal conflict. (Evaluating, Creating)

Module I: Wildlife Health (20 hours)
a) Introduction to disease and epizootiology, Determinants of disease and disease transmission, Disease and population dynamics.
b) Assessment of condition, health and nutritional status in free-ranging populations. Disease control operations, Planning and management of wildlife health programmes.

Module II: Techniques for wildlife study, Capture and handling of wild animals (15 hours)
a) Techniques for wildlife study: Radio telemetry and acoustic analysis.
b) Capture and handling of animals - purpose, restraint techniques, different capture methods and animal barriers. Drug immobilization - drug delivery equipment and accessories. Handling and transport of wild animals, designing sledge, crate and holding enclosures.

Module III: Conservation Genetics, Wildlife Forensics and Trade (15 hours)
a) Application of genetics for wildlife conservation; Application of Molecular markers, PCR, DNA Sequencing in wildlife forensics and conservation. Loss of genetic diversity
b) Wildlife Forensics- Overview, various forensic protocols for species identification.

Module IV: Human-wildlife conflict (10 hours)
a) Causes and management; Impact on ecosystem, lives and livelihood of human
b) Ecotourism: problems and prospects with special reference to northeast India.

Suggested Readings
1. Fowler- Restraint and Handling of wild and Domestic Animals
2. Briscoe, Ballou and Frankhan- Introduction to Conservation Genetics
3. Leeschcke, Temivk and Jain – Conservation Genetics
4. Frankhan, Ballou and Briscoe- Primer of Conservation Genetics
5. Cooper and Cooper- Wildlife Forensic Investigations
6. Huffman and Wallacw- Wildlife Forensics – Methods & Applications
7. Sahai, Thakar & Goyal – Forensic Examination of Hair of Protected Indian Wildlife Species
8. Linacre and Tope- Wildlife DNA analysis
9. Rao, G. Textbook on pathology of Wildlife Diseases
10. Jani, R. Basic of Wildlife Health Care Management
11. Ayadi, D.P. Human Wildlife Conflict

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ZGBE0027: BIOSYSTEMATICS AND EVOLUTION (4 CREDITS -60 HOURS) (L-T-P:4-0-0)

Course Outcomes
1. Explain the concept of Biosystematics and Taxonomy. (Understanding)
2. Explain the causes of evolution and natural selection. (Understanding)
3. Apply Taxonomy to solve the species problem and Identify species on the basis of taxonomic keys. (Applying)
4. Apply bioinformatics tools used for evolutionary studies. (Applying)
5. Justify the role of isolating mechanisms in speciation, estimate, construction of evolutionary trees, and measurement of genetic relationship among organisms. (Evaluating)
6. Create evolutionary trees to understand the evolution of primates. (Creating)

Module I: Biosystematics (10 hours)
Trends in Biosystematics: Chemotaxonomy, Cytotaxonomy, Numerical and Molecular Taxonomy; Dimensions of Speciation; Species Concepts: Subspecies and other intraspecific Categories; Cladistics

Module II: Taxonomy and Nomenclature (10 hours)

Module III: Evolution (15 hours)
Micro and Macro evolution; Natural Selection-Concept of stabilizing selection, Frequency dependent selection, Balancing selection, Disruption selection; Destabilizing factors-Mutation, Genetic drift, Migration, Meiotic drive; Emergence of Non Darwinian theory of evolution, Neutral theory of evolution (Kimura).

Module IV: Speciation and Molecular basis of evolution (15 hours)
  a) Isolation Mechanisms-Isolation Mechanisms and their role in speciation, Models of speciation (Allopatric, sympatric, parapatric)
  b) Molecular basis of evolution-Constructing evolutionary trees, measures of genetic relationship among organisms, Molecular clock of evolution, Molecular phylogeny; Origin and c) Evolution of Primates.

Module V: Evolutionary Bioinformatics (10 hours)
  a) Concept of databases: Biological databases - Primary, secondary, composite databases; Databases for Literature, Sequence and structure; Searching and their retrieval.
  b) Bioinformatics for phylogenetic analysis. DNA and Protein sequence alignments- pairwise alignment, dot plot, global and local alignment algorithms; Multiple sequence alignment; Multiple sequence alignment based database searching- PSI-Blast
  c) Homology modeling.

Suggested Readings
2. V.C Kapoory-Theory and practice of animal taxonomy
3. J.C. Avis. Molecular Markers, Natural History and Evolution, Chapma & Hall, New York.
5. E. Mayer & P. Ashlock. Principles of systematic Taxonomy
10. Futuyma, D.J. Evolutionary Biology, Sinauer Associates, INCPublishers, Dunderland. 11. Jha,
13. Ramesh Chandra Tripathi, Biosystematics and Taxonomy, University Book House, Jaipur.
17. Gallow, P. Evolutionary principles.
22. Wen-Hsiung Li, Molecular Evolution, Sinauer associates Inc. Pub. USA.

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ZGCI0028: CELL BIOLOGY AND IMMUNOLOGY- THEORY AND APPLICATIONS (4 CREDITS-60 HOURS) (L-T-P:4-0-0)

COURSE OUTCOMES (CO)
1. Illustrate and summarize the organization of the cell. (Understanding)

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1. Define cell division and signaling pathways. (Remembering)
2. Explain the different cellular biology with complicated biochemical and physiological processes. (Understanding)
3. Apply immunological techniques. (Applying)
4. Demonstrate molecular techniques to understand underlying cellular composition. (Analyzing)
5. Evaluate the regulation of cell cycle and its control. (Evaluating)

**Module I: Cell Organisation (10 hours)**
- b) Cytoskeletons - Structure and Organisation of Microfilament, Microtubule and Intermediate filament.
- c) Cell Motility- Intracellular transport, kinesin-dynein, cilia and flagella.

**Module II: Cell adhesion molecule, Cell signaling, Cell cycle (15 hours)**
- b) Cell division and cell cycle regulation and control of cell cycle; Cyclins and Cyclin Dependent Kinases(CDK), Regulation of CDK-Cyclin activity, Molecular basis of Cellular Checkpoints
- c) Cell-Cell Signalling-Cell Signalling, Cell surface receptors, G-Protein coupled receptors and Second messenger

**Module III: Immunology (15 hours)**
- a) Immune system-innate and adaptive immunity; components and characteristic features, humoral and cell-mediated immunity;
- b) Cells and organs of immune system; T cells and B cells-maturation, activation and differentiation;
- c) Antigens-immunological properties of antigens, factors influencing antigenicity; Immunoglobulin-structure and function, classes of Ig molecules, Antigen-antibody interactions.

**Module IV: Analytical techniques (20 hours)**
- a) Review of principles of light microscopy; principles and applications of phase contrast and fluorescence microscopy
- b) Principles and applications of Transmission and Scanning Electron microscopy
- c) Spectroscopy: basic principles and types
- d) Theories of Tissue fixation and staining techniques
- e) Basic principles of colorimetry
- f) Principles and applications of centrifugation techniques: types of centrifugation; Introduction to hydrodynamics
- g) Molecular modeling
- h) ELISA, RIA, Immunodiffusion

**Suggested Readings**
1. Cooper, G. M., Cell (A Molecular Approach)
2. Sadava D. E., Cell Biology
3. Kish V. M. and Kleinsmith L. J., Cell and Molecular Biology
4. DeRobertis & DeRobertis: Cell and Molecular Biology (Lee & Febiger, 1987)
5. Karp: Cell and Molecular Biology
6. Lodishet al: Molecular Cell Biology
7. Pollard & Earnshaw: Cell Biology
8. Verma P. S. and Agarwal V.K, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.
9. Verma P.S. and Agarwal V.K, Cell Biology (Cytology, biomolecules and Molecular Biology), S. Chand & Company Ltd.
10. Kuby et al. : Kuby Immunology
13. Williams, B.L. and Wilson, K. ,A Biologist’s Guide to Principles and Techniques of Practical Biochemistry, 1975

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**ZGBG0029: MOLECULAR BIOLOGY AND GENETICS (4 Credits-60 hours) (L-T-P:4-0-0)**

**Course Outcomes**
1. Define the structure of nucleic acids. (Remembering)
2. Explain gene expression. (Understanding)
3. Construct and analyze pedigree. (Analyzing)
4. Analyze the various patterns of genetic inheritance. (Analyzing)
5. Apply bioinformatics tools to archive, retrieve, and analyze biological data. (Analyzing)
6. Analyze macromolecules using electrophoretic techniques. (Analyzing)

Module I: Nucleic Acids (16 hours)
a) Nucleic acids - Molecular Structures of DNA and RNA.
b) DNA Replication - Replication in Prokaryotes and Eukaryotes, Semi conservative nature of DNA replication, Messelsons-Stahl experiment, Enzymes and proteins associated with replication, DNA polymerases, Regulation of eukaryotic genome replication.
c) DNA Damage and Repair Mechanism - Different types of DNA Damage, Direct repair system, Excision repair system, Mismatch repair system, DNA break repair.

Module II: Transcription and Translation (12 hours)
a) Transcription - Basic concept of Prokaryotic and Eukaryotic transcription, Promoters (Pribnow Box, TATAbox, CpGisland).
   - Post Transcriptional Modification
b) Translation - Genetic Code, Mechanism of Initiation, Elongation and Termination.

Module III: (10 hours)
a) Organisation of genetic material - Nucleosome, Molecular anatomy of eukaryotic chromosome; Genome size and Complexity-C value paradox, Unique and repetitive DNA, Euchromatin and Heterochromatin
b) Sex Chromosomes - Sex determination, Role of Y chromosome, Dosage Compensation in Drosophilia and Human Being, X-Chromosome inactivation, Sex chromosome anomalies
   - Human Genetics - Normal Human Karyotyping, Autosomal chromosome abnormalities, Principle and Methods of Pedigree Analysis
d) Genomic Imprinting - Imprinting of genes, Epigenetic, Epigenetic regulation by DNA methylation; Somatic Cell Genetics - Cell fusion technology, Chromosome mapping, Application of Somatic Cell Genetics.

Module IV: Genetic Inheritance (10 hours)
a) Concept of gene: Allele, multiple alleles, pseudo-allele, complementation tests; Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters
b) Extra Chromosomal Inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

Module V: Bioinformatics (5 hours)
a) Gene Prediction - Finding genes in prokaryotic and eukaryotic genomes, Regulatory sequence analysis; Genome maps and markers, Genome variation.
b) Human genome project; Concept and Software used in Gene expression analysis and Microarray.
c) Structural biology - Protein structure prediction and classification.

Module VI: Electrophoretic Techniques (7 hours)
a) Basic principles of Electrophoresis, Agarose gel, native and SDS-PAGE
b) Isoelectric focusing, 2D-PAGE and their uses in protein research
   - Blotting Techniques

Suggested Readings
1. Gardner, Principles of Genetics
2. Strickberger, Genetics
3. Ram Mahabal, Fundamentals of Cytogenetics and Genetics
5. Griffith et al: Modern Genetic Analysis
7. Boyer: Modern Experimental Biochemistry and Molecular biology
8. DeRobertis & DeRobertis: Cell and Molecular Biology
9. Hanes, Gel Electrophoresis of Proteins - A Practical Approach
12. Kanetkar YP. Let Us C [available online].

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ZGAP0030: ANIMAL PHYSIOLOGY (4 CREDITS-60 HOURS) (L-T-P:4-0-0)

Course Outcomes
1. Recall the physiology of digestion, different glands involved in the process, their secretions. (Remember)
2. Explain about the physiology of Respiration, interpret the Oxygen dissociation curve and to understand the regulation of respiration. (Understanding)
3. Develop a clear concept of mammalian blood chemistry, the blood clotting mechanism, musculature in vertebrates, molecular mechanism and regulation of muscle contraction, nerve physiology, and physiology of excretion. (Applying)
4. Analyze the mechanism of digestion, absorption of various biomolecules and the role of gastrointestinal hormones indigestion. (Analyzing)
5. Analyze the integration of the systems. (Analyzing)

Module I Physiology of digestion (10 hours)
a) Glands and secretion of digestive enzymes,
b) Mechanism of digestion, Gastrointestinal hormones
c) Absorption of Carbohydrates, lipids and proteins.

Module II Physiology of Respiration (10 hours)
a) Alveolar ventilation, alveolar-capillary gas exchange, Transport of O2 and CO2
b) Oxygen dissociation curve and the factors influencing it,
c) Regulation of respiration.

Module III Mammalian blood chemistry (10 hours)
a) Mammalian blood chemistry and blood groups.
b) Blood clotting mechanism
c) Cardiac cycle and its regulation in mammals.

Module IV Musculature in vertebrates (10 hours)
a) Musculature in vertebrates: Types of muscles, Ultrastructure and chemical composition of skeletal muscles,
b) Molecular mechanism and regulation of muscle contraction, muscle fatigue and rigor mortis.

Module V Physiology of Excretion (10 hours)
a) Ultrastructure of nephron, mechanism of urine formation, excretion of dilute solutes and mechanism of excretion of exessolutes, counter current mechanism
b) Osmoregulation in different animal groups (aquatic and terrestrial)

Module VI Nerve physiology (10 hours)
a) Neuron: Ultrastructure, types and function,
b) Membrane potential: Resting membrane, membrane potential, action potential, Nernst Equation, Chronaxie, Rheobase, utilization time.
c) Neural impulse induction through an axon, neurotransmitters and synaptic transmission-mode of information transfer across electrical and chemical synapses

Suggested Readings
2. Ganong: Review of Medical Physiology, Lang Medical Publications
3. Guyton and Hall: TextBook of Medical Physiology, W.B. Saunders
5. Keel et al: Samson Wright’s Applied Physiology, Oxford Press,
10. West: Best and Taylor’s Physiological Basis of Medical Practice, Williams and Wilkins,
13. Dharmalingam, Textbook Of Endocrinology, Jaypee Brothers Medical Publisher

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ZGEE0031: ECOLOGY AND ENVIRONMENTAL BIOLOGY (4 CREDITS - 60 HOURS) (L-T-P:4-0-0)

Course Outcomes
1. Outline the foundations of Ecology, (Understanding)
2. Explain the effects of abiotic environment on plants and animals to understand the distribution and abundance of life on earth (Understanding)
3. Develop solutions to pressing environmental problems that threaten ecological systems at every level (Creating)
4. Analyze the importance of biodiversity and threats to biodiversity. (Analyzing)
5. Design steps to protect and conserve biodiversity. (Creating)

Module I (12 hours)
a) Types of ecosystems—Salient features of aquatic and terrestrial ecosystems and their biotic communities.
b) Ecological energetic and energy flow; Measuring ecosystem productivity
c) Population Ecology—Population density, Growth rate, Natality, mortality, survivorship curves and life tables, Biotic potential

Module II (12 hours)
a) Community Ecology—Types of biotic communities, organization, carrying capacity, r and k-selection.
b) Community Development—Types of community changes, ecological succession—its causes and examples, climax community.
c) Species interactions, Competition theory, Niche, Habitat,
d) Ecological Equivalents, Character displacement; Liebig law of minimum, Shelford’s law of tolerance, Significance of limiting factors, Ecotone and Edge effect.
e) Thermoregulation: Heat balance in animals, Adaptations to temperature extremes, Aestivation, hibernation and Diapause, acclimatization, avoidance and tolerance

Module III (12 hours)
a) Eutrophication in the aquatic ecosystem, Remediation of eutrophication.
b) Acidification in aquatic and terrestrial environment, Consequences and control strategies.
c) Environmental monitoring, Environmental impact assessment and environmental management plan.

Module IV (12 hours)
a) Biodegradation and Bioremediation: concept, environmental limitation for bioremediation, bioremediation of ecosystem (Air/water/soil)
b) Wastes in Ecosystem and management: Agricultural wastes and Management, Biomedical wastes and Management, Domestic waste, effects and management for purification and recirculation.
c) Environmental toxico-ology: Diversity and classification of environmental toxins, Air, Water and soil pollutants, Food additives and contaminants, Pesticides, Metals and Solvents, Radioactive pollution.

Module V Biodiversity (12 hours)
a) Components of Biodiversity (Genetic, Organismal and Ecological), Value of Biodiversity, threats to biodiversity, biodiversity conservation, Mega biodiversity countries, hotspots and heritage sites,
b) IUCN Red list categories. Habitat diversity of Indian wildlife, endemic and Threatened species of northeast India
c) Ethnozoology with special reference to Northeast India

Suggested Readings
2. Odum : Basic Ecology (Saunders)
3. Odum : Fundamentals of Ecology (Saunders)
5. Raven, Berg, Johnson : Environment (Saunders College Publishing)
6. Sharma : Ecology and Environment (Rastogi Publication)
8. Trivedi, P.R. and Gurdeepraj, K. Environmental Biology. Akashdeep Publishing House New Delhi
9. Turk and Turk : Environmental Science
12. Manju Yadav, Ecology, Discovery Publishing House

### Mapping of COs to Syllabus

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### ZGEB0032: ENDOCRINOLOGY AND BIOCHEMISTRY (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

#### Course Outcomes
1. Define the various metabolic pathways and the role of hormone. (Remembering)
2. Explain the basic principles of modern analytical techniques. (Understanding)
3. Analyze the energy production and utilization. (Analyzing)
4. Explain the enzyme kinetics. (Evaluating)

#### Module I: Basic concepts: Hormone, action and Feedback Mechanism (5 hours)
Hormone: Classification and Chemical nature of hormones Homeostasis: Concept and Feedback system Hormone receptor and target organ concept, Mechanism of hormone action. Hypothalamo- hypophyseal axis

#### Module II: Endocrine glands—Structure, Hormones, Functions, Axis, Abnormalities (15 hours)
- a) Structure of the pituitary gland; pituitary hormones and their functions
- b) Structure of thyroid glands, thyroid hormones—biosynthesis and metabolic functions. Role of thyroid hormone in amphibian metamorphosis
- c) Structure of adrenal gland; Synthesis of adreno-cortical and medullary hormones and their functions.
- d) Structure of endocrine pancreas and Hormones of Islets of Langerhans.

#### Module III: Reproductive Endocrinology (10 hours)
- a) Testis and ovary—endocrine structure and their functions
- b) Reproductive cycle—Oestrous cycle and Menstrual cycle, Role of Hormones in Implantation, Parturition and Lactation
- c) Neuroendocrine regulators in insects and mammals

#### Module IV: Metabolism (13 hours)
- a) Carbohydrate metabolism—Glycolysis, Glycogenolysis, Gluconeogenesis, TCA cycle, Cori cycle, Phosphogluconate pathway.
- b) Lipid Metabolism—Oxidation of fatty acid, Cholesterol biosynthesis and metabolism, Prostaglandins.
- c) Protein metabolism— Amino acid Classification, Amino acid degradation, Decarboxylation, Deamination, Ornithine Cycle.

#### Module V: Bioenergetics And Enzymes (10 hours)
- a) Bioenergetics—Energy producing and utilizing system, Electron transfer system and Oxidative phosphorylation.
- b) Enzymes—Classification of enzymes, General properties of enzymes, Mechanism of enzyme action, Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk Equations; Enzyme inhibition.

#### Module VI: Basic concepts of biochemistry (10 Hours)
- a) Review of concepts of acids and bases, Principle and working of pH meter, Buffer preparation
- b) Principle of Laminar-air flow chamber
- c) Principles, types and applications of Chromatography
- d) Gas Chromatography, GC-MS, LC – MS / MS, MALDI TOF mass spectrometer
- e) Ion Exchange Chromatography, gel permeation, Affinity and reverse phase chromatography
- f) HPLC and FPLC

#### Suggested Readings
2. Ganong: Review of Medical Physiology, Lang Medical Publications
3. Guyton and Hall: Text Book of Medical Physiology, W.B. Saunders
ZGAZ0033: APPLIED ZOOLOGY (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course Outcomes
1: Identify methods of silkworm cultivation, maintenance of the farm, seed technology, silkworm rearing and silk reeling.(Applying)
2: Assess the basic life cycle of the honeybee and about beekeeping tools and equipment for honey production and pollination. (Evaluating)
3: Apply the latest knowledge in poultry management. (Applying)
4: Develop an overall idea of fish farming, the scientific management of different species in aquaculture, aquarium keeping and fish diseases. (Applying)
5: Identify the different types of parasites, their life cycles and the diseases caused by them. (Applying)
6: Associate the concepts in Zoology with the core principles of Sustainable Development. (Understanding)

Module I (15 hours)
- **Sericulture:** Types of Silk Worm (Muga and Eri), their host plants, silkworm rearing and management practices. Diseases and Pest of SilkWorm and their management, Biodiversity conservation project through sericulture (Case study- 7Weaves Model)
- **Apiculture:** Different species of honey bees, bee plants, pollen calendar, bee keeping and management practices, bee products, Bee enemies and diseases.
- **Vermiculture:** species of worms, condition for efficient vermiculture (domestic and commercial level), Economics of Vermiculture

Module II (10 hours)
**Aquaculture:** Aquarium fish keeping: Ornamental Fishes of India special reference to North East India, common aquarium fishes; Aquarium Maintenance, Fisheries management: Composite fish culture, induced breeding and hybridization; Prawn and Pearl Culture, Exotic and Indigenous food Fishes of NE India, Fish and shellfish diseases and their control measures. Fish genetic resource conservation; Aquaphonics–prospect and future.

Module III: Poultry management (8 hours)
Poultry Rearing / Farming: Housing and equipment; Nutritional Requirements; Poultry diseases; Poultry products: Broilers, meat processing and meat products, Poultry by products

Module IV: Parasitology (10 hours)
Introduction to Parasitology: Types of parasites, Types of Host, Zoonosis, Host-parasite Relationship, Sources of Infection, Mode of infection, Pathogenesis.
- Dengue and Bird flu - Life cycle, mode of transmission, infection and treatment.

Module V: Insect pest management, Public Health and Forensic Entomology (12 hours)
a) Concept of Pest, concept of integrated pest management (IPM)

Module VI: Sustainable Development Goals and Zoology (5 hours)
Concept of Sustainable Development, Background of SDGs, role of a zoologist, SDGs and Zoology (SDGs 1,3,5,6,8,11,12,13,14 and 15), SDG(s)-based projects/dissertations
Suggested Readings
1. Venkitaraman: Economic Zoology, Sudarsana Publishers
9. Chandra Girish. Apiculture & the honeyBee (Know About The Species Of Honey Bees, beekeeping, pollination, beeheives, entomology, beekeepers, honey making
18. John, J. Worm Farming - Creating Compost at Home With Vermiculture. Creates pace Independent Pub
19. NPCS Board of Consultants & Engineers The Complete Technology Book on Vermiculture and Vermicompost
20. ICAR. Handbook of Integrated Pest Management (IPM) Pub: ICAR, Govt. of India
22. https://bloncampus.thehindubusinessline.com/case-studies/figure-out-how-7weaves-can-scale-up-and-go-global/article25933346.ece
23. https://bloncampus.thehindubusinessline.com/case-studies/7weaves-a-promising-model-for-ethical-slow-fashion/article26388043.ece

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ZGEP0034: ETHOLOGY AND POPULATION GENETICS (4 CREDITS- 60 HOURS) (L-T-P: 4-0-0)

Course Outcomes(Co)
1. Define statics and events of behaviour. (Remembering)
2. Illustrate the concept of ethology and its significance. (Understanding)
3. Elaborate fitness in terms of evolution (Creating)
4. Apply Hardy Weinberg law for studying population genetics (Applying)
5. Identify sociobiology, social hierarchy, dominance in group living animals. (Applying)
6. Construct behavioral catalog for studying animal behavior. (Creating)

Module I: Basic Concepts of Ethology (10 hours)
- a) Concepts of Ethology,
- b) Genes and behaviour: Selfish gene concept, Fisher’s Runaway theory
- c) Evolution and development of behaviour
- d) Deception, Mimicry, and Camouflage: Deimatic behaviour, Aposematic behaviour

Module II: Sociobiology (20 hours)
- a) Social Behaviour:Properties And Advantages Social Grouping, social group of monkeys;
- b) Fitness: Darwinian fitness, individual fitness, kin selection, group, cooperation, reciprocation, altruism, reciprocal altruism,Proximate and Ultimate causations;
- c) Parental care in animals(amphibians)

Module III: Learning and Communication (10 hours)
a) Communication in animals: vocal, and aggression tactile, visual and chemical; Territoriality
b) Learning: Introduction and definition, Types-Habituation, trial and error, conditioning, cognition and imprinting; Short and long term memory, neural mechanism of learning

Module IV: Population Genetics (20 hours)

a) Gene frequencies in population - The Hardy-Weinberg principle and analysis of gene frequencies in natural population.
b) Major factors influencing gene frequencies (migration, inbreeding), Effects of selection and mutation on gene frequencies.
c) Gene flow between subpopulations

Suggested Readings
2. Goodenough et al :Perspectives on Animal Behaviour, Wiley,
3. Grier : Biology of Animal Behaviour, Mosby,
5. John Krebs, Baron Krebs: An introduction to behaviour ecology, Blackwell scientifics
6. Aubrey Manning: An introduction to animal Behaviour, Cambridge University press

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ZGSL0100: FOUNDATIONS OF SERVICE LEARNING (2 CREDITS) (L-T-P: 2-0-0)

COURSE OUTCOMES
1. Develop an understanding about the importance of service to community. (Understanding)
2. Identify the needs of a community. (Applying)
3. Apply skills acquired in Zoology to render service to community. (Creating)
4. Examine what can be learned from the community. (Analyzing)

Module I (5 hours)
Service learning: Definitions; Principles of Service Learning; Awareness of Community; Involvement with Community; Commitment to service

Module II (10 hours)
Waste Management: Principles of waste management; types of waste and their management; eco-friendly waste management; Health and Hygiene: Role and control of vectors of various diseases; Personal hygiene

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ZGPP0101: NON-CHORDATES I: PROTISTA TO PSEUDOCOELOMATES (4 CREDITS: 60 HOURS/ L-T-P: 4-0-0)

COURSE OUTCOMES
1. Illustrate the evolution and history of the phylum (Understand).
2. Identify the distinguishing characters of the protists and pseudocoelomates (Applying).
3. Define the life cycles of important representative organisms belonging to these phyla (Remembering).
4. Analyze the pathogenicity of selected non-chordate/ pseudocoelomate organisms (Analyzing).

Module I: Protista, Parazoa and Metazoa (19 Hours)
General characteristics and Classification up to classes Study of Euglena, Amoeba and Paramecium Life cycle and pathogenicity of Plasmodium vivax and Entamoeba histolytica Locomotion and Reproduction in Protista Evolution of symmetry and segmentation of Metazoa

Module II: Porifera (7 Hours)
General characteristics and Classification up to classes. Canal system and spicules in sponges.
Module III : Cnidaria (12 Hours)
General characteristics and Classification up to classes Metagenesis in Obelia Polymorphism in Cnidaria, Corals and coral reefs.

Module IV : Ctenophora (4 Hours)
General characteristics and Evolutionary significance

Module V : Platyhelminthes (10 Hours)
General characteristics and Classification up to classes Life cycle and pathogenicity of Fasciola hepatica and Taenia solium

Module VI : Nemathelminthes (8 Hours)
General characteristics and Classification up to classes Life cycle, and pathogenicity of Ascaris lumbricoides and Wuchereria bancrofti
Parasitic adaptations in helminthes


SUGGESTED READINGS

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ZGPE0102: PERSPECTIVES IN ECOLOGY (4 CREDITS: 60 HOURS/ L-T-P: 4-0-0)

COURSE OUTCOMES
1. Distinguish the mechanism of various biological interactions (Understanding).
2. Describe the relationship between biotic and abiotic factors (Remembering).
3. Analyze different population dynamics and interactions (Analyzing).
4. Evaluate ecosystem energetics with reference to food chain (Evaluating).
5. Apply conservation and management strategies for local endangered species (Applying).

Module I : Introduction to Ecology (6 Hours)
History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors

Module II : Population (24 Hours)
Unitary and Modular populations Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion Exponential and logistic growth, equation and patterns, r and K strategies Population regulation - density-dependent and independent factors Population interactions, Gause’s Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical responses

Module III : Community (12 Hours)
Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example Theories pertaining to climax community

Module IV : Ecosystem (14 Hours)
Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies Nutrient and biogeochemical cycle with one example of Nitrogen cycle Human modified ecosystem

Module V : Applied Ecology (4 Hours)
Ecology in Wildlife Conservation and Management

SUGGESTED READINGS
4. Robert Leo Smith Ecology and field biology Harper and Row publisher

Mapping of COs to Syllabus
ZGCL0103: NON-CHORDATES II: COELOMATES (4 CREDITS: 60 HOURS/ L-T-P: 4-0-0)

COURSE OUTCOMES
At the end of the course, students will be able to:
1. Summarize the evolution of body cavity in coelomates (Understand).
2. Identify the distinguishing characters of the coelomates (Remembering).
3. Comprehend the different larval forms of important representative organisms belonging to these phyla (Understanding).
4. Analyze the unique physiology of selected representative non-chordate/coelomate organisms (Analyzing).

Module I: Introduction to Coelomates (2 Hours)
Evolution of coelom and metamerism

Module II: Annelida (10 Hours)
General characteristics and Classification up to classes Excretion in Annelida

Module III: Arthropoda (17 Hours)
General characteristics and Classification up to classes, Vision and Respiration in Arthropoda Metamorphosis in Insects Social life in bees and termites

Module IV: Onychophora (4 Hours)
General characteristics and Evolutionary significance

Module V: Mollusca (15 Hours)
General characteristics and Classification up to classes, Respiration in Mollusca Torsion and detorsion in Gastropoda, Pearl formation in bivalves, Evolutionary signficance of trochopore larva.

Module VI: Echinodermata (12 Hours)
General characteristics and Classification up to classes, Water-vascular system in Asteroidea, Larval forms in Echinodermata, Affinities with Chordates


SUGGESTED READINGS

Mapping of COs to Syllabus

ZGCB0104: CELL BIOLOGY (4 CREDITS: 60 HOURS/ L-T-P: 4-0-0)

COURSE OUTCOMES
1. Define the composition and function of membrane structure (Remembering).
2. Distinguish the different cell types viz prokaryotes, eukaryotes and viroids (Understanding).
3. Evaluate the complexity and interaction of the varied organelles, including Endoplasmic Reticulum, Golgi apparatus, Mitochondria, nucleus and peroxisomes (Evaluating).
4. Analyze the importance of nucleus in cell division and signaling (Analyzing).
5. Identify the three primary components of the cytoskeleton and their role in affecting cell shape, function and movement (Remembering).

Module I: Overview of Cells (3 Hours)
Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions
Module II: Plasma Membrane (7 Hours)
Various models of plasma membrane structure Transport across membranes: Active and Passive transport, Facilitated transport Cell junctions: Tight junctions, Desmosomes, Gap junctions

Module III: Endomembrane System (10 Hours)
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Module IV: Mitochondria and Peroxisomes (8 Hours)
Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis Peroxisomes

Module V: Cytoskeleton (8 Hours)
Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Module VI: Nucleus (12 Hours)
Structure of Nucleus: Nuclear envelope, nuclear pore complex, Nucleolus Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)

Module VII: Cell Division (8 Hours)
Mitosis, Meiosis, Cell cycle and its regulation

Module VIII: Cell Signaling (4 Hours)
GPCR and Role of second messenger (cAMP)

Suggested Readings

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ZGAD0105: ANIMAL DIVERSITY (4 CREDITS-60 HOURS) (L-T-P:4-0-0)

COURSE OUTCOMES (CO)
1. Explain the diversity and evolution of different non-chordate and chordate phyla, including birds and reptiles. (Understanding)
2. Illustrate the life cycle, pathogenicity, parasitic adaptations and social adaptations of selected non-chordates. (Understanding)
3. Summarize the increasing morphological complexity of different body forms pertaining to both non-chordates and chordates. (Understanding)
4. Identify the different animal phyla based on their general and unique characteristics. (Applying)
5. Compare the patterns of migration, parental care, terrestrial and flight adaptations and dentition in different vertebrate groups. (Analyzing)

Module I: Protista (4 Hours)
General characters of Protozoa; Life cycle of Plasmodium

Module II: Porifera (3 Hours)
General characters and canal system in Porifera

Module III: Radiata (3 Hours)
General characters of Cnidarians and polymorphism

Module IV: Acoelomates (3 Hours)
General characters of Helminthes; Life cycle of Taenia Solium
Module V: Pseudocoelomates (3 Hours)
General characters of Nemathelminthes; Parasitic adaptations

Module VI: Coelomate Protostomes (3 Hours)
General characters of Annelida; Metamerism.

Module VII: Arthropoda (4 Hours)
General characters. Social life in insects.

Module VIII: Mollusca (3 Hours)
General characters of mollusca; Pearl Formation

Module IX: Coelomate Deuterostomes (3 Hours)
General characters of Echinodermata, Water Vascular system in Starfish.

Module X: Protochordata (2 Hours)
Salient features

Module XI: Pisces (4 Hours)
Osmoregulation, Migration of Fishes

Module XII: Amphibia (4 Hours)
General characters, Adaptations for terrestrial life, Parental care in Amphibia.

Module XIII: Arthropoda (4 Hours)
General characters. Social life in insects.

Module XIV: Aves (5 Hours)
The origin of birds; Flight adaptations

Module XV: Mammalia (6 Hours)
Early evolution of mammals; Primates; Dentition in mammals.

Suggested Readings

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ZGEP0106: ENVIRONMENT AND PUBLIC HEALTH (4 CREDITS-60 HOURS) (L-T-P:4-0-0)

Course Outcomes:
1. Illustrate the effects of air, water and noise pollution with regards to human health. (Understanding)
2. Identify the different types and sources of environmental hazards, their persistence, dose and exposure. (Applying)
3. Distinguish the different factors contributing to climate change and their effect in human health. (Analyzing)
4. Compile the various types of waste generated, their disposal and management. (Creating)

Module I: Introduction (8 Hours)
Definition of Environmental Health and Environmental Hazards; Categories of Environmental Hazard; Principles of hazard management; Inherent Capacity of Environment; Categories of Pollution.

Module II: Pollution (24 hours)
Air Pollution: Types, Sources, Effects and Control. Greenhouse effects, Global warming, Acid rain and Ozone layer depletion. Water Pollution: Types, Sources, Effects and Control; Minamata diseases. Noise pollution: Types, Sources, Effects and Control of Noise Pollution.
Module III: Case histories: (8 hours)
Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.

Module IV: Solid Waste Management: (12 hours)
Definition of Solid Waste, Types of Solid Waste, Sources of waste, Management of Solid waste. Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants.

Module V: Diseases (8 Hours)
Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid

Mapping of COs to Syllabus

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ZGDC0107: DIVERSITY OF CHORDATES (4 CREDITS: 60 HOURS) (L-T-P: 4-0-2)

COURSE OUTCOMES
1. Describe the origin and evolution of the phylum Chordata. (Remembering)
2. Distinguish the unique characteristics as well as life functions of different chordate subphylum. (Applying)
3. Evaluate the varied morphological, anatomical and physiological complexity in selected chordate organisms. (Applying)
4. Compare the various theories of animal distribution and their geographical realms. (Analyzing)

Module I: Introduction to Chordates (8 Hours)
General characteristics and outline classification

Module II: Protochordata (8 Hours)
General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata

Module III: Origin of Chordata (3 Hours)
Dipleurula concept and the Echinoderm theory of origin of chordates Advanced features of vertebrates over Protochordata

Module IV: Agnatha (2 Hours)
General characteristics and classification of cyclostomes up to class

Module V: Pisces (8 Hours)
General characteristics of Chondrichthyes and Osteichthyes, classification up to order Migration, Osmoregulation and Parental care in fishes

Module VI: Amphibia (8 Hours)
Origin of Tetrapoda (Evolution of terrestrial ectotherms); General characteristics and classification up to order; Parental care in Amphibians

Module VII: Reptilia (7 Hours)
General characteristics and classification up to order; Affinities of Sphenodon; Poison apparatus and Biting mechanism in snakes

Module VIII: Aves (8 Hours)
General characteristics and classification up to order Archaeopteryx- a connecting link; Principles and aerodynamics of flight, Flight adaptations and Migration in birds

Module IX: Mammals (8 Hours)
General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages

Module X: Zoogeography (8 Hours)
Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms.

Suggested Readings
ZGAP0108: ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS (4 CREDITS: 60 HOURS) (L-T-P: 4-0-2)

Objective: To understand structure and functions of different animal tissues and endocrine glands

COURSE OUTCOMES
1. Define the structure and function of different animal tissues, and the endocrine glands. (Understanding)
2. Distinguish the unique physiological aspects at both the cellular and system levels. (Analyzing)
3. Assess the complexity and co-ordination exhibited by the nervous and muscle system. (Evaluating)
4. Compare the histological intricacy of the endocrine glands, their mechanism of action and the coordination demonstrated by the neuroendocrine system. (Analysing)

Module I: Tissues (6 Hours)
Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue

Module II: Bone and Cartilage (4 Hours)
Structure and types of bones and cartilages, Ossification, bone growth and resorption

Module III: Nervous System (10 Hours)
Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and, Neuromuscular junction; Reflex action and its types - reflex arc; Physiology of hearing and vision.

Module IV: Muscle (12 Hours)
Histology of different types of muscle tissue; Ultrastructure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and

Module V: Reproductive System (10 Hours)
Histology of testis and ovary; Physiology of male and female reproduction; Puberty, Methods of contraception in male and female

Module VI: Endocrine System (18 Hours)
Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Classification of hormones; Regulation of their secretion; Mode of hormone action, Signal transduction pathways for steroidal and non-steroidal hormones; Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Placental hormones.

Suggested Readings

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ZGFB0109: FUNDAMENTALS OF BIOCHEMISTRY (4 CREDITS: 60 HOURS) (L-T-P:4-0-0)

COURSE OUTCOMES
1. Identify the structural and functional aspects of different biomolecules. (Applying)
2. Illustrate and draw the chemical structures of different biomolecules. (Understanding)
3. Interpret their inter-relationship as evident in the living system. (Evaluating)
4. Elaborate the mechanism and regulation of enzyme action and their kinetics with reference to bi-substrate, multi-substrate and allosteric enzymatic reactions. (Creating)

Module I: Carbohydrates (8 Hours)
Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates

Module II: Lipids (8 Hours)
Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Triacylglycerols, Phospholipids, Glycolipids,
Steroids

Module III: Proteins (14 Hours)
Amino acids: Structure, Classification and General Properties of α-amino acids; Physiological importance of essential and non-essential α-amino acids: Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugated proteins: Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants

Module IV: Nucleic Acids (12 Hours)
Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids: Cot Curves: Base pairing, Denaturation and Renaturation of DNA Types of DNA and RNA, Complementarity of DNA, Hypo-Hyperchromicity of DNA

Module V: Enzymes (18 Hours)
Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action

Suggested Readings

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ZGRM0110: RESEARCH METHODOLOGY (2 CREDITS: 30 HOURS) (L-T-P: 2-0-0)

Objective: To introduce students to a few aspects of doing research

COURSE OUTCOMES
1. Define various kinds of research, objectives of doing research, research process, research designs and sampling. (Remembering)
2. Demonstrate basic knowledge on research techniques. (Understanding)
3. Analyze the data collected in research through the use of analytical search tools. (Analyzing)
4. Design solutions to varied biological problems. (Creating)
5. Identify the ethical issues of research. (Applying)

Module I: Foundations of Research (5 Hours)
Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied

Module II: Research Design (8 Hours)
Need for research design: Features of good design, Important concepts related to good design: Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs

Module III: Data Collection, Analysis and Report Writing (12 Hours)
Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis writing, Preparation of Tables and Bibliography. Data Presentation using digital technology

Module IV: Ethical Issues (5 Hours)
Intellectual property Rights, Commercialization, Copyright, Royalty, Patent law, Plagiarism, Citation, Acknowledgement

Suggested Readings
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ZGCA0111: COMPARATIVE ANATOMY OF VERTEBRATES (4 CREDITS: 60 HOURS) (L-T-P:4-0-0)

COURSE OUTCOMES
1. Identify the distinct anatomical structures that comprise the vertebrate body (Applying)
2. Demonstrate the structural and functional similarities and differences of these organ systems amongst different vertebrate groups (Understanding)
3. Evaluate the pattern of organ development in various vertebrate groups (Evaluating)
4. Compare the functioning of these organ systems from lower to higher vertebrates (Understanding)

Module I: Integumentary System (8 Hours)
Structure, functions and derivatives of integument

Module II: Skeletal System (8 Hours)
Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches

Module III: Digestive System (8 Hours)
Alimentary canal and associated glands, dentition

Module IV: Respiratory System (8 Hours)
Skin, gills, lungs and air sacs; Accessory respiratory organs

Module V: Circulatory System (8 Hours)
General plan of circulation, evolution of heart and aortic arches

Module VI: Urinogenital System (6 Hours)
Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uterus

Module VII: Nervous System (8 Hours)
Comparative account of brain autonomic nervous system, Spinal cord, Cranial nerves in mammals

Module VIII: Sense Organs (6 Hours)
Classification of receptors Brief account of visual and auditory receptors in man

Suggested Readings

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ZGSS0112: ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS (4 CREDITS: 60 HOURS) (L-T-P:4-0-0)

Objective: To understand different physiological mechanisms in Mammal

COURSE OUTCOMES
1. Define the organ systems responsible for maintaining a balanced physiological functioning of the mammalian body (Remembering)
2. Summarize the structure and function of the gastrointestinal tract, the lungs, the kidneys, the heart and other related organs (Understanding)
3. Evaluate the effects of organ systems compromised due to infection, disease or injury (Evaluating)
4. Correlate the inter-relationship of these organ systems to maintain a stable homeostasis in the body (Understanding)
5. Develop skills to determine basic blood parameters as a measure of a vigorous physiological system (Applying)
Module I: Physiology of Digestion (14 Hours)
Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in Gastrointestinal tract.

Module II: Physiology of Respiration (12 Hours)
Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration

Module III: Renal Physiology (8 Hours)
Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance

Module IV: Blood (14 Hours)
Components of blood and their functions; Structure and functions of haemoglobin, Haemostasis: Blood clotting system, Kallikrein-Kininogen system, Complement system Fibrinolytic system, Haematopoiesis Blood groups: Rh factor, ABO and MN

Module V: Physiology of Heart (12 Hours)
Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses Cardiac cycle; Cardiac output and its regulation, Frank-Starling Law of the heart, nervous and chemical regulation of heart rate. Electrocardiogram, Blood pressure and its regulation

Suggested Readings
5. https://onlinecourses.nptel.ac.in/noc20_bt42/preview

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ZGBM0113: BIOCHEMISTRY OF METABOLIC PROCESSES (4 CREDITS: 60 HOURS) (L-T-P:4-0-0)

COURSE OUTCOMES
1. Define characteristic features of catabolic and anabolic pathways of metabolism (Remembering)
2. Demonstrate the differences of carbohydrate, lipid and protein metabolism and their inter-relationships (Understanding)
3. Infer the significance of the electron transport system in metabolic pathways (Analyzing)
4. Interpret the biochemistry of metabolic disorders (Evaluating)

Module I: Overview of Metabolism (10 Hours)
Catabolism vs Anabolism, Stages of catabolism, Compartamentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms

Module II: Carbohydrate Metabolism (16 Hours)
Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis

Module III: Lipid Metabolism (14 Hours)
β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis

Module IV: Protein Metabolism (10 Hours)
Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids

Module V: Oxidative Phosphorylation (10 Hours)
Redox systems; Review of mitochondrial respiratory chain, Inhibitors and uncouplers of Electron Transport System

Suggested Readings
5. https://onlinecourses.swayam2.ac.in/cec20_bt19/preview

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ZGSE0114: SERICULTURE (2 CREDITS: 30 HOURS) (L-T-P: 2-0-0)

Course Outcomes

1. Outline various kinds of silkworms, their life cycles, the silk they produce and the present status of silk production in India as well as abroad (Understanding)
2. Examine silkworm rearing techniques, with special importance given to those extensively reared in North East India (Analyzing)
3. Inspect the loss in silk production due to increased silkworm mortality as a result of pests and diseases (Analyzing)
4. Design start-ups or entrepreneur proposals to enhance the economy of the Sericulture industry thereby boosting the younger generation to develop skill in uplifting this indigenous industry (Creating)

Module I: Introduction (3 Hours)
Sericulture: Definition, history and present status; Silk route Types of silkworms, Distribution and Races Exotic and indigenous races Mulberry and non-mulberry Sericulture

Module II: Biology of Silkworm (3 Hours)
Life cycle of Philosamia ricini Structure of silk gland and secretion of silk

Module III: Rearing of Silkworms (13 Hours)
Selection of a non-mulberry variety and establishment of garden Rearing house and rearing appliances Disinfectants: Formalin, bleaching powder, RKO Silkworm rearing technology: Early age and Late age rearing Types of mountages Spinning, harvesting and storage of cocoons

Module IV: Pests and Diseases (4 Hours)
Pests of silkworm: Uzi fly, dermestid beetles and vertebrates Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases

Module V: Entrepreneurship in Sericulture (2 Hours)
Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various sericulture centres.

Suggested Readings

1. Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
4. Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.

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ZGAF0115: AQUARIUM FISH KEEPING (2 CREDITS: 30 HOURS) (L-T-P: 2-0-0)

Course Outcomes
1. Explain the biology of aquarium fishes, both freshwater and marine (Understanding)
2. Compare food formulation and feeding techniques (Analyzing)
3. Analyze the scope of the aquarium fish industry as a means of livelihood (Analyzing)
4. Identify techniques and skills in fish transportation (Applying)
5. Designing and maintenance of aquaria (Creating)

Module I: Introduction to Aquarium Fish (2 Hours)
Introduction to aquarium fish, the scope of aquarium fish industry based on endemic and exotic species

Module II: Biology of Aquarium Fishes (10 Hours)
Common characters and sexual dimorphism of Freshwater and Marine fishes such as Guppy, Molly, Sword tail, Gold fish, Angelfish, Blue morph, Anemone fish and Butterfly fish

Module III: Food and feeding of Aquarium fishes (8 Hours)
Use of live fish feed organisms. Preparation and composition of formulated fish feeds

Module IV: Fish Transportation (4 Hours)
Live fish transport - Fish handling, packing and forwarding techniques.

Module V: Maintenance of Aquarium (6 Hours)
General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry

Suggested Readings
3. Tropical fish setting up & maintaining fresh water & marine aquarium: 1972 – Dutta R Octopus Books, LTD.

Mapping of COs to Syllabus

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ZGMB0116: MOLECULAR BIOLOGY [4 CREDITS: 60 HOURS, L-T-P: 4-0-0]

Course Outcome:
1. Define the molecular structure of DNA and RNA. (Remembering)
2. Explain the mechanism of DNA replication of both linear and circular DNA as well as protein synthesis including transcription and translation in both prokaryotes and eukaryotes. (Understanding)
3. Illustrate the post-translational modifications and processing of eukaryotic mRNA and prokaryotic and eukaryotic generegulation. (Understanding)
4. Distinguish the different DNA repair mechanisms with their significance. (Analyzing)
5. Summarize the interdependence of these molecular mechanisms in providing a holistic environment for the smooth functioning of a cell/organism. (Understanding)

Module I: Nucleic Acids (4 Hours)
Salient features of DNA and RNA Watson and Crick model of DNA

Module II: DNA Replication (12 Hours)
DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear ds-DNA, replication of telomeres

Module III: Transcription (10 Hours)
RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors

Module IV: Translation (12 Hours)
Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure
and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation.

Module V: Post Transcriptional Modifications and Processing of Eukaryotic RNA (6 Hours)
Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA

Module VI: Gene Regulation (10 Hours)
Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac operon and trp operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing, Genetic imprinting

Module VII: DNA Repair Mechanisms (3 Hours)
Pyrimidine dimerization and mismatch repair, Regulatory RNAs 3 Riboswitches, RNA interference, miRNA, siRNA

Suggested Readings
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts,

Mapping of COs to Syllabus

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ZGPG0117: PRINCIPLES OF GENETICS [4 CREDITS: 60 HOURS, L-T-P: 4-0-0]

Course outcome:
1. Define the concept of genes, genomics and inheritance with special reference to Mendelian heredity and inheritance. (Remembering)
2. Describe the mechanism of linkage and crossing-over with models of recombination in prokaryotes, eukaryotes and viruses. (Understanding)
3. Illustrate the different types of mutations and their molecular mechanisms. (Understanding)
4. Analyze and interpret the diverse inheritance patterns (Analyzing, Understanding)
5. Understand DNA recombinant technology and compare the methods of generation of transposons in bacteria, Drosophila, maize and humans. (Understanding)

Module I: Mendelian Genetics and its Extension (8 Hours)
Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limited characters inheritance.

Module II: Linkage, Crossing Over and Chromosomal Mapping (12 Hours)
Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.

Module III: Mutations (10 Hours)
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method.

Module IV: Sex Determination (4 Hours)
Chromosomal mechanisms of sex determination in Drosophila and Man

Module V: Extra-chromosomal Inheritance (6 Hours)
Criteria for extra-chromosomal inheritance, Antibiotic resistance in Chlamydomonas, Mitochondrial mutations in Saccharomyces, Infective
heredity in Paramecium and Maternal effects

**Module VI : Polygenic Inheritance (3 Hours)**
Polygenic inheritance with suitable examples; simple numerical based on it.

**Module VII : Recombination in Bacteria and Viruses (9 Hours)**
Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

**Module VIII : Transposable Genetic Elements (8 Hours)**
Transposons in bacteria, Ac-Ds elements in maize and P elements in Drosophila, Transposons in humans

**SUGGESTED READINGS**

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**ZGWM0118: WILDLIFE CONSERVATION AND MANAGEMENT [4 CREDITS: 60 HOURS, L-T-P: 4-0-0]**

**Course Outcome:**
1. Explain the importance of evaluation and management wildlife and their habitat. (understanding)
2. Identify characteristics of population and protected areas. (Analyzing)
3. Explain the importance of estimation of population characteristics. (Understanding)
4. Explain the management strategies to protect/unprotected areas. (Understanding)
5. Apply conservation and management strategies for local endangered species.(Applying)

**Module I : Introduction (8 Hours)**
Introduction to Wild Life, Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.

**Module II : Evaluation and management (10 Hours)**
Evaluation and management of wild life Habitat analysis, Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS.

**Module III : Management of habitats (8 Hours)**
Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats

**Module IV : Population estimation (10 Hours)**
Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method.

**Module V : Management and planning (8 Hours)**
Management planning of wild life in protected areas Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbation.

**Module VI : Management of excess population (6 Hours)**
Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal

**Module VII : Management in Protected areas (10 Hours)**
Protected areas National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tigerconservation - Tiger reserves in India; Management challenges in Tiger reserve.

**SUGGESTED READINGS**
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ZGAC0119: ANIMAL BEHAVIOUR AND CHRONOBIOLGY [4 CREDITS: 60 HOURS, L-T-P: 4-0-0]

Course Outcome
1. Explain different types, causes and methods of recording of animal behaviour. (Understanding, Analyzing)
2. Define the different types and patterns of animal behavior and chronobiological events. (Remembering)
3. Interpret the various modes of communication, social and sexual behavior in animals. (Applying)
4. Explain and identify biological rhythms. (Understanding, Applying)
5. Apply the knowledge of biological rhythms in the field of chronobiology. (Applying)

Module I: Introduction to Animal Behaviour (8 Hours)
Origin and history of Ethology; Brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Proximate and ultimate causes of behaviour, Methods and recording of a behaviour

Module II: Patterns of Behaviour (14 Hours)
Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting.

Module III: Social and Sexual Behaviour (14 Hours)
Social Behaviour: Concept of Society; Communication and the senses; Altruism; Insects’ society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.
Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

Module IV: Introduction to Chronobiology (14 Hours)
Historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period. Adaptive significance of biological clocks

Module V: Biological Rhythm (8 Hours)
Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms; Photoperiod and regulation seasonal reproduction of vertebrates; Role of melatonin.

Module VI: Biological Clocks (8 Hours)
Relevance of biological clocks; Chronopharmacology, Chronomedicine, Chronotherapy.

SUGGESTED READINGS

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ZGCB0120: COMPUTATIONAL BIOLOGY [4 CREDITS: 60 HOURS, L-T-P: 4-0-0]

Course Outcome:
1. Define the core concept and applications of bioinformatics and identify its different branches. (Remembering)
2. Illustrate the significance of the biological databases in managing and retrieving biological data. (Understanding)
3. Apply different bioinformatics tools and software in decoding nucleic acid and protein sequence, their structure and interactions, and also to correlate these data amongst different species. (Applying)
4. Analyze the evolutionary interrelationship amongst different organisms by aligning their nucleic acid or protein sequences using sequence alignment tools to predict their similarities and dissimilarities. (Analyzing)
5. Evaluate various statistical methods in data analysis and interpretation. (Evaluating)

Module I: Introduction to Bioinformatics (5 Hours)
Importance, Goal, Scope; Genomics, Transcriptomics, Functional Genomics, Metabolomics, Systems Biology, Molecular Phylogeny; Applications and Limitations of Bioinformatics

Module II: Biological Databases (10 Hours)
Introduction to biological databases; Primary, secondary and composite databases; Nucleic acid databases (GenBank, DDBJ, EMBL and NDB); Protein databases (PIR, SWISS-PROT, TrEMBL, PDB); Metabolic pathway database (KEGG, EcoCyc, and MetaCyc); Small molecule databases (PubChem, Drug Bank, ZINC, CSD)

Module III: Data Generation and Data Retrieval (14 Hours)
Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)

Module IV: Basic Concepts of Sequence Alignment (14 Hours)
Scoring Matrices (PAM, BLOSUM), Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Local and global alignment, pair wise and multiple sequence alignments; Similarity, identity and homology of sequences.

Module V: Applications of Bioinformatics (7 Hours)
Structural Bioinformatics (3-D protein, PDB), Functional genomics (genomewide and high throughput approaches to gene and protein function), Drug discovery method (Basic concepts)

Module V: Biostatistics (10 Hours)
Introduction, calculation of standard deviation, standard error, Co-efficient of Variance, Chi-square test, Z test, t-Test

SUGGESTED READINGS

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ZGAB0121: ANIMAL BIOTECHNOLOGY [4 CREDITS: 60 HOURS, L-T-P: 4-0-0]

Course Outcome
1. Define the concept and scope of animal biotechnology. (Remembering)
2. Illustrate the basic molecular technique for gene manipulation. (Understanding)
3. Explain animal cell culture and gene therapy in molecular diagnosis of genetic diseases. (Understanding)
4. Analyze different techniques for the development of genetically modified organisms. (Analyzing)
5. Apply the practical concepts of basic techniques in biotechnology. (Applying)

Module I: Introduction (8 Hours)
Concept and scope of biotechnology

Module II: Molecular Techniques in Gene manipulation (24 Hours)
Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics). Restriction enzymes: Nomenclature, detailed study of Type II. Transformation techniques: Calcium chloride method and electroporation. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization Southern, Northern and Western blotting. DNA sequencing: Sanger method, Pyro-sequencing, Polymerase Chain Reaction, DNA Fingerprinting and DNA microarray.

Module III: Genetically Modified Organisms (18 Hours)

Module IV: Culture Techniques and Applications (10 Hours)
Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia). Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy.

SUGGESTED READINGS

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ZGDB0122: DEVELOPMENTAL BIOLOGY (4 CREDITS; 60 HOURS; 4-0-0)

Course outcome:
1. To demonstrate the mechanisms underlying the process of development. (Understanding)
2. To determine the evolutionary history of living species inferred through the phylogenetic molecular and morphological information using models. (Understanding)
3. Correlate the effects of different natural and artificial factors leading to developmental anomalies or congenital defects in humans. (Analyzing)
4. Interpret the different stages of development of frog, chick and culture preparation of Drosophila. (Analyzing)

Module I: Introduction (4 Hours)
Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division.

Module II: Early Embryonic Development (28 Hours)
Gametogenesis: Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers.

Module III: Late Embryonic Development (8 Hours)
Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta).

Module IV: Post Embryonic Development (12 Hours)
Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories.
Module V: Implications of Developmental Biology (8 Hours)
Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis

Suggested Readings
3. Carlson, R. F. Patten’s Foundations of Embryology

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ZGEB0123: EVOLUTIONARY BIOLOGY (4 CREDITS; 60HRS; 4-0-0)

Course Outcomes
1. Gain a deeper insight into evolutionary processes. (Understanding)
2. To determine the evolutionary history of living species inferred through the phylogenetic analysis of molecular and morphological information using models. (Understanding).
3. To describe the basics of population genetics population evolution. (Understanding). CO4: To interpret the concept of extinction. (Understanding)
4. Apply evolutionary principles in their research. (Applying)

Module I: Life’s Beginnings (7 Hours)
Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes

Module II: Historical review of evolutionary concept (4 Hours)
Lamarckism, Darwinism, Neo-Darwinism

Module III: Evidences of Evolution (10 Hours)
Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse, Molecular (universality of genetic code and protein synthesizing machinery, three domains of life, neutral theory of molecular evolution, molecular clock, example of globin gene family, rRNA/cyt c

Module IV: Sources of variations (8 Hours)
Heritable variations and their role in evolution

Module V: Population genetics (13 Hours)
Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection. Genetic Drift (mechanism, founder’s effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies

Module VI: Product of evolution (7 Hours)
Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation / macroevolution (exemplified by Galapagos finches

Module VII: Extinctions (2 Hours)
Back ground and mass extinctions (causes and effects), detailed example of K-T extinction

Module VIII: Origin and evolution of man (6 Hours)
Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from Dryopithecus leading to Homo sapiens, molecular analysis of human origin

Module IX: Phylogenetic trees (2 Hours)
Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees

Suggested Readings
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ZGIM0124: IMMUNOLOGY (4 CREDITS; 60 HRS; 4-0-0)

Course Outcomes
1. Define the basic concepts of immunology and distinguish the two important facets of immunity, innate and adaptive. (Understanding)
2. Develop critical definition of the antigen and the self, antigen-antibody interactions and how the different barriers of the innate immune system work in relation to the adaptive immune response to eliminate the antigen. (Understanding)
3. Apply the concepts of immunology through various laboratory techniques. (Applying)
4. Analyze the importance of the Major Histocompatibility Complex proteins and their role in transplantation immunology. (Analyzing)
5. Describe the concept of hypersensitivity, types of cytokines and cytokines. (Understanding)
6. Demonstrating vaccine production against some major infectious diseases. (Understanding).

Module I: Overview of Immune System (8 Hours)
Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system

Module II: Innate and Adaptive Immunity (13 Hours)

Module III: Antigens (8 Hours)
Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cellepitopes

Module IV: Immunoglobulins (10 Hours)
Structure and functions of different classes of immunoglobulins, Antigenantibody interactions, Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis

Module V: Major Histocompatibility Complex (6 Hours)
Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation Module VI: Cytokines (4 Hours)
Properties and functions of cytokines, Therapeutics Cytokines

Module VII: Complement System (4 Hours)
Components and pathways of complement activation.

Module VIII: Hypersensitivity (4 Hours)
Gell and Coombs’ classification and brief description of various types of hypersensitivities

Module IX: Vaccines (3 Hours)
Vaccine preparations and types of vaccines.

Suggested Readings

Mapping of COs to Syllabus

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ZGPA0125: PARASITOLOGY (4 CREDITS; 60 HRS; 4-0-0)

Course Outcomes
1. Define the basic concepts of parasitology and host-parasite interactions and mechanisms of parasitic transmissions. (Understanding)
2. Illustrate the different life cycles parasites. (Understanding)
3. Articulate major helminth, arthropod and parasitic vertebrates, their morphology, epidemiology, treatment, pathogenicity and their importance. (Understanding)
4. Analyze different techniques for parasite control as well as treating parasitic diseases. (Analyzing)
5. Apply the knowledge for correct identification of parasites. (Applying)

Module I: Introduction to Parasitology (3 Hours)
Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship

Module II: Parasitic Protists (15 Hours)
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani.

Module III: Parasitic Platyhelminthes (15 Hours)
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Fasciolopsis buski, Schistosoma haematobium, Taenia solium and Hymenolepis nana

Module IV: Parasitic Nematodes (15 Hours)
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti and Trichinella spiralis. Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylenchus (lesion nematode)

Module V: Parasitic Arthropoda (10 Hours)
Biology, importance and control of ticks, mites, Pediculus humanus (head and body louse), Xenopsylla cheopis and Cimex lectularius

Module VI: Parasitic Vertebrates (2 Hours)
A brief account of parasitic vertebrates; Cookiecutter Shark, Candiru, Hood Mockingbird and Vampire bat

Suggested Readings

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ZGFF0126: FISH AND FISHERIES (4 CREDITS; 60 HOURS; 4-0-0)

Course Outcomes
1. Classify fishes based on habitat, feeding habit and mode of reproduction. (Understanding)
2. Acquire basic knowledge on their morphology and physiology. (Understanding)
3. Compare the productivity of inland and marine fisheries, and the fishing gears and tools required for the same. (Understanding).
4. To describe the basic concept of aquaculture. (Understanding)
5. Develop skills in measuring the morphometric and meristic characters in fishes, identify their scales, breathing organs and other associated characters. (Applying)
Module I: Introduction and Classification (6 Hours)
General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction.

Module II: Morphology and Physiology (18 Hours)
Types of fins and their modifications; Locomotion in fishes; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fishes); Electric organs; Bioluminescence; Mechanoreceptors; Schooling; Parental care; Migration

Module 3: Fisheries (12 Hours)
Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations

Module IV: Aquaculture (20 Hours)
Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

Module V: Fish in research (4 Hours)
Transgenic fish, Zebrafish as a model organism in research

Suggested Readings
1. Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
2. D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK
4. J.R. Norman, A history of Fishes, Hill and Wang Publishers

Mapping of COs to Syllabus

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ZGBI0127: BIOLOGY OF INSECTA (4 CREDITS; 60 HRS; 4-0-0)

Course/Outcomes
1. To demonstrate the concepts of insect biology including basic systematics of insects. (Understanding)
2. Illustrate the role of insects as vectors and pests. (Understanding)
3. Develop an understanding of insect plant interactions. (Understanding)
4. Acquire knowledge regarding morphology of insects and physiology of insect body systems. (Understanding)
5. Interpret the behavioral aspects of social insects. (Understanding)

Module I: Introduction (4 Hours)
General Features of Insects Distribution and Success of Insects on the Earth

Module II: Insect Taxonomy (4 Hours)
Basis of insect classification; Classification of insects up to orders

Module III: General Morphology of Insects (8 Hours)
External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat Abdominal appendages and genitalia

Module IV: Physiology of Insects (28 Hours)
Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system Sensory receptors Growth and metamorphosis

Module V: Insect Society (6 Hours)
Group of social insects and their social life Social organization and social behaviour (w.r.t. any one example)
Module VI: Insect Plant Interaction (5 Hours)
Theory of coevolution, role of allelochemicals in host plant mediation Host-plant selection by phytophagous insects, Insects as plant pests

Module VII: Insects as Vectors (5 Hours)
Insects as mechanical and Biological vectors, Brief discussion on houseflies and mosquitoes as important insect vectors

Suggested Readings
1. A general text book of entomology, Imms , A. D., Chapman & Hall, UK
2. The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK
3. Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
5. The Insect Societies, Wilson, E. O., Harward Univ. Press, UK
7. Physiological system in Insects, Klowden, M. J., Academic Press, USA
8. The Insects, An outline of Entomology, Gullan, P. J., and Cranston, P. S., Wiley Blackwell, UK
9. Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA

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ZGSL0200: SERVICE LEARNING IN ZOOLOGY

Course Outcomes
1. Develop an understanding about the importance of service to community. (Understanding)
2. Identify the needs of a community. (Applying)
3. Apply skills acquired in Zoology to render service to community. (Creating)
4. Examine what can be learned from the community. (Analyzing)

Module I (5 hours)
Service learning: Definitions; Principles of Service Learning; Awareness of Community; Involvement with Community; Commitment to service

Module II (10 hours)
Aquaculture: Aquarium management - Aquarium fish keeping and breeding using local resources
Sericulture: Eri and their host plants plantations; indoor rearing and management practices; marketing and management of produce

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LABORATORY COURSES

ZGPR6004: PROJECT MANAGEMENT, REPORTING AND DOCUMENTATION (30 HOURS) (P/NP)

Course Outcomes
1. Identify qualities of a successful entrepreneur and develop competencies. (Applying)
2. Construct economically and socially sound business ideas. (Creating)
3. Analyze the potentials of a social catalyst and examine case studies. (Analyzing)
4. Assess plans for effective preparation of Detailed Project Report (DPR) and financials of a DPR. (Analyzing)
5. Develop skills for project implementation and management. (Applying)
6. Define concept of market. (Remembering)
7. Distinguish different methods of Bookkeeping and Accountancy. (Analyzing)
8. Adapt effective plans for preparing accurate project report and practicing positive documentation. (Creating)
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<th>Objective</th>
<th>Help the student to understand Entrepreneurship, identification of qualities of a successful entrepreneur &amp; how to develop it</th>
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| Module I: Entrepreneurship : Concept and Functions | Who is an entrepreneur?  
Entrepreneurial competencies (Initiative, Creativity and Innovation, Risk Taking and Risk Management, Problem Solving, Leadership, Persistence, Quality Performance, Information Seeking, Systematic Planning, Persuasion and Influencing Others, Enterprise Launching Competencies, Enterprise Management Competencies)  
Functions of an entrepreneur (Promotional functions: Innovation, Risk-taking, Organisation Building, Discovery of an idea, Detailed Investigation, Assembling the Requirements, Financing the Proposition. Managerial functions: Planning, Organizing, Staffing, Leadership, Supervision, Communication, Motivation, Controlling.  
Commercial Functions: Production, Finance, Marketing, Accounting)  
Types of entrepreneur (Innovative Entrepreneur, Imitative Entrepreneur, Fabian Entrepreneurs, Drone Entrepreneurs)  
Entrepreneurship: meaning and definition; types of entrepreneurship; entrepreneur and entrepreneurship  
Difference between entrepreneur and employee |
| Module II: Generation of business ideas and linking | EDP: Meaning, Need, Importance of EDP  
Necessity of generating ideas  
Ways to generate ideas, Area Assessment Survey – Modes (Desk Research, Field Work, Market Need Based Opportunities, Ideas from Existing Entrepreneurs)  
Linking business ideas with the entrepreneur  
Methodology of Opportunity Identification & Profiling Business Ideas (Preparation of Personal Profile, Development of OS (decision making) Framework, Snap Investigation of ideas generated, Evaluation in terms of OS (decision making) Framework and Short-listing of ideas, Pre-feasibility Studies, Errors in Selection, Final Opportunity Selection)  
Preparation of business project plan and business project plan execution (Summary of the Project/Project at a Glance, General Information, Details of the Proposed Project, Market Potential, Manufacturing Process, Production Programme/Sales Revenue, Cost of Manufacturing and Profitability Projections) |
| Module III: Social entrepreneurship | To impart knowledge on social entrepreneurship |
| Module IV: Preparation of Detailed Project Report (DPR) and Financials of a DPR | Who is a social entrepreneur (definition and case study)  
Difference between entrepreneurship and social entrepreneurship  
Characteristics of social entrepreneur (Social Catalysts, Socially aware, Opportunity-seeking, Innovative, Resourceful, Accountable)  
Examples and case study |
| Module V: Project implementation and management | To impart knowledge on preparing of DPR  
Business plan: key questions  
Technical arrangement & Production process (Manufacturing process, Sources of technical know how, plant & machinery, Supplier identification & supplier selection, Raw materials, packaging, land requirement, utilities and manpower, financial viability) and Location selection (Layout, built up area etc.)  
Product and Market (Product description, Capacity, Market study and market demand, Product mix, Branding, Channels of distribution, Advertising and Promotion etc.)  
Project cost and means of finance (Land, site development, building and civil works, plant and machinery cost, other fixed assets, technical knowhow fees, preliminary and preoperational expenses, working capital margin, contingency and escalation)  
Income analysis (Capital utilisation and income estimate, Expenditure estimate, Profit estimate, income tax estimate, profitability ratios: TC ratio, cash flow estimate, risk analysis, sensitivity analysis etc.)  
Impact knowledge on implementing, managing and monitoring the progress of the selected project |

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Managing Business Crisis – Starting and Liquidity Crisis

**Objective**  
To impart the Knowledge of different component of Market

**Module VI:** Concept of market

- Traditional market
- Emerging market: E commerce
- Analysing the market environment
- Researching the market and market survey
- Marketing mix
- Product mix
- Promotion mix
- Price mix, method of pricing

**Objective**  
To impart knowledge on Book Keeping

**Module VII:** Bookkeeping and Accountancy

- Basic concept of Accounting (Management and financial accounting)
- Financial statement: Meaning, Importance
- Profit and loss account
- Balance sheet
- Depreciation and adjustment etc.
- Interpretation of financial Statement (Liquidity, Current ratio, Profitability ratio, Inventory turnover ratio, Debtorsturnover ratio, ROI etc)
- Fund flow Analysis

**Objective**  
To impart knowledge on Documentation and Reporting

**Module VIII:** Documentation and Reporting

- Why to Document
- What is a Documentation Report
- When and How to prepare the Documentation Report
- Typical format of a Documentation report
- Layout of the Report
- Writing a Report

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**ZGDI6006: DISSERTATION PHASE I (4 CREDITS)**

**Course Outcomes**

At the end of Dissertation phase I students will be able to:

1. Review and analyse scientific papers (Analyzing)
2. Design and perform experiments and prepare work plan (Applying)
3. Formulate hypotheses and choose appropriate methodologies to achieve the desired objectives (Creating)

- The dissertation phase I is the preliminary stage where a student selects a research topic on interest in consultation with the assigned supervisor. In this phase the student is learns to identify research gap, formulate objectives and hypothesis, design work plan and experiments and fixes his/her methodologies to achieve the desired objectives.
ZGWP6011: INTRODUCTION TO WILDLIFE PHOTOGRAPHY (30 HOURS, L-T-P: 2-0-0) (P/NP)

Course Outcomes
1. Discuss the history of Photography, moving images and Stock photography Creating
2. Demonstrate a brief understanding of ethics of journalism, photo journalism and sources (Understanding)
3. Assess the importance of digital technology in photography (Evaluating)
4. To define camera basics and different genres of photography (Remembering)

Learning Objective
1. Through theory and practical assignments, this class provides the students with hands on experiences in photography. Lectures, field studies, guest instructors, student presentation and group work will help you develop the analytical basis and insight to reflect upon and assess the impact of photographs on our ideas of the world.
2. By the end of this course, Students will: Be able to start their career in photography. Will be able to create picture story / Photo Essays and understand the conventions and challenges of telling stories through images
3. Gain personal leadership through challenging, intercultural assignments

Objective: This module will help to understand the students about photography basics

Module I: Introduction to photography
Camera Basics, Types of Camera, Operating a Camera, Exposure, Aperture & Shutter Speeds Light Meter, Depth of Field, Choosing Lenses, Types of lens, Lighting, Flash Photography, Filters, Steady Shooting, Composition in wildlife Photography.

Objective: This module will help to understand the students about different types of photography in details

Module II: Different genres of photography
Mobile Photography, Microscopic photography, Macro photography, Drone photography, Wildlife Photography

Objective: Post production is an important part of photography student will learn post-production in this module

Module III: Post Processing
Enhancing Photographs, Organizing the Picture, Quality Control, Intermediate/advanced use of post-production software like Adobe Photoshop, Lightroom etc

Objective: How to earn the livelihood from selling your images internationally

Module IV: Stock Photography
Introduction to Stock Photography, How to contribute to various stock photo agencies. Causes of rejections, Submitting Guidelines, Meta Data

Objective: This module focuses on photojournalism.

Module V: Ethics in Wildlife Photography
How to prepare for a photo tour (Dress code in wildlife photography, permissions, water bottle, notebook and other accessories) How to remain safe during shooting (How close is too close, keeping antivenom & antiallergen; leach guard, safety of gears used) Ethics in wildlife photography (knowing Schedules of animals in Wildlife (Protection) Act, 1972, not using any bait, not taking any animal out of its habitat without permission, non use of flash, not altering the habitat)

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ZGDS6009: DISSERTATION PHASE II (8 CREDITS)

Course Outcomes
At the end of Dissertation phase II students will be able to:
1. Conduct experiments/ field studies using different materials and methods (Analyzing)
2. Collect various types of data and use those data for testing hypotheses (Analyzing, Evaluating)
3. Make use of several statistical tools for data analysis (Analyzing)
4. Create a scientific report based on the study (Creating)
During the dissertation phase II, a student learns how to perform experiment/field study and collect necessary data for data analysis. He/She also learns to use several statistical tools to analyze data and create a dissertation thesis based on original work done during the end semester examination.

ZGT6010: TEACHING METHODOLOGY AND CLASSROOM MANAGEMENT (30 HOURS: P/NP)

Course Outcome (CO):
1. Define different concepts of teaching skills (Remembering)
2. Create effective teaching instruction (Creating)
3. Evaluate assessments (Evaluate)
4. Make use of ICT(Analyzing)

Module I: Introduction to Core teaching Skills. Micro- teaching.
- Introduction to Methods, Maxims, Devices and techniques of teaching. Practice teaching on Core teaching Skills in Microteaching mode.
- Approaches and methods of teaching Science - (i) Lecture, demonstration, explanation, Observation. (ii) Ensuring Problem solving, laboratory, Project, Heuristic, Discussion for teaching science. (iii) Learning by discovery, group work and team teaching. (iv) Collaborative strategies, provision in heterogeneous classroom.

Module II: Planning and designing for effective instruction in science.
- Design of unit and lesson planning approaches to lesson planning, format of lesson plans
- Teaching aids and laboratories in science, their necessity and importance.
- Museum, field trips and excursion, their relevance to science. Preparation of simple aids of Science teaching.

Module III: Evaluation of Learners Progress.
- Concept and importance of assessment & evaluation.
- Techniques of evaluation (Theory & Practical)
- Construction of Unit test: Design and blueprint, Item construction, Question wise analysis, Construction of Science question paper including marking scheme.

Module IV: Information and Communication Technology (ICT) Integration in Science teaching.
- Introduction to ICT
- Importance of ICT in Science teaching.
- Exploring various ICT tools for Science teaching.
- Open Education Resources (OER) and its uses in Science teaching.
- ICT Integration in Science teaching.
- Exploring FOSS in Science teaching

Mapping of COs to Syllabus

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ZGEE6011: SPECIALIZATION LAB I – ENTOMOLOGY (2 CREDITS)

Course Outcomes
1. Explain and Identify insects of different insect orders
2. Develop the skill required to properly collect and preserve insects (Creating)
3. Compare the different types of legs, antennae and mouthparts of insects (Analyzing)
4. Develop a sound knowledge on basic aspects of anatomy of different systems, physiology of internal systems like digestive system, circulatory system, reproductive system and nervous system. (Creating)
5. To Estimate haemolymph, chitin and uric acid in insects (Creating)

Syllabus
1. Insect collection and preservation
2. Different types of mouth parts
3. Different types of antenna
4. Different types of legs
5. Preparation of arolium, empodium and pollen basket
7. Detection of chitin in insect cuticle
8. Detection of Uric acid in insects
10. Histological study of foregut, midgut and hindgut of insect.
11. Reproductive system of cockroach
12. Prothoracic gland of cockroach
13. Biosensing activity in Butterflies, Honeybees and beetles
14. Identification Of insects of forensic importance and forest defoliator

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ZGCM6012: SPECIALIZATION LAB I- CELL AND MOLECULAR BIOLOGY (2 CREDIT; 30 HRS, 0-0-2)

Course Outcome
1. To demonstrate the method to study cell morphology. (applying)
2. Demonstrating the method of preparation of histological slides. (applying)
3. Show the method of preparation to study various chromosome. And also demonstrating the pk value of buffer.(analysing)
4. To demonstrate various method of detecting concentration of an unknown sample. (applying)
5. Demonstrating the enzyme end point techniques. (anlayzing)
6. Illustrating various immunological techniques. (analysing)
7. Creating a report on the techniques observed in advanced lab. (creating)

Syllabus
1. Use of oculometer-standardization and measurements of cell height, nuclear diameters and tabular diameters
2. Histology of biological tissues and sectioning by microtome
3. Preparation of salivary gland chromosomes from Drosophila /Chironomous larva and stain with acetocarmine/aceto-orcein/fuelgen
4. Preparation of mammalian chromosomes from bone marrow or testis and stain with Giemsa stain
5. Determination of pk value of buffer
6. Determination of relationship between absorption and various concentration of a solution using a colorimeter, spectrophotometric.
7. Preparation of standard curve for total cholesterol
8. Quantization of enzymes: End point techniques (alkaline phosphatase), enzyme kinetics.
9. Permanent Slides: Types of cells (squamous, cuboidal, columnar epithelial cells, blood cells, nerve cells, muscle cells), connective tissues of various types, adipose tissue, mitotic & meiotic chromosomes and their different phases.
10. Preparation of emulsions - syringe method and hubbed needle method
11. Immunization routes: Intradermal, Subcutaneous, Intramuscular, Intrapertioneal, Intravenous
12. Bleeding Schedules and collection of blood: cardiac puncture, external jugular vein
13. Separation and preservation of serum: Liquid Storage using preservative and by sterilization

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ZGFS6013: SPECIALIZATION LAB I- FISHERY SCIENCE (2 CREDITS: 30 HOURS/ L-T-P: 0-0-2)

COURSE OUTCOMES (CO)
1. Identify commercially important fish species of Northeast India. (Applying)
2. Prepare fish bones using various techniques. (Analyzing)
3. Analyze various biological parameters of fish. (Analyzing)
4. Determine various indices of fish. (Evaluating)
5. Create reports on visits to fish landing centres and fish farms. (Creating)

**Syllabus**

1. Identification of commercially important fish species of north east India representing all fish groups
2. Fish osteology — preparation of fish skeleton (using KOH and Trypsin).
3. Biological Analysis of fish samples for gut contents, maturity stages and fecundity
4. Dissecting out the pituitary gland and preparing the extract, Weberian Ossicle.
5. Determination of length-weight analysis in fishes.
6. Determination of gonado somatic index (GSI), hepatosomatic index(HSI), condition factor(CF), and fecundity.
7. External characters, types of scales, fins, types of teeth, structure of alimentary canal, gill rakers.
8. Visit to fish landing centre and fish farms and make Reports of visit

### Mapping of COs to Syllabus

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**ZGAW6014: SPECIALIZATION LAB I - ANIMAL ECOLOGY AND WILDLIFE BIOLOGY [2 CREDITS: 30 HOURS, L-T-P: 0-0-2]**

**Course Outcome**

1. Identify different flora and fauna (Applying).
2. Applying ecological sampling techniques (Applying)
3. Create and Analyse animal behavior (Analyzing, Creating)
4. Identify different successional stages (Applying)
5. Evaluate species diversity and similarity between communities (Analyzing)
6. Create field reports by studying different protected areas (Creating)

**Syllabus:**

1. Identification of species of butterfly, fishes, amphibia, reptilia, aves and mammalia from collection/model/photographs etc.
2. Identification of fish, amphibian and reptiles (local fauna) using Morphometric landmarks.
3. Ecological Sampling techniques: a) point transect, b) line transects, c) belt transect,
4. Behavioural study through Ethogram preparation
5. Time and Activity budgeting using Focal/Scan sampling.
7. Study of successional stages of various forest communities.
8. Measuring diversity using Diversity:
   a) Diversity Indices: Shannon Weinier Index, Brillouin’s index, Simpson index.
   b) Similarity Indices: Morisita’s index, Sorenson's coefficient, Sorenson’s and Dice index, Jaccard index
   c) Dissimilarity indices: Bray-Curtis, Ochiai index
9. Report Submission: Study of nearby protected areas (forests and grasslands) under various management regimes and makea report

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**ZGEE6015: SPECIALIZATION LAB II – ENTOMOLOGY AND ENVIRONMENTAL BIOLOGY [2 CREDITS, L-T-P: 0-0-2]**

**Course Outcomes**

1. To categorize aquatic, terrestrial and boring insects (Analysing)
2. To Identify different pests of insects, insects of forest importance and forest defoliator (Analysing)
3. To identify major vector species of insects (Analysing)
4. Demonstrate phylogenetic tree (Understanding)
5. Develop a sound knowledge on basic aspects of physiology of different systems (Applying)

**Syllabus:**

ADBU| Regulations and Syllabus|2021-22| 409
1. Alimentary canal of house fly with crop
2. Bacterial chamber of termite
3. Pharyngeal, labial and thoracic salivary gland of honey bee
4. Sting apparatus of honey bee
5. Identification of aquatic, terrestrial and boring insects with specific adaptive characteristics.
6. Visit to agricultural field/tea garden and forest for on spot study of pest and damage caused by them
7. Preparation of Phylogenetic tree of Insect species
8. Study of Life Cycle of Mosquito, Housefly, Drosophila
9. Collection and identification of economically important insects and various stages of their life history (using unique representatives)
10. Identification Of Pests (Tea, Jute, Paddy stored grain)
11. Identification and anatomical studies of major vector species of Anopheles, Culex and Ades

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**ZGCM6016: SPECIALIZATION LAB II- CELL AND MOLECULAR BIOLOGY (2 CREDIT; 30 HRS; 0-0-2)**

**Course outcomes:**
1. Demonstrating the method of separation of various cell organelles. (Understanding)
2. Illustrating the separation of nuclie acid, proteins, and amino acids. (Applying)
3. Qualitative analysis of carbohydrate, protein, lipid, nuclic acid by various methods. (Analysis).
4. Demonstration the method of lymphocyte count. (Applying)

**Syllabus**
1. Tissue homogenization and fractionation by differential centrifugation for isolation of mitochondria, nuclei and cytosol
2. Separation of DNA by agarose gel electrophoresis
3. Separation of proteins on Sodium dodecyl sulphate - polyacrylamide gel electrophoresis
4. Separation of amino acids by Thin Layer Chromatography.
5. Detection of Carbohydrate (a) PAS method/(b) Alcian blue method
6. Detection of Proteins (a) Mercury bromophenol blue method/(b) Ninhydrin method
7. Detection of Lipids (a) Phosphomolybic acid method/(b) Copper phthalocyanine method
8. Detection of DNA by Feulgen method and differential detection of DNA and RNA in a cell by Methyl green- Pyronin method.
9. Isolation and vital staining of lymphocytes obtained from spleen and lymph nodes of sensitized animals

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**ZGFS6017: SPECIALIZATION LAB II- FISHERY SCIENCE (2 CREDITS: 30 HOURS/ L-T-P: 0-0-2)**

**Course Outcomes**
1. Evaluate the physicochemical parameters of water samples. (Evaluating)
2. Estimate and determine productivity of water bodies and its biotic components. (Evaluating)
3. Analyze important fish parasites. (Analyzing)
4. Develop efficient fishing tools for sustainable utilization of the resources. (Creating)
5. Create reports on the study of freshwater bodies and fish processing centre. (Creating)

**Syllabus**
1. Analysis of water samples for various physicochemical parameters–pH, freeCO2, dissolved oxygen, alkalinity, chloride, hardness, nitrates, phosphates, BOD, COD
2. Estimation of primary productivity by light and dark method.
3. Composition and biomass of phytoplankton, Collection, enumeration and biomass of Zooplankton
4. Identification of important fish parasites (external and internal).
5. Identification of fishing gears and fish by products.
6. Fieldwork: Visit to fresh water bodies, study of physico-chemical and biological status and make a report
7. Visit fish processing centers and make a report.

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### Course: ZGEB6018: BIOSYSTEMATICS AND ENVIRONMENTAL BIOLOGY LAB (2 CREDITS) (L-T-P: 0-0-2)

#### Syllabus:
1. Collection, preservation, curation and identification of non-chordata and chordate species (only pest and cultured species)
2. Identification with only diagnostic features (specimen or model/diagnostic photograph) of different phyla
3. Survey and application of biodiversity indices on animal species (any one group)
4. Calculation of Pearson correlation coefficient, T-test (One sample t-test, Two sample t-test, Paired t-test); Chi square test, ANOVA, Mann-Whitney test on supplied data.
5. Preparation of Taxonomic key, study of evolution through models/charts.
6. Sequence alignments, Blastn, Blastp, Psi-Blast, Clustal Omega
7. Homology modeling
8. Phylogenetic Analysis using academic software
10. Study of zooplanktons and its role in a pond ecosystem.
11. Analysis of physical parameters of soil.
12. Study of different types of survey techniques

Mapping of COs to Syllabus

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ZGC6020: CELL BIOLOGY, GENETICS AND BASIC BIOINFORMATICS LAB (2 CREDITS) (L-T-P:0-0-2)

Course Outcomes
1. Demonstrate laboratory safety protocols. (Understanding)
2. Identify laboratory equipment and their uses. (Remember)
3. Interpret cell division and the stages. (Understanding)
4. Analyze macromolecules using electrophoretic techniques. (Analyzing)
5. Apply bioinformatics tools to archive, retrieve, and analyze biological data. (Analyzing)

Syllabus
1. Use and care and maintenance of common lab equipment (microscope, colorimeter/ spectrophotometer, balance, pHmeter, oven, incubator, microtome, electrophoretic apparatus, centrifuge, water bath etc.) and glass wares.
2. Identification of various stages of mitosis and meiosis from prepared slides.
3. Temporary squash preparation of onion root-tip/tadpole tail-tip cells to study stages of mitosis and Grasshopper/ Gryllotalpa testis to study meiotic stage of cell division.
4. Comparison of RBC and WBC in different groups of Vertebrate.
5. Isolation of DNA from any animal source.
6. Agarose Gel electrophoresis of isolated genomic DNA.
7. Usage of NCBI resources
8. Usage/Retrieval of sequence/structure from databases
9. Visualization of structures
10. Protein Docking and Docking of ligand receptors

Mapping of COs to Syllabus

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ZGDB6021: DEVELOPMENTAL BIOLOGY AND BIOCHEMISTRY LAB (2 CREDITS: 30 HOURS) (L-T-P: 2-0-0)

Course Outcomes
1. Compare the differences between developmental stages of chick embryo. (Evaluating)
2. Identify characteristic features of different phases of the mouse estrous cycle. (Applying)
3. Utilize microtomy in histological study of different tissues (Applying)
4. Determine the physiological amounts of important biological macromolecules and plant antioxidant property through various estimation methods. (Evaluating)
5. Apply Henderson-Hasselbalch Equation for preparing buffers. (Applying)

Syllabus
1. In vivo/in vitro culture and study of chick embryo.
2. Study of developmental stages of Chick embryo from permanent slides.
3. Study of different stages of estrous cycle in mice.
4. Tissue processing, sectioning, staining, analysis of histological tissues
8. Estimation of glucose in serum by glucose oxidase peroxidase method/tissue by Anthrone reagent

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ZGEP6022: ETHOLOGY AND POPULATION GENETICS LAB (2 CREDITS: 30 HOURS) (L-T-P: 0-0-2)

Course Outcomes
1. Compare different types of behavior and analyze the methods of behavior sampling. (Evaluating)
2. Identify characteristic features of social organization in primates and analyze inclusive fitness. (Applying)
3. Construct gene frequencies using Hardy Weinberg Law. (Creating)
4. Determine food preferences in fish or insects. (Evaluating)
5. Distinguish behavioral changes in zooplanktons in relation to temperature and chemicals. (Analyzing)

Syllabus
1. Identification of different behavioral types (States and Events) in any group of animals.
2. Preparation of behavioral catalog (Ethogram)
3. Behavioral sampling Techniques: Scan animal Sampling, Focal animal sampling
4. Time and activity budgeting
5. Social organisation in primates
7. Thermotactic behaviour in Zooplanktons/ Earthworm
8. Chemotactic behaviour in Zooplanktons/ Earthworm
10. Study of Deimatic behaviour/ Aposematic behaviour in any group of animals.
11. Analysis of inclusive fitness.

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SERVICE LEARNING IN ZOOLOGY PRACTICAL

Course Outcomes
1. Demonstrate aquaculture practices and techniques. (Applying)
2. Demonstrate techniques in Sericulture. (Applying)
3. Examine what can be learned from the community. (Analyzing)

Syllabus
1. Identification of local potential aquarium fishes
2. Aquarium making and management
3. Preparation and setting up of aquarium
4. Rearing of Eri silkworm
5. Identification of silkworm pests

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ZGPP6101 – NON-CHORDATES I: PROTISTA TO PSEUDOCOELOMATES LAB (2 CREDITS: 30 HOURS/ L-T-P: 0-0-2)

Course Outcomes
1. Identify and classify the specimens under the protists and pseudocoelomates (Applying).
2. Discover and identify the diversity of Protists in different areas (Analysing).
3. Analyze the pathogenicity of selected non-chordate/ pseudocoelomate organisms (Analyzing).
4. Create the permanent slides of specimens (Creating).
5. Design a project for any related topic (Creating).

Syllabus
1. Study of whole mount of Euglena, Amoeba and Paramecium, Binary fission and Conjugation in Paramecium
2. Examination of pond water collected from different places for diversity in protista
3. Study of Sycon (T.S. and L.S.), Hyalonema, Euplectella, Spongilla
4. Study of Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora
5. One specimen/slide of any ctenophore
6. Study of adult Fasciola hepatica, Taenia solium and their life cycles (Slides/microphotographs)
7. Study of adult Ascaris lumbricoides and its life stages (Slides/micro-photographs)


Suggested Readings

Mapping of COs to Syllabus

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ZGPE6102 – PERSPECTIVES IN ECOLOGY LAB (2 CREDITS: 30 HOURS/ L-T-P: 0-0-2)

Course Outcomes
1. Investigate life tables and survivorship curves of different types (Analyzing).
2. Estimate and analyze different population dynamics and interactions (Analyzing).
3. Evaluate the aquatic ecosystem (Evaluating).
4. Design a project for any related topic (Creating).

Syllabus
1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
2. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler’s method), Chemical Oxygen Demand and free CO₂
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

Suggested Readings
4. Robert Leo Smith Ecology and field biology Harper and Row publisher

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414 | ADBU | Regulations and Syllabus | 2021-22
ZGCL6103 – NON-CHORDATES II: COELOMATES LAB (2 CREDITS: 30 HOURS/ L-T-P: 0-0-2)

Course Outcomes
1. Examine and investigate different species of non-chordate (Analyzing).
2. Examine various systems of non-chordate species (Analyzing).
3. Differentiate different parts of body thorough prepared slides (Analyzing).
4. Design a project for any related topic (Creating).

Syllabus
2. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm
3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm
4. Mount of mouth parts and dissection of digestive system and nervous system of Periplaneta*
5. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)


Suggested Readings

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ZGCB6104 – CELL BIOLOGY LAB (2 CREDITS: 30 HOURS/ L-T-P: 0-0-2)

Course Outcomes
1. Create the temporary stained slides of different stages of cell division (Creating).
2. Investigate various stages of meiotic cell division (Analyzing).
3. Create the permanent slides to investigate various structural components inside the cell (Analyzing).

Syllabus
1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
4. Preparation of permanent slide to demonstrate:
   i) DNA by Feulgen reaction
   ii) DNA and RNA by MGP
   iii) Mucopolysaccharides by PAS reaction
   iv) Proteins by Mercurobromophenol blue/Fast Green

Suggested Readings
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ZGAD6105: ANIMAL DIVERSITY LAB (2 CREDITS) (L-T-P: 0-0-2)

Course Outcome
1. To familiar with the different types of invertebrate and vertebrate with the help of the preserved specimen available in the laboratory. (Applying)
2. To learn the techniques how to prepare the permanent slides. (Applying)
3. To understand the integument system with the help of preparing temporary slides. (Applying)
4. To know digestive system and nervous system with the help of dissections. (Understanding)

Syllabus:
3. Temporary mounts of Septal & pharyngeal nephridia of earthworm. Unstained mounts of Placoid, cycloid and ctenoid scales.
4. Dissections of Digestive and nervous system of Cockroach or Urinogenital system of Rat

Mapping of COs to Syllabus

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Suggested Readings

ZGEP6106: ENVIRONMENT AND PUBLIC HEALTH LAB (2 CREDITS) (L-T-P: 0-0-2)

Course Outcome
1. To learn the procedure to find out the pH, Cl, SO₄ and NO₃ of soil of different location. (Applying)
2. To learn the procedure of determination of pH, DO and CO₂ in pond water. (Applying)

Syllabus
1. To determine pH, Cl, SO₄, NO₃ in soil samples from different locations.
2. To determine pH, CO₂, DO, Transparency and NO₃ in water samples from different locations.

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ZGDC6107: DIVERSITY OF CHORDATES LAB (2 Credits: 30 hours) (L-T-P: 0-0-2)

Course Outcomes
1. Identify distinguishing characteristics of representative museum specimens belonging to different phyla. (Applying)
2. Determine their affinities and evolutionary relationships. (Evaluating)
3. Examine specific organ structures through dissections. (Analyzing)

**Syllabus**
1. Protocordata: Balanoglossus, Herdmania, Branchiostoma, Colonial Urochordata
   Sections of Balanoglossus through proboscis and branchiogenital regions, Sections of Amphioxus through pharyngeal, intestinal and caudal regions. Permanent slide of Herdmania spicules
2. Agnatha: Petromyzon, Myxine
3. Pieces: Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas, Flat fish
5. Reptilia: Chelone, Trionyx, Hemidactylus, Varanus, Uromastyx, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus Key for Identification of poisonous and non-poisonous snakes
6. Aves: Study of six common birds from different orders. Types of beaks and claws
7. Mammalia: Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestes, Erinaceous. Mount of weberian ossicles of Mystus, pector from Fowl head Dissection of Fowl head (Dissections and mounts subject to permission) Powerpoint presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)

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**ZGAP6108: ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS LAB (2 CREDITS: 30 HOURS) (L-T-P: 0-0-2)**

**Course Outcomes**
1. Estimate specific physiological functions of muscle tissues (Applying)
2. Compare structural organization of various tissue through temporary and permanent slides. (Evaluating)
3. Utilize the process of microtomy to visualize histological structures in different mammalian tissues. (Applying)

**Syllabus**
1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
4. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
5. Microtomy: Preparation of permanent slide of any five mammalian (Goat/white rat) tissues (*Subject to UGC guidelines)

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**ZGFB6109: FUNDAMENTALS OF BIOCHEMISTRY LAB (2 CREDITS) (L-T-P: 0-0-2)**

**Course Outcomes**
1. Estimate biochemical functional groups of different macromolecules. (Evaluating)
2. Develop chromatography and electrophoresis skills for separation of amino acids and proteins (Evaluating)
3. Determine the enzyme kinetics of given enzyme: salivary amylase. (Evaluating)

**Syllabus**
1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
3. Action of salivary amylase under optimum conditions.
5. Demonstration of proteins separation by SDS-PAGE.

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ZGCA6110: COMPARATIVE ANATOMY OF VERTEBRATES LAB (2 Credits) (L-T-P: 0-0-2)

Course Outcomes
1. Compare the different types of scales. (Analyzing)
2. Demonstrate the structural and functional similarities and differences of these organ systems amongst different vertebrate groups (Understanding)
3. Compare the functioning of these organ systems from lower to higher vertebrates (Understanding)
4. Identify internal organs. (Applying)

Syllabus
1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Disarticulated skeleton of Frog, Varanus, Fowl, Rabbit
3. Carapace and plastron of turtle/tortoise
4. Mammalian skulls: One herbivorous and one carnivorous animal
5. Dissection of rat to study arterial and urogenital system (subject to permission)
6. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted)
7. Project on skeletal modifications in vertebrates (may be included if dissection not permitted)

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ZGAS6111: ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS LAB (2 CREDITS) (L-T-P: 0-0-2)

Course Outcomes
1. Develop Skills to Determine Basic Blood Parameters As A Measure Of A Vigorous Physiological System (Applying)
2. Examine the anatomy of various internal organs. (Analyzing)

Syllabus
1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli’s haemoglobinometer
4. Preparation of haemin and haemochromogen crystals
5. Recording of frog’s heart beat under in situ and perfused conditions
6. Recording of blood pressure using a sphygmomanometer
7. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney (*Subject to UGC guidelines)

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ZGBM6112: BIOCHEMISTRY OF METABOLIC PROCESSES (2 CREDITS) (L-T-P: 0-0-2)

Course Outcomes
1. Estimation of protein content (Evaluating)
2. Interpretation of enzyme activity (Evaluating)
3. Determination of metabolic pathways (Evaluating)

Syllabus
1. Estimation of total protein in given solutions by Lowry’s method.
2. Detection of SGOT and SGPT or GST and GSH in serum/ tissue
3. To study the enzymatic activity of Trypsin and Lipase.
4. Study of biological oxidation (SDH) [goat liver]
5. To perform the Acid and Alkaline phosphatase assay from serum/tissue.
6. Dry Lab: To trace the labelled C atoms of Acetyl-CoA till they evolve as CO₂ in the TCA cycle

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ZGMB6113: MOLECULAR BIOLOGY LAB [2 CREDITS: 30 HOURS, L-T-P: 0-0-2]

Course Outcome:
1. Explain the structure of chromosome. (Understanding)
2. Design the growth medium and estimate growth kinetics. (Creating)
3. Demonstrate antibiotic resistance and sensitivity. (Understanding)
4. Estimation of DNA and RNA using different analytical tools. (Evaluating)
5. Interpret the micrographs of DNA replication and split genes. (Understanding)

Syllabus:
1. Study of Polytenes chromosomes from Chironomous / Drosophila larvae
2. Preparation of liquid culture medium (LB) and raise culture of E. coli
3. Estimation of the growth kinetics of E. coli by turbidity method
4. Preparation of solid culture medium (LB) and growth of E. coli by spreading and streaking
5. Demonstration of antibiotic sensitivity/resistance of E. coli to antibiotic pressure and interpretation of results
6. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement)
7. Quantitative estimation of RNA using Orcinol reaction
8. Study and interpretation of electron micrographs/ photograph showing (a) DNA replication (b) Transcription (c) Split genes

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ZGPG6114: PRINCIPLES OF GENETICS LAB [2 CREDITS: 30 HOURS, L-T-P: 0-0-2]

Course Outcome:
1. Explain the laws of Inheritance. (Evaluating)
2. Analyze organisms trait using Chi Square test. (Analyzing)
3. Construct linkage maps (Applying)
4. Construct human karyotype (Applying)
5. Constructing and analyzing pedigree for inherited traits. (Applying)

Syllabus:
1. To study the Mendelian laws and gene interactions.
2. To study the traits using Chi-square analyses [seeds/beads/Drosophila].
3. Linkage maps based on data from conjugation, transformation and transduction.
4. Linkage maps based on data from Drosophila crosses.
5. Study of human karyotype (normal and abnormal).
6. Pedigree analysis of some human inherited traits.

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ZGWM6115: WILDLIFE CONSERVATION AND MANAGEMENT LAB [2 CREDITS: 30 HOURS, L-T-P: 0-0-2]
Course Outcome:
1. Identify different flora and flora. (Applying)
2. Demonstrate and apply the equipment used for wildlife studies. (Understanding, applying)
3. Analyze animal signs (Analyzing)
4. Explain different field techniques (Understanding)
5. Perform vegetation analysis (Analysis)
6. Apply different survey techniques (Applying)

Syllabus:
1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spottingscope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna
5. PCQ, Ten tree method, Circular, Square & rectangular plots, Parker’s 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

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ZGAC6116: ANIMAL BEHAVIOUR AND CHRONOBIOLOGY LAB [2 CREDITS: 30 HOURS, L-T-P: 0-0-2]

Course Outcome:
1. Explain different types of nests and nesting habits. (Understanding)
2. Analyse different types of behavioral responses (Analyzing)
3. Create field reports with observational data (Creating)
4. Construct actogram for locomotory activity (Creating)
5. Analyse circadian rhythms (Analyzing)

Syllabus:
1. To study nests and nesting habits of the birds and social insects.
2. To study the behavioural responses of wood lice to dry and humid conditions.
3. To study geotaxis behaviour in earthworm.
4. To study the phototaxis behaviour in insect larvae.
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.
6. Study and actogram construction of locomotor activity of suitable animal models.
7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

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ZGCB6117: COMPUTATIONAL BIOLOGY LAB [2 CREDITS: 30 HOURS, L-T-P: 0-0-2]

Course Outcome:
1. Choose different types of databases for their study (Applying)
2. Analyze nucleotide and protein sequences (Analyzing)
3. Make use of different bioinformatics software (Applying)
4. Analyse nucleotide sequences (Analyzing)
5. Evaluate various statistical methods in data analysis and interpretation
Syllabus
1. Accessing biological databases
2. Retrieval of nucleotide and protein sequences from the databases.
3. To perform pair-wise alignment of sequences (BLAST) and interpret the output
4. Translate a nucleotide sequence and select the correct reading frame of the polypeptide from the output sequences
5. Predict the structure of protein from its amino acid sequence.
6. To perform a “two-sample t-test” for a given set of data
7. To learn graphical representations of statistical data with the help of computers (e.g. MS Excel).

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ZGA6118: ANIMAL BIOTECHNOLOGY LAB [2 CREDITS: 30 HOURS, L-T-P: 0-0-2]

Course Outcomes:
1. Explain and perform the process of DNA isolation (Understanding, Applying)
2. Experiment with DNA with different enzymes (Applying)
3. Construct restriction maps and analyse transformation efficiency (Creating)
4. Explain and interpret different biological techniques (Understanding)
5. Create report on methods of cell culture (Creating)

Syllabus:
1. Genomic DNA isolation from E. coli
2. Plasmid DNA isolation (pUC 18/19) from E. coli
3. Restriction digestion of plasmid DNA.
4. Construction of circular and linear restriction map from the data provided.
5. Calculation of transformation efficiency from the data provided.
6. To study following techniques through photographs
   a) Southern Blotting
   b) Northern Blotting
   c) Western Blotting
   d) DNA Sequencing (Sanger’s Method)
   e) PCR
   f) DNA fingerprinting
7. Project report on animal cell culture

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ZGDB6119: DEVELOPMENTAL BIOLOGY LAB (2 CREDITS; 30HRS; 0-0-2)

Course Outcome:
1. To demonstrate the mechanisms underlying the process of development. (Understanding).
2. To explain different histological structure of placenta. (Understanding)
3. To prepare drosophila culture media or make a proper environment to study the chick embryo development. (Creating)

Syllabus:
1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
3. Study of the developmental stages and life cycle of Drosophila from stock culture
4. Study of different histological structures of placenta (photomicrograph/ slides)
5. Project report on Drosophila culture/chick embryo development

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ZGDB6120: EVOLUTIONARY BIOLOGY LAB (2 CREDITS; 30 HRS: 0-0-2)

Course Outcomes
1. To explain the details about fossils from different models. (Understanding).
2. To demonstrate the concept of homology and analogy and Hardy Weinberg Law. (Understanding)
3. To demonstrate the role of various phenomenon of evolution. (Understanding)
4. To create graphical representation of data various physiological data. (Creating)
5. To understand the concept of pohylogenetic tree and construct it. (Understanding and creating)

SYLLABUS
1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies
5. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.
6. Construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, Phylip, NJ) and its interpretation.

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ZGIM6121: IMMUNOLOGY LAB (2 CREDITS; 30 HRS; 0-0-2)

Course Outcomes
1. To describe the structure and function of the lymphoid organ, spleen, thymus, lymph node. (Understand)
2. To prepare blood film for various blood cell studies. (Creating)
3. Develop various methods for blood group determination. (Creating)
4. Demonstration of cell viability test. (Creating)
5. Demonstration of various immunological techniques. (Creating)

Syllabus
1. *Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of blood cells.
5. ABO blood group determination.
6. * Cell counting and viability test from splenocytes of farm bred animals/cell lines.
7. Demonstration of:
   a) ELISA
   b) Immunoelectrophoresis
   * The experiments can be performed depending upon usage of animals in UG courses.

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ZGPA6122: PARASITOLOGY LAB (2 CREDITS; 30 HRS; 0-0-2)
Course Outcomes
1. To demonstrate the life cycle of various invertebrate species. (Understanding)
2. To demonstrate various types of gills from marine and fresh water fish. (Creating)
3. To demonstrate the structure of nematode from intestine of poultry bird. (creating)

Syllabus
1. Study of life stages of Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani and Plasmodium vivax through permanent slides/micro photographs
2. Study of adult and life stages of Fasciolopsis buski, Schistosoma haematobium, Taenia solium and Hymenolepis nana through permanent slides/micro photographs
3. Study of adult and life stages of Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti and Trichinella spiralis through permanent slides/micro photographs
4. Study of plant parasitic root knot nematode, Meloidogyne from the soil sample
5. Study of Pediculus humanus (Head louse and Body louse), Xenopsylla cheopis and Cimex lectularius through permanent slides/photographs
6. Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
7. Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market asa byproduct]

*Submission of a brief report on parasitic vertebrates*

Mapping of COs to Syllabus

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**ZGFF6123: FISH AND FISHERIES LAB (2 CREDITS; 30 HRS; 0-0-2)**

Course Outcomes
1. To describe the morphological characters of fishes. (Understanding)
2. To demonstrate different fish species and fishing gears. (Understanding)
3. To demonstrate different types of scales. (Understanding)
4. To analyze the water quality by using various parameters. (Analyzing)
5. To demonstrate mechanism of breeding and breeding organ of fishes. (Understanding).
6. To describe the concept of induced breeding and parental care in fishes. (Understanding)
7. To prepare a report of any fish farm or rearing unit. (Creating)

Syllabus
1. Morphometric and meristic characters of fishes
2. Study of Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas
3. Study of different types of scales (through permanent slides/photographs).
4. Study of crafts and gears used in Fisheries
5. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
6. Study of air breathing organs in Channa, Heteropneustes, Anabas and Clarias
7. Demonstration of induced breeding in Fishes (video)
8. Demonstration of parental care in fishes (video)

Mapping of COs to Syllabus

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**ZGBI6124 BIOLOGY OF INSECTA LAB (2 CREDITS; 30 HRS; 0-0-2)**

Course Outcomes
1. To demonstrate on specimen from each order. (Understanding)
2. To demonstrate various morphological characteristics of insects. (Understanding)
3. Explain various taxonomic techniques. (Understanding)
4. Explaining different types of pest. (Applying)
5. Prepare a report on beneficial effect of insects. (Creating)

Syllabus
1. Study of one specimen from each insect order
2. Study of different kinds of antennae, legs and mouth parts of insects
3. Study of head and sclerites of any one insect
4. Study of insect wings and their venation.
5. Study of insect spiracles
7. Morphological studies of various castes of Apis, Camponotus and Odontotermes
8. Study of any three insect pests and their damages
9. Study of any three beneficial insects and their products Field study of insects and submission of a project report on the insect diversity.

Mapping of COs to Syllabus

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FOUNDATIONS OF SERVICE LEARNING PRACTICAL (2 CREDITS)(L-T-P: 0-0-2)

Course Outcomes
1. Demonstrate waste management practices. (Applying)
2. Demonstrate proper health and hygiene practices. (Applying)
3. Examine what can be learned from the community. (Analyzing)

Syllabus
1. Identification and segregation of waste in designated bins
2. Composting of biodegradable waste
3. Visit to nearby school and demonstration of personal hygiene habits
4. Awareness Programme on breeding grounds
5. of vectors and their control.

Mapping of COs to Syllabus

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DEPARTMENT OF BOTANY

PROGRAM OUTCOMES- BSc Programme
PO 1: Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO 2: Effective Communication: Speak, read, write and listen clearly in person and through electronic media, and make meaning of the world by connecting people, ideas, books, media and technology.
PO 3: Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO 4: Effective Citizenship: Demonstrate empathetic social concern and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO 5: Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO 6: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
PO 7: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PROGRAMME SPECIFIC OUTCOMES (PSO)-BSc Botany (Honours)
PSO 1: Understand the principles of identification and classification of various plants groups and microbes according to their morphology, anatomy and reproductive biology
PSO 2: Understand the fundamental principles of life processes, biomolecules and genetic make-up
PSO 3: Assessment of biodiversity, identification of the core threats to biodiversity and development of conservation strategies
PSO 4: Familiarization with various classical and advanced laboratory techniques in plant biology

COURSES OFFERED IN BSc Botany (Honours)
1.1 Algae and Microbiology
1.2 Algae and Microbiology Lab
1.3 Biomolecules and Cell Biology
1.4 Biomolecules and Cell Biology Lab
1.5 Biodiversity (Microbes, Algae, Fungi and Archegoniate) (GE1)
1.6 Biodiversity (Microbes, Algae, Fungi and Archegoniate) Lab (GE)
1.7 Plant Anatomy and Embryology (GE2)
1.8 Plant Anatomy and Embryology Lab (GE)
1.9 Service learning on ethno botanical practices
2.1 Mycology and Phytopathology
2.2 Mycology and Phytopathology Lab
2.3 Archegoniate
2.4 Archegoniate Lab
2.5 Plant Ecology and Taxonomy (GE)
2.6 Plant Ecology and Taxonomy Lab (GE)
3.1 Morphology and Anatomy
3.2 Morphology and Anatomy Lab
3.3 Economic Botany
3.4 Economic Botany Lab
3.5 Genetics
3.6 Genetics Lab
3.7 Plant Physiology and Metabolism (GE1)
3.8 Plant Physiology and Metabolism Lab
3.9 Environmental Biotechnology (GE2)
3.10 Environmental Biotechnology Lab
3.11 Ethno botany (Skill development 1)
3.12 Intellectual Property Rights (Skill development 2)
4.1 Molecular Biology
4.2 Molecular Biology Lab
4.3 Plant Ecology and Phytogeography
4.4 Plant Ecology and Phytogeography Lab
4.5 Plant Systematics
4.6 Plant Systematics Lab
4.7 Biofertilizers (Skill development 1)
4.8 Medicinal Botany (Skill development 2)
4.9 Economic Botany and Biotechnology (GE)
4.10 Economic Botany and Biotechnology Lab (GE)

5.1 Reproductive Biology of Angiosperms
5.2 Reproductive Biology of Angiosperms Lab
5.3 Plant Physiology
5.4 Plant Physiology Lab
5.5 Analytical Techniques in Plant Science (DSE1)
5.6 Analytical Techniques in Plant Science Lab
5.7 Biostatistics (DSE2)
5.8 Biostatistics Lab

6.1 Plant Metabolism
6.2 Plant Metabolism Lab
6.3 Plant Biotechnology
6.4 Plant Biotechnology Lab
6.5 Industrial and Environmental Microbiology (DSE1)
6.6 Industrial and Environmental Microbiology Lab
6.7 Bioinformatics (DSE2)
6.8 Bioinformatics Lab

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PROGRAM OUTCOMES (POs)- MSC BOTANY

PO 1: **Reasoning and Reflective Thinking**: Will enable in identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at the concepts and decisions from different perspectives.

PO 2: **Productive Communication**: Communication skills through effectual presentations and interactive sessions in the class.

PO 3: **Community based Interactivity**: Knowledge of the community and health issues that plague the modern society, contributing in their own little ways, showing empathy and spreading awareness.

PO 4: **Effective Volunteering**: Demonstrate empathetic social concern and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO 5: **Morality**: Recognize different value systems including our own, understand the moral dimensions of our decisions, and accept responsibilities for them.

PO 6: **Ecological Feasibility**: Understand the issues of environmental contexts and sustainable development.

PO 7: **Independent and Long-Lasting Education**: Interest in reading quality books so as to engage in a life-long learning process, helping all along the way, beginning with home and reaching society.

PO 8: **Skill Development**: Develop expertise needed for teaching and research, problem-solving skills to help generate confidence for a more functional life.

PO 9: **Entrepreneurship**: Prepare for entrepreneurship, self-employability and setting up of start-ups.

PO 10: **Creative Thinking**: Propagation of creative technologies and novel ideas in biological science for betterment of the society.

PROGRAMME SPECIFIC OUTCOMES (PSOs)-MSC BOTANY

PSO 1: Differentiate plant groups and microbes according to their morphology, anatomy and genetics.

PSO 2: Understand the advanced concept of plant taxonomy, physiology, biochemistry, molecular biology and ecology of plants and microbes.

PSO 3: Learn practical techniques for insightful study of plant cell structure, reproduction, anatomy, breeding procedures for hybridization. Maintain a high level of scientific excellence in botanical research with specific emphasis on the role of plants.

PSO 4: Adapt scientific methods in plant research and create entrepreneurs. Prepare students for competitive exams.

Courses offered in MSC BOTANY

3.1 Mycology and Phycology
3.2 Bryophytes, Pteridophytes and Gymnosperms
3.3 Angiosperms
3.4 Phycology & Mycology Lab
3.5 Bryophytes, Pteridophytes, Gymnosperms & Angiosperms Lab
4.1 Cell and Molecular Biology
4.2 Plant Physiology and Biochemistry
4.3 Plant Microbiology and Plant Pathology
4.4 Cell and Molecular Biology, Plant Physiology and Biochemistry Lab
4.5 Plant Microbiology and Plant Pathology Lab
5.1 Cytogenetic and Plant Breeding
5.2 Plant Ecotone and Phytogeography
5.3 Biochemicals, Molecular Techniques and Bioinformatics
5.4 Plant Cell and Tissue Culture
5.5 Cytogenetics, Molecular Techniques and Tissue Culture Lab
5.6 Plant Ecology Lab
6.1 Environmental Management, Research Methodology and Biostatistics
6.2 Departmental Elective/Specialization Paper 1
6.3 Departmental Elective/Specialization Paper 2

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THEORY COURSES

BOMP0021: MYCOLOGY AND PHYCOLOGY
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course outcomes
At the end of this course, student will be able to:
1. Understand general characteristics, classification and economic importance of fungi and algae (Remembering)
2. Able to compare the vegetative and reproduction structures among groups of fungi and algae (Understanding)
3. Able to tell the importance of algae in environment and agriculture (Evaluating)
4. Develop scientific skill sets in and implement in agriculture (Applying)

Module I: Introduction (4 Hours)
Introduction, history, general features and economic importance of fungi

Module II: Classification of fungi (20 Hours)
Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina- important features; thallus organizations; modes of reproduction

Module III: Role of Fungi in agriculture and environment (4 Hours)
Mycorrhizal associations and Lichens-their importance to agriculture and environment; Fungi as bio-fertilizers

Module IV: Introduction to algae (4 Hours)
History; general description; systems of classification and economic importance of algae

Module V: Classification of algae (20 Hours)

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Module VI: Role of algae in agriculture and environment (4 Hours)
Algal blooms - its importance; Algae as feed; bio-fertilizers; pollution indicators

Module VII: Research on Fungi and algae (4 Hours)
Current and future research; Future prospects/scopes in these areas

Suggested Readings
3. Aneja KR. Mehrotra RS. Introduction to Mycology, New Age International Publisher.
5. Smith AL. Lichens, Wentworth Press.
8. Bilgrami, K.S. and Saha, L.C. A textbook of Algae, CBS.

Mapping of COs to Syllabus

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BOBP0022: BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Summarize the general characteristics, morphological and reproductive diversity among different groups of Bryophytes (Understanding)
2. Compare the general characteristics, morphological and reproductive diversity among different groups of Pteridophytes (Understanding)
3. Interpret the general characteristics, morphological and reproductive diversity among different groups of Gymnosperms (Understanding)
4. Identify the different economic importance of the Bryophytes, Pteridophytes and Gymnosperms (Applying)
5. Infer fossils and fossilization (Understanding)

Module I: Bryophytes (20 Hours)
General introduction, Classification of Bryophytes; evolutionary history and phylogenetic characterization of bryophytes; comparative account of gametophyte and sporophyte structure of Hepaticopsida, Bryopsida and Anthocerotopsida; Peristome structure and its significance in the classification of Mosses; Economic importance of Bryophytes

Module II: Pteridophytes (20 Hours)
General introduction, Classification and range of thallus of Pteridophytes; evolutionary history and phylogenetic characterization of pteridophytes; early vascular plants; a brief account of the following classes of Pteridophytes: Psilotopsida, Lycopsida, Sphenopsida, Pteropsida; Telome concept, apogamy and apospory, heterospory and seed habit; Economic importance of Pteridophytes

Module III: Gymnosperms (15 Hours)
General introduction, Classification of Gymnosperms; Comparative study of Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales; Economic importance of Gymnosperms

Module IV: Paleo-botany (5 Hours)
Introduction, Fossils, Kinds of fossils and process of fossilization; Geological time scale; Importance of fossils

Suggested Readings
Mapping of COs to Syllabus

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**BOAN0023: ANGIOSPERMS**  
(4 Credits-60 Hours) (L-T-P: 4-0-0)

**Course Outcomes**  
At the end of this course, student will be able to:
1. Understand the concepts of plant identification, classification, nomenclature (Understanding)
2. Understand the general morphology and distinguishing characteristics of different angiosperm families (Understanding)
3. Identification of dicotyledons and monocotyledons plants with reference to specific key characters (Applying)
4. Understand the internal organization of the tissue and cell structure of both vegetative and floral parts of angiosperm plants (Understanding)
5. Understand the development of gametophytes, fertilization, endosperm, embryo, apomixis and parthenocarpic inangiospermic families (Understanding)
6. Application of anatomy and embryology in taxonomy (Applying)

**Module I: Taxonomy (12 Hours)**  
History of plant taxonomy; Methods of Plant identification; Taxonomic Keys: Single access and Multi-access; Field inventory; Collection; Herbaria: Functions of Herbarium, Preparation of Herbarium; Major systems of classification: Cronquist(1981); Takhtajan’sSystem (1997), APG IV (2016) (merits and demerits). Principles and rules of Botanical Nomenclature

**Module II: Morphology (8 Hours)**  
Vegetative Characters: Modified Roots and Stems; Leaf Phyllotaxy, Venation; Trichomes. Reproductive Characters: Floral parts, Arrangements of flowers on the floral axis, Unisexual and Bisexual Flowers, Variation in fruit surface, Placentation, Variation in seed coats

**Module III: Angiospermic Families (15 Hours)**  

**Module IV: Anatomy(10 Hours)**  
Meristem, Classification of meristems; Permanent tissue; Theory of shoot apical meristem and root apical meristem; Origin, structure and function of cambium; Primary and secondary structure of root and stem, Anomalous secondary growth in roots and stems. Cork cambium and its derivatives, function of cork and abscission layers. General structure of plants; cell wall, stomata and secretary structure; Anatomy of floral organs; Anatomy in relation to taxonomy

**Module V: Embryology (15 Hours)**  
Structure of microsporangium, microsporogenesis and development of male gametophyte; Structure of ovule, megasporogenesis and development of female gametophyte; Pollen-Pistil interaction; Fertilization and its control; Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship; Polyembryony and its induction, Apomixis, causes and significance; Parthenocarp; Embryology in relation to taxonomy

**Suggested Readings**
2. Sharma, O.P. Plant Taxonomy McGraw-Hill Education
3. Nair, R. Taxonomy of Angiosperms APH Publishing Corporation
5. Lawrence, G.H.M. Taxonomy of Vascular Plants Scientific Publisher.
9. Pandey, B.P. Plant anatomy, S. Chand & Co., New Delhi

Mapping of COs to Syllabus

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BOCM0024: CELL AND MOLECULAR BIOLOGY
(4 Credits-60 Hours) [L-T-P: 4-0-0]

Course Outcomes
At the end of this course, student will be able to:
1. Memorize the key concepts of cell and its structural organization (Remembering)
2. Analyse the process of DNA replication and compare various repair mechanism (Analysing)
3. Gain better understanding of gene cloning and DNA libraries (Understanding)
4. Understand the basics of gene cloning and importance of genome evolution (Understanding)

Module I: Basics of Cell (4 Hours)
Cell: Concept, structural organization of plant cell.

Module II: Cellular Organelles: Their Organizations and Functions (15 Hours)

Module III: Gene and Genome (6 Hours)
Gene and genome: fine structure of gene, genome organization

Module IV: Enzymes for Gene Manipulations (7 Hours)
DNA/gene manipulating enzymes, restriction enzymes: endonuclease, exonuclease, types of endonucleases, recognition sequences, ligase, polymerase, phosphatase, transcriptase, transferase, topoisomerase

Module V: DNA Replication (7 Hours)
Various models, enzymes for replication, structure of DNA polymerase, speed of replication, collaboration of proteins, process and termination of replication

Module VI: DNA Damage and Repair Mechanism (6 Hours)
Basic concept, types of DNA damage thymine dimer, 6- 4 photoproducts, photo-reactivation, excision repair

Module VII: Transposons and Genetic Recombination (8 Hours)

Module VIII: Basics of Gene Cloning (7 Hours)
Gene cloning: cloning vectors (types and characteristics), molecular cloning and construction of DNA libraries

**Suggested Readings**
1. Lewin. Genes. Published by Pearson Prentice Hall
2. Albert. Molecular Biology of Cell
5. Watson J. Molecular Biology of Gene

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**BOPB0025: PLANT PHYSIOLOGY AND BIOCHEMISTRY**

*(4 Credits-60 Hours) (L-T-P: 4-0-0)*

**Course Outcomes**
At the end of this course, student will be able to:
1. Highlights the mechanism of water and mineral transport in plants (Understanding)
2. Apprises students of photosynthesis and transpiration and its importance (Understanding)
3. The course will help students analyze how abiotic stress affects the physiological response, photophysiology-induced responses and role of photoperiodism in flowering process (Analysing)
4. Explain the concepts of energetics, enzyme kinetics and biomolecules metabolisms (Understanding)
5. Analyze the various biochemical reactions and processes undergoing in plants (Analyzing)

**Module I: The Basic Concept and Transport Mechanism (4 Hours)**
Water potential, theories supporting uptake of water: Bose theory, cohesion-adhesion theory, Comparison of xylem and phloem transports, phloem loading and unloading, passive and active transports

**Module II: Photosynthesis and Transpiration (14 Hours)**
Cyclic and non-cyclic photophosphorylation; PSI and PSII system, stages of photosynthesis, light reaction and dark reaction. C3, C4 and CAM pathways, photorespiration, photophosphorylation, factors effecting photosynthesis, types of transpiration, mechanism and factors effecting transpiration

**Module III: Sensory Photobiology and Growth Hormones (8 Hours)**
Discovery of phytochromes and cryptochromes and their photochemical and biochemical properties, molecular mechanism of action of photo morphogenetic receptors, physiological effects and mechanism of action of plant growth hormones, signal transduction and gene expression

**Module IV: Photoperiodism and Physiological Stress (6 Hours)**
The flowering process: endogenous clock and its regulation, ABA model physiological responses to abiotic stresses: light, temperature, water and salts; acclimation of physiological processes under abiotic stresses

**Module V: Thermodynamics and Bioenergetics: (8 Hours)**
Laws of thermodynamics; Gibbs Free Energy; enthalpy, entropy, energy change in coupled reactions energy rich phosphate compounds, energetics of metabolic processes, energy rich phosphate compounds, ATP as universal currency of energy, ATP synthesis

**Module VI: Properties of Water and Enzyme Kinetics (10 Hours)**
Dissociation of water, ion product of water, pH, ionization of weak bases, biological buffers Henderson-Hasselbach Equation. prosthetic groups and co-enzyme, mechanism of catalysis, kinetics, Michaelis-Menten Equation, bisubstrate reaction, active sites, factor contributing to catalytic efficiency, enzyme inhibition, regulatory enzyme, ribozyme

**Module VII: Metabolism of Biomolecules (10 Hours)**
Structures and functions of amino acids, peptides and proteins; lipid: synthesis of saturated and unsaturated fatty acids, oxidations of fatty acid. Carbohydrate- classification, structures, functions, biosynthesis and metabolism;glycolysis, gluconeogenesis, and the pentose phosphate pathway assimilation, transportation and metabolism of sulphur in plants
Suggested Reading

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BOPP0026: PLANT MICROBIOLOGY AND PLANT PATHOLOGY
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Classify various microorganisms and their reproduction and isolation methods (Understanding)
2. Analyze the roles of microorganisms in environment (Analyzing)
3. Identify and detect microbial plant diseases and decide control strategies (Applying)
4. Asses and apply post-harvest controls measures and techniques (Evaluating)

Module I: Introduction to microbial world and microscopy (6 Hours)
A brief history of microbiology and its evolution; Microscopy-principle, types and applications

Module II: Microbial diversity and applications (10 Hours)
Bacteria & Archaebacteria: properties, classification, nutritional types; Viruses- properties and classification, prions and bacteriophages; Role of microorganisms in the environment

Module III: Isolation and cultivation of bacteria and viruses (10 Hours)
Types of nutritional media (Liquid & solid), types of bacterial cultures- batch, continuous and synchronous, growth curve and pure culture of microorganism; Isolation methods of bacteria, virus and phages

Module IV: Microbial Genetics and its life cycle (8 Hours)
Genome organization in microorganism (DNA, RNA, Plasmids); mechanisms of transformation, conjugation and transduction in bacteria; Life cycle of viruses and bacteriophages

Module V: An insight into Plant Pathology (8 Hours)
Historical and developmental aspects of plant pathology, mode of infection and role of enzymes and toxins in plant disease, defense mechanisms of plants against infection

Module VI: Plant diseases & control measures (12 Hours)
Study of plant diseases caused by fungi, bacteria, viruses, nematodes and mycoplasma; approaches for plant disease control- cultural, chemical, biological, bio pesticides, breeding for resistant varieties, plant quarantine, integrated pest management; molecular and transgenic approach for crop protection

Module VII: Post-harvest Management (6 Hours)
Post-harvest pathology: Fungal deterioration of food commodities, mycotoxins and health hazards, control measures; overview of integrated pest management

Suggested Reading
3. Campbell NA, Reece JB, Urry A., Cain L, Wasserman SA, Minorsky PV, Jackson
7. Sambamurty AVSS. A textbook of Plant Pathology, Dreamtech Press, Wiley.
8. Gour HN. Physiological and Molecular Plant Pathology, Scientific Publishers India.
9. Dickinson M. Molecular Plant Pathology, Garland Science

Mapping of COs to syllabus

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BOCP0027: CYTOGENETICS AND PLANT BREEDING
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Infer euukaryotic genome organization structure of nucleosome, its assembly and deassembly (Understanding)
2. Summarize the cytogenetics of haploids and their uses in plant breeding (Understanding)
3. Compare euploids with aneuploids and explain chromosomal banding patterns (Understanding)
4. Illustrate the role of plant breeding and transgenic research in crop improvement (Understanding)
5. Outline the various methods of gene transfer (Understanding)
6. Compare the different types of DNA and also interpret gene mapping (Understanding)

Module I: Overview of Gene and Genome Organization (10 Hours)
Organization of euukaryotic genetic material, Chromatin organization and replication: Chemical constituents-DNA and histones, nucleosome and higher order organization, DNA packaging and genetic activity, nucleosome assembly and deassembly, DNA content and adaptability, nuclear DNA and C-value paradox

Module II: Cytogenetics of Haploids (8 Hours)
Haploidy/monoploidy, meiosis and breeding behaviour of haploids, uses of haploids in plant breeding and genetic studies

Module III: Euploidy and Aneuploidy (10 Hours)
Induction and characterization of monosomics, trisomics and nullisomics, aneupoloid gene mapping, inheritance pattern in autopolyploids, status of allopolyploids in plant evolution

Module IV: Chromosomal banding (6 Hours)
Chromosome banding patterns: Linear differentiation of chromosome segments, types of chromosome banding, uses of chromosome banding in cytogenetics

Module V: Plant Breeding and Crop Improvement (10 Hours)
Objectives and scope of plant breeding, hybridization in self- and cross-pollinated crops, genetic basis of inbreeding depression and heterosis, breeding for disease and insect resistance, transgenes and transgenic plants, bio-safety concerns & regulation of transgenic crops in India

Module VI: Gene Transfer Technology (6 Hours)
Alien gene transfer through chromosome: Transfer of gene through individual chromosome, characterization and utility of alien addition and substitution lines

Module VII: Types of DNA and Gene Mapping (10 Hours)
Repetitive DNA, split genes, overlapping genes, physical and genetic mapping using molecular markers

Suggested Reading
1. Allard RW. Principles of Plant Breeding (2nd Edition), John Wiley and Sons
3. Acquaah G. Principles of Plant Genetics and Breeding, Blackwell Publishing Ltd. USA.
5. Lewin B. Genes IX, Jones and Barlett Publishers.

Mapping of COs to Syllabus

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BOPE0028: PLANT ECOLOGY AND PHYTOGEOGRAPHY
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Understand the concepts and scope of ecology (Remembering).
2. Understand about the fundamental structural and functional aspect of ecosystem (Understanding)
3. Analyze the characteristic feature of plant population, dynamics and interrelationships (Analysis)
4. Understand the concept of community, concept of climax, ecological succession (Understanding).
5. Understanding the concept of ecological stability and perturbations (Understanding)
6. Acquire detail knowledge on plant diversity, its status and threats, strategies for conservation (Remembering)
7. Understanding the concept of phytogeography and phyto-geographical division of India (Understanding)

Module I: Introduction to Ecology and Ecological Organization (12 Hours)
Introduction to ecology, scope of ecology, Ecosystem: concept, components and organization, structure and functions of ecosystem, energy dynamics (trophic organization, energy flow pathways, ecological efficiencies), eco-physiology, ecosystem nutrient cycles, ecological niche, ecosystem types, major ecosystems of the world

Module II: Population Ecology (14 Hours)
Population Ecology: Characteristics of population, population growth curves, population size and density, spatial distribution, Agestructure, natality, mortality, biotic potential; life history strategies (r and k selection), population dynamics, competition and coexistence, population interaction, Intra-specific interactions, interspecific interactions, Mutualism and commensalism, Prey-predator interactions, Scramble and contest competition.

Module III: Community Ecology and Ecological Succession (12 Hours)
Concepts of community, species diversity and pattern diversity in community, Ecological succession: Trends of succession, Types and general process of succession, models and mechanisms of ecological succession, concept of climax, community evolution

Module IV: Ecosystem Stability (10 Hours)
Concept (resistance and resilience); ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion

Module V: Biodiversity and Phytogeography (12 Hours)
Plant diversity: Concept, status in India, utilization and concerns, Loss of diversity and causes, Indigenous medicinal systems, Strategies for conservation - in situ conservation and ex situ conservation: general account of the activities of Botanical Survey of India (BSI), Sustainable development, Phytogeography - Principles and importance of plant geography, phyto-geographic regions of world and India, biomes: Classification and components, Willis - Age and Area hypothesis. Continuous range, cosmopolitan circum polar, circum boreal and circum austral, Discontinues distribution - Wagener theory - continental drift hypothesis, endemism

Suggested Readings

Mapping of COs to Syllabus

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BOBB0029: BIOCHEMICALS, MOLECULAR TECHNIQUES & BIOINFORMATICS
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
- CO1: Interpret different molecular biology techniques (Understanding)
- CO2: Compare various blotting techniques, summarize spectrometry and spectroscopy (Understanding)
- CO3: Interpret RNAi (Understanding)
- CO4: Demonstrate various chromatographic and microscopic techniques (Understanding)
- CO5: Utilize the knowledge on bioinformatics to use various biological databases and software (Applying)

Module 1: An introduction to Molecular Biology: methods & techniques (15 Hours)
Isolation and purification: Genomic and plasmid DNA; RNA; proteins. Electrophoresis: Polyacrylamide gel electrophoresis (PAGE), agarose gel electrophoresis, native PAGE, SDS-PAGE, 2D electrophoresis. DNA amplification and genome mapping: PCR, RT-PCR, RFLPs, RAPD, AFLP, SSR, ISSR, SNP, isoelectric focusing (IEF): Principles, kinds of pH gradients used in IEF- free carrier ampholytes, immobilized pH gradients, genome expression analysis: Microarray, EST, SAGE. DNA sequencing: Various methods of DNA sequencing, protein and whole genome sequencing strategies. Isolation, separation and analysis of carbohydrate and lipid molecules, Bar-coding with references to plants.

Module 2: Immunotechniques & Biophysical methods (10 Hours)
Blotting: Principles, types of blotting, immunoblotting: Southern, Northern, Western and Dot blots, FISH, GISH, Massspectrometry: GC-MS, LC-MS, Spectroscopy: basic concept, NMR & ESR spectroscopy

Module 3: Basic principle of Gene silencing (5 Hours)
Gene silencing: RNA interference (RNAi)

Module 4: Chromatographic techniques (10 Hours)
Chromatography: Gel filtration, ion exchange & affinity chromatography, paper chromatography, TLC, HPLC, GC- basic concept

Module 5: Microscopic techniques (10 Hours)
Resolving powers of different microscopes, Microscopy: Phase contrast, confocal, fluorescence, scanning & transmission electron microscopy

Module 6: Bioinformatics (10 Hours)
Basic concepts of computer hardware; Operating systems-Windows, Unix and Linux; use of common application software in biology: word processing, spread sheets, graphics and database; introduction to web browsing software and search engines with special reference to online bioresource; database, sequence analysis, phylogenetic inference package, sites and centres, Primer designing using various softwares, BLAST

Suggested Reading
4. Bajpai PK. Biological Instrumentation & Methodology, S. Chand.

Mapping of COs to Syllabus

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BOER0031: ENVIRONMENTAL MANAGEMENT, RESEARCH METHODOLOGY & BIOSTATISTICS
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Acquire the concepts of Environmental Management and Environmental Impact assessment (Understanding)
2. Understand the salient features of EIA and safety norms (Understanding)
3. Identify and argue the complex issues inherent in selecting a research problem, selecting an appropriate research design and implementing a research project (Applying)
4. Understand the principal concepts in biostatistics (Understanding)
5. Analyze the concepts of scientific research problems and its solutions (Analyzing)

Module I: Basics of Environmental Management & Impact Assessment (10 Hours)
Introduction and scope of environmental management; basic concepts of sustainable development; Environmental impact assessment (EIA); general guidelines for the preparation of environmental impact statement; scope and types of environmental audit; energy audit; cost benefit analysis.

Module II: Environmental Management Plans and Safety Norms (10 Hours)
Environmental management plan; ISO 14000 standards and certification; environmental risk management and environmental safety norms; International summits and treaties related with environment.

Module III: Introduction to Research Methodology (10 Hours)
Definition; basic and applied research; interdisciplinary research; Discriminative reading; reading and reviewing scientific literature; biological abstract; review; monograph; peer-reviewed journals; e-resources; research and review articles.

Module IV: Introduction to Research Problems, Communication and Ethics (10 Hours)
Definition of scientific problems; scientific papers and posters; Introduction to ethics, scientific conducts and misconduct; plagiarism; authorship issues; ethics of animal and human research.

Module V: Introduction to Biostatistics (5 Hours)
General concepts and terminology; measures of location; scale and shape; mean, median, mode, standard deviation, standard error and coefficient of variance; Binomial, Poisson and Normal distribution.

Module VI: Hypothesis Tests, Multivariate Analysis and Sampling Design (15 Hours)
Contingency tables and chi-square test; comparison of means: t-test, multiple range tests, F-test, Run test, sign test, Karl Pearson coefficient of correlation, Kruskal-Wallis H test and Mann-Whitney U-test; Analysis of variance; Correlation and regression analysis; Introduction to multivariate methods; Sampling methods; Simple experimental design

Suggested Readings
4. Easterling RG. Fundamentals of Statistical Experimental Design and Analysis, Wiley

Mapping of COs to Syllabus

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SPECIALIZATION: PLANT BIOTECHNOLOGY

BOFP0032: FUNDAMENTALS OF PLANT BIOTECHNOLOGY
(4 Credits-60 Hours) (L-T-P: 4-0-0)
Course Outcomes
At the end of this course, student will be able to:

CO1: Grasp the insight of plant biotechnology (Remembering)
CO2: Comprehend the underlying concept of tissue culture (Understanding)
CO3: Learn and analyse the importance of genetic engineering in crop improvement (Analysing)
CO4: Utilize biosafety measures in handling GMOs and transgenics in laboratories (Applying)

Module I: Elementary Plant Biotechnology (5 Hours)
Historical background: plant cell and tissue and organ culture, principle of genetic engineering; totipotency and morphogenesis, scope and importance in crop improvement: plant tissue culture practical application and conventional plant breeding; Advantages - disadvantages

Module II: Basics of Organogenesis (7 Hours)
Organogenesis and somatic embryogenesis in plant tissue culture - development of whole plant - root formation, transfer of plant lets to the soil, hardening, principles of cellular regeneration, single cell culture and its applications, protoplast culture, factors effecting organogenesis, advantages-disadvantages and application

Module III: Micropropagation and Virus Indexing (8 Hours)
Shoot-tip meristem culture - raising virus free plants for rapid, methods of virus indexing in vitro mutagenesis; in vitro fertilization; in vitro germplasm conservation; hybrid embryo rescue, production of secondary metabolites, synthetic seed production technology, production of industrial phytochemicals, advantages of micropropagation in agriculture and horticulture

Module IV: Principles of Genetic Engineering (15 Hours)
Principles of recombinant DNA technology, restriction enzymes; vectors for gene transfer – gene cloning, viral vectors and their benefits, screening and selection of transformants; DNA profiling and blotting techniques, types, procedure, application, advantages-disadvantages, nanobiotechnology and its application

Module V: Genetically Modified Organisms (GMOs) and Transgenics (15 Hours)
GMOs and their significance in biotechnology, transgenic plants and its application in agriculture, different methods of plant genetic transformation, Agrobacterium tumefaciens, infection and molecular mechanism of tumor formation, Ti plasmids and Ri plasmids, binary vectors, genetic markers, reporter genes and its application in genetic engineering, other methods of plant genetic transformation, environmental issues associated with transgenic crops

Module VI: Biosafety, IPR and Bioethics (10 Hours)
Biosafety and risk assessment issues; national biosafety policies and law, General principles for the laboratory and environmental biosafety; creation of superweeds/superviruses, ecological aspects of GMOs and impact on biodiversity; food and feed safety issues associated with transgenic crops, intellectual properties, copyrights, trademarks, trade secrets, patents; Indian patent act and amendments, patent filing, Implications of intellectual property rights on the commercialization of biotechnology products

Suggested Readings
4. Herman EB. Media and Techniques for Growth, Regeneration and Storage Agritech Publications, New York, USA.
6. Watson J. Molecular Biology of Gene

Mapping of COs to Syllabus

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BOAB033: ADVANCES IN PLANT BIOTECHNOLOGY
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course outcomes
At the end of this course, student will be able to:

1. Apply the concept of plant biotechnology into practice (Applying)
2. Work out the significance of tissue culture technique (Understanding)
3. Learn and analyze the importance of molecular techniques in up-scaling crop improvement (Understanding)

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4. Figure out the importance of molecular farming in transforming secondary metabolites (Analysing)

Module I:  Haploid Production and Cybridization (7 Hours)
Haploid production and uses, anther and microspore culture, pathways of development, factors affecting androgenesis, diploidization of haploids applications of haploids, limitations of haploids, cytoplasmic hybrids: technique of cybridization, application of cybrids, limitations, transgenics developed through cybridization and haploid productions

Module II:  Biotransformation (7 Hours)
Hairy root cultures; screening of high yielding cell lines; procedures for extraction of high value industrial products, fractionation, bioassays; growth and production kinetics of cell cultures in shake flasks; scale-up procedures in bioreactors, types of bioreactors for plant cell cultures; Manipulation in production profile by biotic and abiotic elicitation; biotransformation of secondary metabolites

Module III:  Molecular Farming and Energy Crops (7 Hours)
Aims and scope, strategies of molecular farming, production of industrial enzymes, biodegradable plastics, antibodies, edible vaccines; manipulation of metabolic pathways for production of secondary metabolites, transplastomics plants; energy crops: concept, types and examples, advantages-disadvantages of biofuels, application

Module IV:  Molecular Markers in Crop Improvement (15 Hours)
DNA marker techniques, PCR and hybridization-based methods, methods of physical mapping – restriction mapping, DNA fingerprinting and foot printing methods, Development of sequence based molecular markers - SSRs and SNPs; advanced methods of genotyping, QTL mapping, Marker assisted selection (MAS)

Module V:  Advanced Molecular Techniques (12 Hours)
Gel electrophoresis- agarose and PAGE (nucleic acids and proteins), isolation of high molecular weight DNA and analysis, southern hybridization; northern hybridization; western blotting and ELISA RNAi, antisense RNA, biosensor, Microarray studies, Marker-free transgenic development strategies

Module VI:  Transgenics and Their Applications (12 Hours)
Target traits and transgenic crops, Genetic engineering for resistance against abiotic and biotic stresses; genetic engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation and nutrient uptake efficiency; genetic engineering for quality improvement; Discussion on application of molecular, transformation and genomic tools for the genetic enhancement in some major field crops such as rice, wheat, cotton, maize, soybean, oilseeds, sugarcane

Suggested Readings
4. Herman EB. Media and Techniques for Growth, Regeneration and Storage Agritech Publications, New York, USA.

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SPECIALIZATION PAPER: PLANT GENETICS

BOGT0034: GENETICS, PLANT BREEDING AND TRANSFORMATION
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Summarize the concepts of cell division and cell cycle (Understanding)
2. Interpret classical genetics (Understanding)
3. Illustrate the role of plant breeding in crop improvement (Understanding)
4. Outline the various techniques of plant genetic engineering (Understanding)
5. Infer the concept of cisgenics (Understanding)

Module I:  Fundamentals of cell division and cell cycle (10 Hours)
Mitosis and meiosis: cell cycle, stages, synoptnomal complex, cytokinesis, molecular basis of cell cycle: cyclin dependent kinases (Cdks)

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and cyclins, cell cycle and cancer

Module II: Plant Genetics: an overview (10 Hours)
Mendelian genetics, multiple alleles, linkage and crossing over, sex linked traits and sex determination, cytoplasmic inheritance, structural and numerical changes in chromosome, mutation

Module III: Plant breeding for crop improvement (20 Hours)
Hybridization techniques in self- and cross-pollinated crops, molecular markers and their applications, role of association mapping and allele mining in crop improvement

Module IV: Recombinant DNA technology and genetic engineering (20 Hours)
Gene cloning, methods of plant transformation, biosafety issues and regulation of GMOs, generation of marker free transgenic lines: cre-lox system, co-transformation, FLP/FRT recombination system, AC/DS transposon system, twin T-DNA binary vector, cisgenics

Suggested Reading
2. Acquaah G. Principles of Plant Genetics and Breeding, Blackwell Publishing Ltd. U.S.A.
5. Singh BD. Plant Breeding: Principles and Methods, Kalyani Publishers, India
9. Gupta PK. Molecular Biology and Genetic Engineering, Rastogi Publications

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BOMB0035: MOLECULAR GENETICS AND BIOINFORMATICS
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Interpret the fundamental processes in biology (Understanding)
2. Summarize the concepts of gene silencing (Understanding)
3. Comprehend the notions of genome editing (Understanding)
4. Utilize the knowledge on bioinformatics to run various biological databases and soft-ware (Applying)

Module 1: Understanding the fundamental processes (20 Hours)
DNA replication, repair and recombination, RNA and protein synthesizes and their processing, regulation of gene expression

Module 2: Gene silencing: Its concepts (10 Hours)
Transcriptional and post transcriptional gene silencing, RNAi: History, mechanism, enzymes involved; role of RNAi in crop improvement

Module 3: Introduction to genome editing (15 Hours)
Genome editing: basic concepts, history, techniques of genome editing: TALENs, ZFNs, CRISPR/Cas (CRISPR/Cpf1), application of genome editing in crop improvement

Module 4: Bioinformatics (15 Hours)
Understanding the concepts of bioinformatics, its applications, introduction to online biological databases, phylogenetic inference package, sites and centers, BLAST, sequence alignment, primer designing, conceptual data modeling

Suggested Reading

440 | ADBU | Regulations and Syllabus | 2021-22
1. Lewin B. Genes IX, Jones and Barlett Publishers
4. Ridge Y. CRISPR: A powerful way to change DNA, Annick Press

**Mapping of COs to Syllabus**

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**SPECIALIZATION PAPER: PLANT MICROBIOLOGY**

**BOMG0036: MICROBIAL PHYSIOLOGY AND GENETICS**  
(4 Credits-60 Hours) (L-T-P: 4-0-0)

**Course Outcomes**

At the end of this course, student will be able to:

- **CO1:** Tell the chemistry and functions of microbial cells and organelles (Understanding)
- **CO2:** Understand and analyze various metabolic pathways of microbes (Analyzing)
- **CO3:** Understand the gene regulatory mechanisms and pathways and their functions (Understanding)
- **CO4:** Apply the concepts of vector and cloning mechanisms in plant improvement (Applying)

**Module I: Microbial Cells and organelles (10 Hours)**

Over view of prokaryotic cell- structure & functions, cell wall synthesis, Membrane transport in bacteria-simple, group translocation, ABC transporters, Protein export in bacteria. Membrane organelles: lysosomes, mitochondria (with small ribosomes), Golgi bodies, endoplasmic reticulum, nucleus

**Module II: Microbial physiology (15 Hours)**

Pathways of pyruvate generation from sugars (EMP, Gluconeogenesis, HMP, ED, PK); Aerobic respiration (Kreb’s cycle, ETC (oxidative phosphorylation) in bacteria); Anaerobic respiration (reduction of nitrate and sulphate); Nitrifying bacteria, sulphur bacteria, iron bacteria and hydrogen bacteria; Fermentation pathways (outline of pathway and significance of lactic acid fermentation, ethanol fermentation, mixed acid fermentation, butanediol fermentation), Lipid and protein metabolism; photosynthesis in purple and green bacteria

**Module III: Microbial Genetics (15 Hours)**

Structure, function and types of DNA and RNA, DNA replication in bacteria; Gene expression (concept of gene, gene structure, genetic code, transcription and translation, post transcriptional and post translational modifications); Gene regulation in prokaryotes- The operon concept (Lac and Trp operon -induction and repression); Mutations (Definition, types, molecular basis of mutations, detection of mutants); DNA repair mechanisms (Dark repair, photo-reactivation, recombination repair, SOS repair), Transposons

**Module IV: Microbial stress biology and response (10 Hours)**

Concept of stress in microorganism, response against stress; types of stress, stress mediated modification in metabolism, oxidative stress and redox metabolism, ROS and free radical production during stress, heat shock regulon, SOS regulon and Cps regulon

**Module V: Microbial vectors in genetic Engineering (10 Hours)**

Plasmid (size, copy numbers, classification, applications as vectors; Bacteriophages (types, applications as vectors); vectors for eukaryotes and other higher plants; plasmids and antimicrobial resistance, cloning (basic principle, techniques and applications)

**Suggested Readings**


### Mapping of COs to Syllabus

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### BOAM0037: APPLIED MICROBIOLOGY
(4 Credits-60 Hours) [L-T-P: 4-0-0]

**Course Outcomes**

At the end of this course, student will be able to:

- **CO1**: Understand the roles of microbes in industries and environment (Understanding)
- **CO2**: Detect and identify microorganisms from any samples (Evaluating)
- **CO3**: Use microbes in agriculture, industries and environmental protection (Applying)
- **CO4**: Develop diagnostic protocols for microbial diseases (Creating)

**Module I: Microbes Preservation techniques (6 Hours)**

Importance of preservation of microbes, types of preservation techniques, revival of microbes

**Module II: Fermentation technology and microorganisms (15 Hours)**

History of fermentation, introduction to fermentation processes, Microbial culture selection for fermentation processes. Media formulation and process optimization; Design and operation of Fermenters, Basic concepts for selection of a reactor, Packed bed reactor, Fluidized bed reactor, Trickle bed reactor, Bubble column reactor, Scale up of Bioreactor; basic concept of upstream and down-stream processing

**Module III: Environmental microbiology (15 Hours)**

Microbes as tools for pollution abatement, bio-indicators, restoration of degraded ecosystem, biodegradation, bioremediation, biogenic gases; microbes as causal agents of diseases; basic concepts of immunology, vaccines, immunotherapy, microbes in biological warfare

**Module IV: Microorganisms and agriculture (8 Hours)**

Role of microbes in relation to agriculture: nitrogen economy, plant health, biological control. Symbiotic association: concepts, types and application

**Module V: Microorganisms in food and dairy industries (10 Hours)**

Microbes in food and dairy industries: mushroom, fermented foods, microbial spoilage of food and dairy products

**Module VI: Microorganisms and pharmaceutical industries (6 Hours)**

Gene manipulation for production microbial toxin, types, biochemical and molecular basis of toxin production, mode of action, production of novel commercial products such as biopolymer and antibiotics

### Suggested Reading


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### SPECIALIZATION PAPER: ANGIOSPERM TAXONOMY

**BOTSO038: TAXONOMY OF ANGIOSPERMS AND BIOSYSTEMATICS**
(4 Credits-60 Hours) [L-T-P: 4-0-0]

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Course Outcomes
At the end of this course, student will be able to:
1. Understand the concepts of plant identification, classification, nomenclature and biosystematics (Understanding)
2. Identification of plant with the help of keys and their relevant literatures (Applying)
3. Comparison of classical plant taxonomy with modern experimental plant taxonomy (Analyzing)
4. Summarize taxonomic hierarchy and principles and rules of botanical Nomenclature (Understanding)
5. Application of numerical taxonomy and phylogenetic systematic in angiosperms (Applying)

Module I: Taxonomy and Biosystematics (10 Hours)

Module II: Identification and Taxonomic Literature (10 Hours)
Methods of Plant identification; Taxonomic Keys: Single access and Multi-access; Character and Character states; Field inventory; Collection; Herbaria: Functions of Herbarium, Preparation of Herbarium; Important herbaria and botanical gardens of the World and India; Virtual herbarium. Taxonomic Literature: Flora, E-flora, Monographs, Revisions, Checklists, Periodicals; Taxonomic Indexes; Ret Data Book

Module III: Taxonomic Hierarchy and Botanical Nomenclature (15 Hours)
Concept of taxa (family, genus, species); Categories and Taxonomic Hierarchy; Infra-species; Species Concept (taxonomic, biological, evolutionary); Principles of Nomenclature (ICNafp); Rules of Nomenclature: Ranks and names; Typification, Priority of Publication; Nomenclature of Taxa; Effective Publication; Valid Publication; Author Citation; Rejection of Names, principle of priority and its limitations; Names of hybrids

Module IV: Systems of classification and Systematic evidences (10 Hours)

Module V: Numerical Taxonomy, Phylogenetic Systematic (Cladistics) (15 Hours)
Numerical Taxonomy: Principles, Methods, Characters, Variations; OTUs, Character Weighting, Coding, Cluster analysis, Phenogram, Merits and Demerits; Biometrics. Cladistics: Methodology of Cluster Analysis, Applications. Homology and Homoplasy; Monophyly, Paraphyly and Polyphly; Primitive and Advanced; Phylogenomic

Suggested Readings
2. Sharma, O.P. Plant Taxonomy McGraw-Hill Education
4. Nair, R. Taxonomy of Angiosperms Aph Publishing Coorporation
5. Gupta, R. Plant Taxonomy: Past, Present and Future The Energy and Research Institute TERI.
10. Lawrence, G.H.M. Taxonomy of Vascular Plants Scientific Publisher

Mapping of COs to Syllabus

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BOBE0039: ECONOMIC BOTANY AND ETHNO-BOTANY
(4 Credits-60 Hours) (L-T-P: 4-0-0)
Course Outcomes
At the end of this course, student will be able to:

CO1: Understand the nature of plant products, aspects and classification of economic important plants (Understanding)
CO2: Taxonomic status of food plants, industrial plants and drug plants and its uses (Understanding)
CO3: Understand the cultivation, extraction processes and uses of different economically useful plants (Understanding)
CO4: Understand the need to conserve floristic and cultural diversity of the region (Understanding)
CO5: Rescue and document Ethno-botanicals for sustainable use of plant resources (Analyzing)

Module I: Introduction to Nature of Plant Products (10 Hours)
Importance and Nature of Plant Products; Protoplasm and its Activities; Photosynthesis; Plant skeleton; Reserved food (Carbohydrates, Fats and Proteins); Secretions and Excretions (Essential Oils, Pigments, Tannins, Latex, Waxes, Alkaloids, Glycosides, Organic Acids, Enzymes, Vitamins, Hormones). Different Aspects of Economic Botany; Classification of Economically Important Plants

Module II: Fibers and Fibers Plants (5 Hours)
Economic Classification of Fibers: Textile Fibers; Surface Fibers; Soft Fibers; Structural Fibers; Brush Fibers; Plaiting and Rough Weaving Fibers; Filling Fibers; Natural Fabrics; Paper Making Fibers. Cotton, Jute, Flax and Agave (Characteristics, Cultivation, Importances and Uses)

Module III: Forest Products and Resources (5 Hours)
Importance and Structures of Wood; Mechanical Properties and Factors of Wood; General account with special reference to Teak, Sal, Pine and Bamboos

Module IV: Tanning and Dye materials (5 Hours)

Module V: Oil-Yielding, Sugar-Yielding and Rubber-Yielding Plants (5 Hours)
General account with special reference to Drying oils, semi drying oils; Non-drying oils and Vegetables Fats. Sugarcane and Sugar beet (cultivation, extraction and uses); Para rubber and Assam Rubber: Tapping, Processing and Uses. Fatty oils and their extractions

Module VI: Cereals, Pulses, Beverages and Spices (5 Hours)
Staple food crops - cereals, pulses, millets; tropical, subtropical and temperate fruits; Tea, Coffee processing and uses; Important spices, their family and part used

Module VII: Introduction to Ethno-botany (10 Hours)
Concept, Relevance, Scope and Status; Plant parts used in Ethno-medicine; Role of Ethno-medicine and its scope in modern times. Concept of Protected Areas; CITES, IUCN Red List Categories. Role of Ethno-botany in conservation and sustainable development; Centers of Ethno-botanical studies in India; Contributions of AICRPE and FRLHT to ethno-biology of India

Module VIII: Methods and techniques in Ethno botany (15 Hours)
Field activities for data collection: Approach, Documentation, Consent forms, Forest productivity check by analyzing the log books of Forest, Authentication of plant species and Lab Procedures, Preparation of Data Sheet and Data Base. People Biodiversity Register (PBR). Impact of Ethno-botany in herbal medicine industry, land-use development, agriculture, forestry, betterment of rural livelihoods and education; Biodiversity and conservation of useful medicinal plants; Sharing of wealth concept with few examples from India; Plant used in ethno-medicine e.g.: Emblica officinalis, Ocimum sanctum, Saraca asoca, Rauwolfia serpentina, Mentha piperita, Aloe vera, Eclipta alba, Azadirachta indica, Centella asiatica preparation and their uses.

Suggested Readings
8. Saroya, A.S. Herbalism, Phytochemistry and Ethnopharmacology, CRC Press, UK

Mapping of COs to Syllabus

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SPECIALIZATION: PLANT ECOLOGY

BOEG0040: ECOLOGY, ENVIRONMENT AND GLOBAL CONCERNS
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Understand about the fundamental characteristic, structural and functional aspect of ecosystem (Understanding)
2. Understand environmental pollution its cause, effects and control (Understanding)
3. Understand the scenario and mechanism of climate change and also various mitigation initiatives undertaken (Understanding)
4. Addresses ecological resilience and its relationship to ecosystem services (Analyzing)

Module I: Ecology and Ecosystem Analysis (12 Hours)
Principles and Scope of Ecology Structure and Functions of Ecosystems - Abiotic and Biotic components; Energy dynamics; Niche concept; Eco-physiology; Ecosystem nutrient cycles; Ecosystems Types and Diversity; Concepts relating to limiting factors; Populations and communities characteristics; Population dynamics; Population interaction; Models and mechanisms of ecological succession; Ecosystem Stability

Module II: Environment and Pollution (18 Hours)
Energy and Environment; Components, types and segments of Environment; Environmental pollution: Origin of pollution, types of pollutions; Atmosphere: region and composition of atmosphere; Air pollution: classification and major air pollutants, sources and effect of air pollution; Water pollution: types of pollution and pollutants, sources and effect of water pollution; Soil pollution: sources and effect of soil pollution; Treatment and control of pollution

Module III: Climate Change and Awareness (18 Hours)
Basic concepts and mechanism: Climate change, ozone layer depletion, global warming and greenhouse effect, causes and consequences; Mitigation and adaptation: Carbon storage and sequestration, carbon management: Abiotic and autotrophic, Carbon farming and carbon trading; International responses: Intergovernmental Panel on Climate Change (IPCC) and its role, United Nations Framework Convention on climate change (UNFCCC), CDM and Kyoto Protocol, REDD+, The Copenhagen Accord; India’s response to climate change

Module IV: Ecological Resilience and Ecosystem Services (12 Hours)
Definitions and concepts of ecological resilience; Characteristics of Resilient Ecosystem; Ecological, General, and Spatial Resilience; Linkage between Resilience, Vulnerability and Adaptive Capacity; Components of Resilience-Based Management; Ecosystem service concept, model and classification; Factors and drivers determining ecosystem services; Mapping and assessment of ecosystem services, Ecosystem services in natural resource management

Suggested Readings

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BORE0041: RESTORATION ECOLOGY
(4 Credits-60 Hours) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Understand the ecological perspectives of restoration including factors that regulate ecosystem function (Understanding)
2. Understand the ecological theories that have molded restoration ecology (Understanding)
3. Relate restoration practices and efforts to different ecological levels (Applying)
4. Explores into the planning, execution, monitoring, and assessment of restoration work (Analysing)
5. Role of remote sensing as a tool for ecological restoration processes (Applying)

Module I: Introduction to Restoration Ecology (8 Hours)
Concept and Definition of Restoration Ecology; Degradation of Ecosystems; Different Restoration Approaches; Varying Scales of Restoration; Ecosystem Disturbances; Fire Disturbances; Fragmentation; Nutrient and Hydrological Cycling; Keystone Species

Module II: Succession and Assembly (8 Hours)
Theories of Succession; Successional Processes and Restoration; Management of Succession; Monitoring Succession; Ecosystem Resistance and Stability; Regime Shift; Assembly Rules

Module III: Biodiversity and Forest Restoration (10 Hours)
Levels of Biodiversity; Threats to Biodiversity; Extinction; Rate of Extinction and Species vulnerability; Restoration of Genetic Diversity; Restoration of Species Diversity; Ecosystem Diversity; Forest Degradation; Forest Restoration

Module IV: Landscape and Invasive Species (12 Hours)
Definition and Types of Landscape; Landscape matrices; Connectivity and Metapopulation; Landscape Restoration; Process of Invasion; Effects of Invasion on Ecosystems; Methods to Control Invasion; Restoration to Constrain Invasion

Module V: Management of Restoration Plans (10 Hours)
Project Planning; Implementation; Adaptive Management Cycle; Monitoring; Selecting Monitoring Parameters and Methods; Additional Considerations in Developing a Monitoring Plan; Legal Framework and International Agreements

Module VI: Remote Sensing in Restoration Ecology (12 Hours)
Remote sensing fundamentals; Satellite Data and Sensors; Spectral, Temporal, Radiometric and Temporal Resolutions; Image Processing; Image Interpretation and Classification; Accuracy Assessment; Measuring and Monitoring Land Cover, Land Use, Change and Vegetation Characteristics; Conservation and Ecology Applications; Global Positioning System

Suggested Readings

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BOAM0101: ALGAE AND MICROBIOLOGY (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course outcomes
At the end of this course, student will be able to:
1. Understand different microorganisms and their importance (Understanding)
2. Able to identify and characterize microorganisms (Applying)
3. To assess the importance of microbial activities in food industry and therapeutics (Analyzing)
4. Able to identify beneficial and harmful microbes (Evaluating)
Module I: Introduction to Microbial World (7 Hours)
Microbes in Our Lives; History of Microbiology; Modern Microbiology; Scope of Microbiology; Major Groups of the Microbial world. Microbial nutrition, growth and metabolism

Module II: Viruses (7 Hours)
Viruses Discovery, physicochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV); Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, ascasual organisms of plant diseases

Module III: Bacteria (7 Hours)
Bacteria Discovery, general characteristics; Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance of bacteria with reference to their role in agriculture and industry (fermentationand medicine)

Module IV: Algae (11 Hours)
Algae General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; Classification; criteria, system of Fritsch, and evolutionary classification of Lee (only up to groups); Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar). Role of algae in the environment, agriculture, biotechnology and industry

Module V: Cyanophyta and Xanthophyta (8 Hours)
Cyanophyta and Xanthophyta Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of Nostoc and Vaucheria

Module VI: Chlorophyta and Charophyta (8 Hours)
Chlorophyta and Charophyta General Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction; Morphology and life-cycles of Chlamydomonas, Volvox, Oedogonium, Coleochaete, Chara; Evolutionary significance of Prochloron

Module VII: Phaeophyta and Rhodophyta (12 Hours)
Phaeophyta and Rhodophyta Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction; Morphology and life-cycles of Ectocarpus, Fucus and Polysiphonia

Suggested Readings

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BOBC0102: BIOMOLECULES AND CELL BIOLOGY (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course outcomes
At the end of this course, student will be able to:
1. To recall the properties and economic importance of enzymes (Remembering)
2. To memorize the general characteristics of carbohydrates, proteins, nucleic acids and lipids and how they are imported/exported to various organelles (Remembering)
3. To acquire comprehensive knowledge on the general structure of proteins (Understanding)
4. To interpret the basics of mode of actions of enzymes (Understanding)
5. To understand the importance of cell cycle and its regulation in controlling diseases (Understanding)

Module I: Biomolecules (20 Hours)
Types and significance of chemical bonds; Structure and properties of water; pH and buffers; Carbohydrates: Nomenclature and classification; Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacylglycerols structure, functions and properties; Phosphoglycerates. Proteins: Structure of amino acids; Levels of protein structure-
primary, secondary, tertiary and quaternary; Protein denaturation and biological roles of proteins. Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA

Module II: Bioenergetics (4 Hours)
Principles of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as an energy currency molecule

Module III: Enzymes (6 Hours)
Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity

Module IV: The cell (4 Hours)
Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory)

Module V: Cell wall and Plasma Membrane (4 Hours)
Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis

Module VI: Cell Organelles (16 Hours)
Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament. Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. Endomembrane system: Endoplasmic Reticulum — Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus — organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes

Module VII: Cell Division (6 Hours)
Importance of cell cycle, Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases

Suggested Readings

Mapping of COs to Syllabus

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BOMP0103: MYCOLOGY AND PHYTOPATHOLOGY (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Able to tell and name different fungi, allied fungi and lichens and their classification process/criteria (Remembering)
2. Able to explain fungal cell organization; illustrate their reproduction mechanisms (Understanding)
3. Make use of the knowledge gained to solve important fungal and other related diseases in plants (Applying)
4. Determine the application of fungi in food industries, pharmaceutical preparations and agriculture (Evaluating)

Module I: Introduction to True Fungi (6 Hours)
General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification

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Module II: Chytridiomycota and Zygomycota (5 Hours)
Characteristic features; Ecology and significance; Thallus organization; Reproduction; Life cycle with reference to Synchytrium, Rhizopus

Module III: Ascomycota (10 Hours)
General characteristics (sexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and Para sexuality; Life cycle and classification with reference to Saccharomyces, Aspergillus, Penicillium, Alternaria, Neurospora and Peziza

Module IV: Basidiomycota (8 Hours)
General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat Puccinia (Physiological Specialization), loose and covered smut (symptoms only), Agaricus; Bioluminescence, Fairy Rings and Mushroom Cultivation

Module V: Allied Fungi (3 Hours)
General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies

Module VI: Oomycota (4 Hours)
General characteristics; Ecology; Life cycle and classification with reference to Phytophthora, Albugo

Module VII: Symbiotic Associations (4 Hours)
Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance

Module VIII: Applied Mycology (10 Hours)
Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycophericides, Mycoinsecticides, Myconematicides); Medical mycology

Module IX: Phytopathology (10 Hours)
Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing; Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers

Suggested Readings:

Mapping of COs to Syllabus

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BOAR0104: ARCHEGONIATE (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course outcomes
At the end of this course, student will be able to:
1. Recall the unique features of archegoniate (Remembering)
2. Summarize the different land habits and alternation of generation inarchegoniates (Understanding)
3. Classify the different archegoniates and demonstrate their morphology, anatomy and reproduction (Understanding)
4. Illustrate the economic importance of bryophytes, pteridophytes and Gymnosperms (Understanding)

Module I: Introduction (2 Hours)
Unifying features of archegoniates; Transition to land habit; Alternation of generations

Module II: Bryophytes (18 Hours)
General characteristics; Adaptations to land habit; Classification; Range of thallus organization Classification (up to family) Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum and Funaria; Reproduction and evolutionary trends in Riccia, Marchantia, Anthoceros and Funaria (developmental stages not included)

Module III: Pteridophytes (18 Hours)
General characteristics, classification, early land plants (Cooksonia and Rhynia). Classification (up to family), morphology, anatomy and reproduction of Psilotum, Selaginella, Equisetum and Pteris (Developmental details not to be included) Apogamy, and apospory, heterospor and seed habit, telome theory, stellar evolution

Module IV: Gymnosperms (18 Hours)
General characteristics, classification (up to family), morphology, anatomy and reproduction of Cycas, Pinus and Gnetum and Ephedra; (Developmental details not to be included) Ecological and economic importance

Module V: Economic Importance (4 Hours)
Ecological and economic importance of bryophytes with special reference to Sphagnum; Ecological and economic importance of pteridophytes and gymnosperms

Suggested Readings
5. Vander-Poorter 2009 Introduction to Bryophytes. COP

Mapping of COs to Syllabus

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BOMA0105: MORPHOLOGY AND ANATOMY (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Develop an understanding of concepts and fundamentals of plant anatomy (Understanding)
2. Examine the internal anatomy of plant systems and organs (Remembering)
3. Comprehend the concepts of organization and development of shoot and root apices (Understanding)
4. Examine the structure and role of cambium (Analyzing)
5. Studying the various concepts of wood and dendrochronology (Analyzing)
6. Evaluate the adaptive and protective systems of plants (Evaluating)
7. Evaluate the secretory systems in plants (Evaluating)

Module I Introduction and Scope of Plant anatomy (2 Hours)
Applications in systematics, forensics and pharmacognosy

Module II Tissues (12 Hours)
Classification of tissues; Simple and complex tissues (no phylogeny); cyto-differentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, encrustation and incrustation, Ergastic substances

Module III Stem, Leaves and Roots (18 Hours)
Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytho-histological zonation); Types of vascular bundles; Structure of dicot and monocot stem Structure of dicot and monocot leaf, Kranz anatomy, Organization of root apex (Apical cell theory, Histogen theory, Korper- Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root

Module IV Vascular Cambium, Periderm and Wood (17 Hours)
Structure, function and seasonal activity of cambium; Secondary growth in root and stem, Development and composition of periderm, rhytidome and lenticels, Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology

Module V Adaptive and Protective Systems (8 Hours)
Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni and multicellular, glandular and non-glandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes

Module X Secretory System (3 Hours)
Hydathodes, cavities, lithocysts and laticifers

Suggested Readings

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BOEB0106: ECONOMIC BOTANY (4 CREDIT-60 HOURS) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:

**CO1**: Tell the concept of origin of crops, crop domestication, evolution of new crops (Remembering)

**CO2**: Perceive the ideas of different economically useful crops (Understanding)**CO3**: Execute the concepts developed in the class in their daily activities (Applying)**CO4**: Survey the uses of economically important plants (Analyzing)**CO5**: Modify and improve processing methods and techniques for essential oils and other useful crops (Creating)

**Module I: Origin of Cultivated Plants (6 Hours)**
Concept of Centres of Origin; their importance with reference to Vavilov’s work examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity

**Module II Cereals (6 Hours)**
Wheat and Rice (origin, morphology, processing & uses), brief account of millets

**Module III Legumes (4 Hours)**
General account, importance to man and ecosystem

**Module IV Sugars & Starches (4 Hours)**
Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses

**Module V: Spices (6 Hours)**
Listing of important spices, their family and part used, economic importance with Special reference to fennel, saffron, clove and black pepper

**Module VI: Beverages (4 Hours)**
Tea, Coffee (morphology, processing & uses)

**Module VII: Oils & Fats (8 Hours)**
General description, classification, extraction, their uses and health implications groundnut, coconut, linseed and Brassica and Coconut (Botanical name, family & uses)

**Module VIII: Essential Oils (4 Hours)**
General account, extraction methods, comparison with fatty oils & their uses

**Module IX: Natural Rubber (3 Hours)**
Para-rubber: tapping, processing and uses

**Module X: Drug-yielding plants (4 Hours)**
Therapeutic and habit-forming drugs with special reference to *Cinchona, Digitalis, Papaver* and *Cannabis*

**Module XI: Tobacco (4 Hours)**
Tobacco (Morphology, processing, uses and health hazards)

**Module XII: Timber plants (3 Hours)**
General account with special reference to teak and pine

**Module XIII: Fibres (4 Hours)**
Classification based on the origin of fibres, Cotton and Jute (morphology, extraction and uses)
Suggested Readings

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BOGE0107: GENETICS (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Summarize the concepts of Mendelian genetics (Understanding)
2. Infer the ideas behind extrachromosomal inheritance, linkage and crossing over (Understanding)
3. Explain numerical and structural chromosomal aberrations (Understanding)
4. Compare the various genetic mutations and explain DNA repair (Understanding)
5. Demonstrate the fine structure of the gene including complementation test (Understanding)
6. Rephrase the Hardy Weinberg Law (Understanding)
7. Solve numericals based on genetics (Applying)

Module I: Mendelian Genetics and Its Extension (16 Hours)
Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Incomplete dominance and codominance; Multiple alleles, lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Numericals; Polygenic inheritance

Module II: Extrachromosomal Inheritance (6 Hours)
Chloroplast mutation: Variegation in Four o’clock plant; Mitochondrial mutations in yeast; Maternal effects - shell coiling in snail; Infective heredity - Kappa particles in Paramecium

Module III: Linkage, Crossing Over and Chromosome Mapping (12 Hours)
Linkage and crossing over-Cytological basis of crossingover; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage

Module IV: Variation in Chromosome Number and Structure (8 Hours)
Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy

Module V: Gene Mutations (6 Hours)
Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of transposons in mutation DNA repair mechanisms

Module VI: Fine Structure of Gene (6 Hours)
Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rll Locus

Module VII: Population and Evolutionary Genetics (6 Hours)
Allele frequencies, Genotype frequencies, Hardy – Weinberg Law, role of natural selection mutation, genetic drift Genetic variation and Speciation

Suggested Readings

Mapping of Co to Syllabus

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BOET0108: ETHNOBOTANY (2 CREDITS-30 HOURS) (L-T-P: 2-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Demonstrate the concept, scope and objectives of ethnobotany with reference to tribal lifestyle (Understanding)
2. Interpret different ethno botanical methodologies (Understanding)
3. Examine the role of various plants in traditional and modern medicine (Analyzing)
4. Infer the legal aspects of ethnobotany (Understanding)

Module I: Ethnobotany (6Hours)
Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science; the relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses

Module II: Methodology of Ethnobotanical Studies (6 Hours)
a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places

Module III: Role of Ethnobotany in Modern Medicine (10 Hours)
Medico-ethno botanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) Azadiractha indica b) Ocimum sanctum c) Vitex negundo. d) Gloriosa superba e) Tribulus terrestris) Pongamyia pinnata g) Cassia auriculata h) Indigofera tinctoria. Role of ethnobotany in modern medicine with special example Rauwolfia serpentina, Trichopus zeylanicus, Artemisia, Withania; Role of ethnic groups in conservation of plant genetic resources.Endangered taxa and forest management (participatory forest management)

Module IV: Ethnobotany and Legal Aspects (8 Hours)
Ethnobotany as a tool to protect interests of ethnic groups; Sharing of wealth concept with few examples from India; Biopiracy, Intellectual Property Rights and Traditional Knowledge

Suggested Readings

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BOIP0109: INTELLECTUAL PROPERTY RIGHTS (2 CREDITS-30 HOURS) (L-T-P: 2-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Interpret IPR and its philosophy (Understanding)
2. Summarize copyrights and related rights and industrial property rights like designs, trademarks, patents and geographical indications (Understanding)
3. Infer the importance of protecting traditional knowledge (Understanding)
4. Explain the necessity to protect plant varieties (Understanding)
5. Summarize the roles of information technology and biotechnology in the field of IPR (Understanding)
6. Utilize the concepts of intellectual property rights in safeguarding innovations, products etc in future (Applying)

Module I: Introduction to Intellectual Property Right (IPR) (2 Hours)
Concept and kinds Economic importance IPR in India and world: Genesis and scope, some important examples. IPR and WTO(TRIPS, WIPO)

Module II: Patents and Copyrights (6 Hours)

Module III: Trademarks and Industrial Designs (5 Hours)
Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name, Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

Module IV: Geographical Indications (3 Hours)
Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position

Module V: Protection of Traditional Knowledge (4 Hours)
Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prospeacting and Bio-Piracy, Alternative ways, Protectability, need for a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library

Module VI: Protection of Plant Varieties (2 Hours)

Module VII: Intellectual Property Rights: Information Technology & Biotechnology (8 Hours)

Suggested Readings

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BOMB0110: MOLECULAR BIOLOGY (4 CREDITS-60 HOURS) (L-T-P: 3-1-0)

Course Outcomes
At the end of this course, student will be able to:
1. Recall the various experiments proving DNA to be the carrier of genetic information (Remembering)
2. Perceive of structure of DNA and RNA and also central dogma and genetic code (Understanding)
3. Interpret the mechanism of DNA replication, transcription and translation in prokaryotes and eukaryotes(Understanding)
4. Summarize gene regulation (Understanding)
5. Inspect the concept of the processing and modification of RNA (Analyzing)

Module I: Nucleic acids: Carriers of Genetic Information (4 Hours)
Historical perspective; DNA as the carrier of genetic information (Griffith’s, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat’s experiment RNA and its significance in evolution

Module II: The Structures of DNA and RNA (10 Hours)
DNA Structure: Miescher to Watson and Crick-historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves; Organization of DNA-Prokaryotes, Viruses, Eukaryotes. RNA: Types and Structure, Organelle DNA–mitochondria and chloroplast DNA. The nucleosome, chromatin structure–Euchromatin, Heterochromatin – Constitutive and Facultative heterochromatin

Module III: The Replication of DNA (10 Hours)
Chemistry of DNA synthesis (Kornberg’s discovery); General principles—bidirectional, Semiconservative and semi discontinuous replication, RNA priming; various models of DNA replication, including rolling circle, θ (theta) mode of replication, Enzymes for replication, process of prokaryotic and eukaryotic replication

Module IV: Central Dogma and Genetic Code (4 Hours)
Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)

Module V: Mechanism of Transcription (8 Hours)
Mechanism of transcription in prokaryotes and eukaryotes, Role of transcription factors

Module VI: Processing and Modification of RNA (8 Hours)
Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I & group II intron splicing, alternative splicing eukaryotic mRNA processing (5’ cap, 3’ poly A tail); Ribozymes, exon shuffling; RNA editing and mRNA transport

Module VII: Translation (Prokaryotes and eukaryotes) (8 Hours)
Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; post-translational modifications of proteins

Module VIII: Regulation of Transcription in Prokaryotes and Eukaryotes (8 Hours)
Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in E.coli. Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing

Suggested Readings

Mapping of COs to Syllabus

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**BOPE0111: PLANT ECOLOGY AND PHYTOGEOGRAPHY (4 CREDITS-60 HOURS) (L-T-P: 3-1-0)**

Course Outcomes
At the end of this course, student will be able to:
1. Recollect the concepts of ecology of individual, population, community and ecosystem (Remembering)
2. Perceive the basic knowledge of biotic and abiotic factors of environment their interaction, ecosystem and its functional aspects (Understanding)
3. Utilize the concepts of population dynamics and community succession in understanding the composition of particular area (Applying)
4. Inspect the ideas on ecosystem and its functional aspects (Analysing)
5. Check their knowledge on phytogeography (Evaluating)

Module I: Introduction (4 Hours)
Basic concepts of ecology, Levels of organization, Inter-relationships between the living world and the environment, the components and dynamism, homeostasis

Module II: Abiotic and Biotic Components of Ecosystem (20 Hours)
Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil
development, Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table. Variations; adaptations of plants to their variation in Light, temperature, wind and fire, Host-Pathogen interaction

Module III: Ecosystem, Its Structural and Functional Aspects (10 Hours)
Structure; Processes; trophic organization, Food chains and Food webs; Ecological pyramids, Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus

Module IV: Population Ecology (6 Hours)
Characteristics and Dynamics of population ecology, ecological Speciation

Module V: Plant Communities (8 Hours)
Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts

Module VI: Phytogeography (12 Hours)
Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Local Vegetation

Suggested Readings

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BOPS0112: PLANT SYSTEMATICS (4CREDITS-60 HOURS) (L-T-P: 3-1-0)

Course outcomes
At the end of this course, student will be able to:
1. Summarize the concepts of plant identification, classification, nomenclature and biosystematics (Understanding)
2. Outline taxonomic identification and hierarchy (Understanding)
3. Infer systematics as an interdisciplinary science (Understanding)
4. Summarize botanical nomenclature and various systems of classification (Understanding)
5. Explain biometrics, numerical taxonomy and cladistics (Understanding)
6. Summarize the phylogeny in angiosperms (Understanding)

Module I: Introduction to Plant Systematics (2 Hours)
Plant identification, Classification, Nomenclature; Biosystematics

Module II: Identification (6 Hours)
Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: Single access and Multi-access

Module III: Systematics-An InterdisciplinaryScience (6 Hours)
Evidence from palynology, cytology, phytochemistry and molecular data

Module IV: Taxonomic Hierarchy (6 Hours)
Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary)

Module V: Botanical Nomenclature (10 Hours)
Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids

Module VI: Systems of Classification (10 Hours)
Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series); Brief reference of Angiosperm Phylogeny
Group (APG III) classification

Module VII: Biometrics, Numerical Taxonomy and Cladistics (8 Hours)
Characters; Variations; OTUs, character weighting and coding; cluster analysis; Phenograms, cladograms (definitions and differences)

Module VIII: Phylogeny of Angiosperms (12 Hours)
Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin & evolution of angiosperms; co - evolution of angiosperms and animals; methods of illustrating evolutionary relationship (phylogenetic tree, cladogram)

Suggested Readings

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BOBF0113: BIOFERTILIZERS (2 CREDITS-30 HOURS) (L-T-P: 2-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Recollect their knowledge on the role of microbes in producing biofertilizers (Remembering)
2. Perceive the concept of the various components of biological organisms used as biofertilizer (Azospirillum, cyanobacteria, VAM (Understanding)
3. Use the idea of organic farming in the field (Applying)
4. Survey the various ways of generating biofertilizers (Analyzing)

Module I: General Introduction (4 Hours)
General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, and carrier- based inoculants, Actinorrhizal symbiosis

Module II: Azospirillum and Azotobacter as Biofertilizer (8 Hours)
Azospirillum: isolation and mass multiplication – carrier-based inoculant, associative effect of different microorganisms, Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication

Module III: Blue Green Algae (4 Hours)
Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation

Module IV: VAM fungi (8 Hours)
Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants

Module V: Organic Farming (6 Hours)
Organic farming – Green manuring and organic fertilizers, recycling of biodegradable municipal, agricultural and Industrial wastes – bio compost making methods, types and method of vermi-composting – field Application

Suggested Readings
1. Dubey, R.C., A Textbook of Biotechnology S. Chand & Co, New Delhi, 2005
2. Kumaresan, V., Biotechnology, Saras Publications, New Delhi, 2005
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BOMB0114: MEDICINAL BOTANY (2 CREDITS - 30 HOURS) (L-T-P: 2-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Interpret age-old systems of medicine (Understanding)
2. Infer the importance of conserving endangered and endemic medicinal plants (Understanding)
3. Make use of traditional and folk medicine for the betterment of the society (Applying)

Module I: General Introduction (10 Hours)
History, Scope and Importance of Medicinal Plants, Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e-tabiya, tumors treatments/therapy, polyherbal formulations

Module II: Conservation Strategies (10 Hours)
Conservation of endangered and endemic medicinal plants Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, prickling, use of green house for nursery production, propagation through cuttings, layering, grafting and budding

Module III: Ethnobotany (10 Hours)
Ethnobotany and Folk medicines Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany:
National interacts, Palaeo-ethnobotany, Folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases

Suggested Readings

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BOBV0115: BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE) (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course outcomes
At the end of this course students will be able to:
1. Summarize viruses with respect to their types, replication, life-cycle, reproduction and economic importance(Understanding)
2. Illustrate the classification, morphology, anatomy and economic importance of algae (Understanding)
3. Compare fungi, lichens and mycorrhiza (Understanding)
4. Interpret the classification, morphology, anatomy, reproduction and economic importance of archegoniate(Understanding)

Module I: Microbes (10 Hours)
Viruses-Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria-Discovery, General characteristics and cell structure; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance

Module II: Algae (12 Hours)
General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life - cycles of the following: Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia Economic importance of algae

Module III: Fungi (12 Hours)
Introduction - General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi – General characteristics, ecology and significance, life cycle of Synchytrium (Chytridiomycota), Rhizopus (Zygomyctota) Penicillium, Alternaria (Ascomycota), Puccinia, Agaricus (Basidiomycota); Symbiotic Associations - Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

Module IV: Introduction to Archegoniate (2 Hours)
Unifying features of archegoniates, Transition to land habit, Alternation of generations

Module V: Bryophytes (10 Hours)
General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of Marchantia and Funaria (Developmental details not to be included) Ecology and economic importance of bryophytes with special mention of Sphagnum

Module VI: Pteridophytes (8 Hours)
General characteristics, classification, Early land plants (Cooksonia and Rhynia). Classification (up to family), morphology, anatomy and reproduction of Selaginella, Equisetum and Pteris (Developmental details not to be included) Heterospory and seedhabit, stellar evolution Ecological and economical importance of Pteridophytes

Module VII: Gymnosperms (6 Hours)
General characteristics, classification: Classification (up to family), morphology, anatomy and reproduction of Cycas and Pinus (Developmental details not to be included) Ecological and economical importance

Suggested Readings

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BOEB0117: ENVIRONMENTAL BIOTECHNOLOGY (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Recall the basic knowledge of environment, its policies and how to protect it (Remembering)
2. Understand the concept of environmental hazards and how bioremediation helps in cleansing it (Understanding)
3. Analyze the basic concept of sustainable development (Analyzing)
4. Assess the various ways of microbial treatment to make the environment pollution free (Evaluating)

Module I: Environment (4 Hours)
Environment -basic concepts and issues, global environmental problems - ozone depletion, UV-B, greenhouse effect and acid rain due to anthropogenic activities, their impact and biotechnological approaches for management

Module II: Atmospheric Stratification (6 Hours)
An overview of atmosphere, hydrosphere, lithosphere and atmosphere - environmental problems Environmental pollution - types of pollution, sources of pollution, measurement of pollution, methods of measurement of pollution, fate of pollutants in the environment, Bioconcentration, bio/geomagnification

Module III: Microbial Treatment (8 Hours)
Microbiology of waste water treatment, aerobic process - activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process - anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blanket reactors, treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industries

Module IV: Anthropogenic Factors and its Bioremediation (10 Hours)
Xenobiotic compounds - organic (chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants) and inorganic (metals, radionuclides, phosphates, nitrates). Bioremediation of xenobiotics in environment - ecological consideration, decay behaviour and degradative plasmids, molecular techniques in bioremediation

Module V: Biohazardous Substance (6 Hours)
Role of immobilized cells/enzymes in treatment of toxic compound; Biopesticides, bioreactors, bioleaching, biomining, biosensors, biotechniques for air pollution abatement and odour control

Module VI: Sustainable Development (8 Hours)
Sustainable Development: Economics and Environment: Economic growth, Gross National Productivity and the quality of life, Tragedy of Commons, Economics of Pollution control, Cost-benefit and cost effectiveness analysis, WTO and Environment, Corporate Social Responsibility, Environmental awareness and Education; Environmental Ethics

Module VII: Laws and Policies for Environment Protection (12 Hours)

Module VIII: Public Participation for Environmental Protection (6 Hours)
Public Participation for Environmental Protection: Environmental movement and people’s participation with special references to Gandharmardan, Chilika and Narmada BachaoAndolan, Chipko and Silent valley Movement; Women and Environmental Protection, Role of NGO in bringing environmental awareness and education in the society

Suggested Readings
3. Introduction to Biodeterioration, D.Allsopp and K.J. Seal, ELBS / Edward Arnold.

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BOBB0118: ECONOMIC BOTANY AND PLANT BIOTECHNOLOGY (4 Credits: 60 Hours) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Recall the concept of origin of crops, and evolution of new crops (Remembering)
2. Perceive the ideas of different economically useful crops and their products processing (Understanding)
3. Apply the knowledge of plant tissue culture and DNA technologies in producing disease free plants (Applying)
4. Generate ideas and techniques on hybridoma technology and disease diagnosis (Creating)

Module I: Origin of Cultivated Plants (4 Hours)
Concept of centres of origin, their importance with reference to Vavilov's work

Module II: Cereals (4 Hours)
Wheat -Origin, morphology, uses

Module III: Legumes (6 Hours)
General account with special reference to Gram and soybean

Module IV: Spices (6 Hours)
General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses).

Module V: Beverages (4 Hours)
Tea (morphology, processing, uses)

Module VI: Oils and Fats (4 Hours)
General description with special reference to groundnut

Module VII: Fibre Yielding Plants (4 Hours)
General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

Module VIII: Introduction to biotechnology (2 Hours) Module IX: Plant Tissue Culture (8 Hours)
Micropropagation; haploid production through androgenesis and gynogenesis; brief account of embryo and endosperm culture with their applications

Module X: Recombinant DNA Techniques (18 Hours)
Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR, Hybridoma and monoclonal antibodies, ELISA and Immunodetection Molecular diagnosis of human disease, Human gene Therapy

Suggested Readings

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BORA0119: REPRODUCTIVE BIOLOGY OF ANGIOSPERMS (4 CREDITS - 60 HOURS) (L-T-P: 4-0-0)

Course Outcomes
At the end of this course, student will be able to:
1. Define and tell the basic ideas of anther, ovule, endosperm, and embryoand seed (Remembering)
2. Demonstrate and explain concepts of pollen biology, pollination and fertilization, self-incompatibility (Understanding).
3. Plan and develop protocols for studying pollination, fertilization and embryogenesis (Applying)
4. Categorize and distinguish different reproductive mechanisms in Angiosperm (Analyzing)
5. Compare and evaluate methods of pollination and self-incompatibility in plants (Evaluating)
6. Design and improve protocols for transformation (Creating)

Module I: Introduction to Reproductive Biology in Angiosperms (2 Hours)
History (contributions of G.B. Amici, W. Hofmeister, E. Strasburger, S.G. Nasawchin, P. Maheshwari, B.M. Johri, W.A. Jensen, J. Heslop-Harrison) and scope

Module II: Anther and Pollen Biology (12 Hours)
Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance, Microgametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC system; Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; abnormal features: Pseudomonads, polyads, massulae, pollinia

Module III: Ovule (8 Hours)
Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of Polygonum type); Organization and ultrastructure of mature embryo sac

Module IV: Pollination and Fertilization (6 Hours)
Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization

Module V: Self Incompatibility (8 Hours)
Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self-incompatibility: mixed pollination, bud pollination, stub pollination; Intraovarian and in vitro pollination; Modification of stigma surface, parasexual hybridization; Cybrids, in vitro fertilization
Module VI: Endosperm and Embryo (16 Hours)
Types, development, structure and functions, Six types of Embryogeny; General pattern of development of dicot and monocot embryo; Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo; Unusual features; Embryo development in *Paeonia*, polyembryony and apomixes

Module VII: Seed and Germline Transformation (4 Hours)
Structure, importance and dispersal mechanisms, Pollen grain and ovules through pollen tube pathway method/ *Agrobacterium* / electrofusion/ floral dip/ biolistic
Suggested Readings

Mapping of COs to Syllabus

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BOPP0120: PLANT PHYSIOLOGY (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course outcomes
At the end of this course, student will be able to:

CO1: Recall nutrient uptake and translocation in plants (Remembering)

CO2: Explain concepts of plant water relation and mineral nutrition (Understanding)

CO3: Interpret the concepts of photoperiodism, phytochrome and vernalization (Understanding)

CO4: Understand the models for diffusion and translocation studies (Applying)

CO5: Analyze the functions of growth regulators (Analyzing)

CO6: Formulate methods to test actions of Plant Growth Regulators in vitro/in vivo (Creating)

Module I: Plant Water Relationship (10 Hours)
Water Potential and its components, water absorption by roots, aquaporins, and pathway of water movement, symplast, apoplasm, transmembrane pathways, root pressure, and guttation. Ascent of sap–cohesion-tension theory, transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement

Module II: Mineral Nutrition (8 Hours)
Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents

Module III: Nutrient Uptake (8 Hours)
Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport

Module IV: Translocation in the Phloem (8 Hours)
Experimental evidence in support of phloem as the site of sugar translocation, Pressure–Flow Model; Phloem loading and unloading; Source–sink relationship

Module V: Plant Growth Regulators (14 Hours)
Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, brassinosteroids and Jasmonic acid, Biosynthetic pathways

Module VI: Physiology of Flowering (6 Hours)
Photoperiodism, flowering stimulus, ABC model and florigen concept, vernalization, seed dormancy

Module VII: Phytochrome (6 Hours)
Discovery, chemical nature, role of phytochrome in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action

Suggested Readings

Mapping of COs to Syllabus
CO1                  H     M
CO2                  H     M     L
CO3                  H     H     H
CO4                  H
CO5                  H
CO6                  H

BOAP0121: ANALYTICAL TECHNIQUES IN PLANT SCIENCES (4 CREDITS: 60 HOURS) (L-T-P: 4-0-0)

Course outcomes
At the end of this course, student will be able to:
1. Interpret various microscopic techniques (Understanding)
2. Compare the different centrifugation techniques (Understanding)
3. Apply radioisotopes and spectrophotometry in biological research (Applying)
4. Illustrate the various chromatographic and molecular techniques (Understanding)
5. Utilize the knowledge of biostatistics in solving related problems (Applying)

Module I: Imaging and Related Techniques (15 Hours)
Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching

Module II: Cell Fractionation (8 Hours)
Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2gradient, analytical centrifugation, ultracentrifugation, marker enzymes

Module III: Radioisotopes (4 Hours)
Use in biological research, auto-radiography, pulse chase experiment

Module IV: Spectrophotometry (4 Hours)
Principle and its application in biological research

Module V: Chromatography (8 Hours)
Principle; Paper chromatography, Column chromatography, TLC, GLC, HPLC, ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography

Module VI: Characterization of Proteins and Nucleic Acids (6 Hours)
Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE, native PAGE

Module VII: Biostatistics (15 Hours)
Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit

Suggested Readings

Mapping of COs to Syllabus

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BOBS0122: BIOSTATISTICS (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course outcomes
At the end of this course, student will be able to:
1. Define basic terminologies in Biostatistics (Remembering)
2. Explain the concepts of biostatistics and its use in biology (Understanding)
3. Apply the statistics tools for data analysis (Applying)
4. Design sampling methods to generate significant data (Creating)

Module I: Introduction (12 Hours)
Biostatistics - definition - statistical methods - basic principles Variables - measurements, functions, limitations and uses of statistics

Module II: Collection of Data (12 Hours)
Collection of data primary and secondary - types and methods of data collection procedures - merits and demerits Classification - tabulation and presentation of data - sampling methods

Module III: Measures of Central Tendency (14 Hours)
Measures of central tendency - mean, median, mode, geometric mean - merits & demerits. Measures of dispersion - range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co-efficient of variations

Module IV: Correlation & Regression (12 Hours)
Correlation - types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression

Module V: Statistical Inference (10 Hours)
Statistical inference - hypothesis - simple hypothesis - student’t’ test - chi square test

Suggested Readings
4. Bishop, O. N. Houghton, Mifflin Statistics for Biology, Boston

Mapping of COs to Syllabus:

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BOPM0123: PLANT METABOLISM (4 CREDITS-60 HOURS)(L-T-P: 4-0-0)

Course outcomes
At the end of this course, student will be able to:
1. Interpret the ideas of metabolism (Understanding)
2. Summarize photosynthesis and the different pathways involved (Understanding)
3. Explain carbohydrate metabolism (Understanding)
4. Rephase respiration and the different pathways involved (Understanding)
5. Explain the mechanisms of ATP synthesis and compare oxidative, substrate level and photophosphorylation (Understanding)
6. Outline lipid and nitrogen metabolism (Understanding)
7. Demonstrate signal transduction (Understanding)

Module I: Concept of Metabolism (6 Hours)
Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and Isozymes)

Module II: Carbon Assimilation (14 Hours)
Historical background, photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centers, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO2 reduction, photorespiration, C4 pathways; Crassulacean acid metabolism; Factors affecting CO2 reduction
Module III: Carbohydrate Metabolism (2 Hours)
Synthesis and catabolism of sucrose and starch

Module IV: Carbon Oxidation (10 Hours)
Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle, amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration

Module V: ATP Synthesis (8 Hours)
Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyers conformational model, Racker’s experiment, Jagendorf’s experiment; role of uncouplers

Module VI: Lipid Metabolism (8 Hours)
Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation

Module VII: Nitrogen Metabolism (8 Hours)
Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination

Module VIII: Mechanisms of Signal Transduction (4 Hours)
Calcium, phospholipids, cGMP, NO

Suggested Readings

Mapping of COs to Syllabus

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BOPB0124: PLANT BIOTECHNOLOGY (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course outcomes
At the end of this course, student will be able to:
1. Memorize the various concepts of plant tissue culture (Remembering)
2. Explain Plant tissue culture & recombinant DNA Technology (Understanding).
3. Apply basic knowledge in plant tissue and modern techniques of micropropagation in their future research works(Applying)
4. Develop/improve protocols for better transgenic products (Creating)

Module I: Plant Tissue Culture (16 Hours)
Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation)

Module II: Recombinant DNA Technology (30 Hours)
Restriction Endonucleases (History, Types, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC and briefly PAC, MAC, HAC).Gene Cloning (Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning); Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; Probes-oligonucleotide, heterologous, PCR; Methods of gene transfer.
Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics–selectable marker and reporter genes (Luciferase, GUS, GFP)

Module III: Applications of Biotechnology (14 Hours)
GMOS, Pest resistant (Bt-cotton); herbicide resistant plants (Roundup Ready soybean); Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns

Suggested Readings

Mapping of COs to Syllabus

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BORM0125: RESEARCH METHODOLOGY FOR BOTANY
(4 Credits-60 Hours) [L-T-P: 4-0-0]

Course outcomes
At the end of this course, student will be able to:
1. Infer the basic idea of research (Understanding)
2. Interpret common laboratory calculations, handling of laboratory chemicals and instruments, maintenance of laboratory records and documentation of observations (Understanding)
3. Interpret various biological problems (Understanding)
4. Demonstrate various plant tissue culture and cytological techniques (Understanding)
5. Utilize the concepts of research methodology in presenting research data and writing research articles (Applying)

Module I: Basic concepts of research (10 Hours)
Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical) Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research

Module II: General laboratory practices (12 Hours)
Common calculations in botany laboratory practices, understanding the details on the label of reagent bottles molarity and normality of common acids and bases. Preparation of solutions, Dilutions, Percentage solutions. Molar, molal and normal solutions, technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling

Module III: Data collection and documentation of observations (6 Hours)
Maintaining a laboratory record; Tabulation and generation of graphs imaging of tissues specimens and application of scale bars, the art of field photography

Module IV: Overview of Biological Problems (6 Hours)
History; Key biology research areas, Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics- Transcriptional regulatory network

Module V: Methods to study plant cell/tissue structure (6 Hours)
Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives; tissue dehydration using graded solvent series; Paraffin and plastic infiltration; Preparation of thin and ultrathin sections
Module VI: Plant microtechniques (12 Hours)
Staining procedures, classification and chemistry of stains, staining equipment, reactive dyes and fluorochromes (including genetically engineered protein labeling with GFP and other tags) Cytogenetic techniques with squashed plant materials

Module VII: The art of scientific writing and its presentation (8 Hours)
Numbers, units, abbreviations and nomenclature used in scientific writing, writing references, powerpoint presentation, Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism

Suggested Readings

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BOIE0126: INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY (4 CREDITS-60 HOURS) (L-T-P: 4-0-0)

Course outcomes
At the end of this course, student will be able to:
1. Tell the basics of bioreactors and fermentation process (Remembering)
2. Explain the role of microbes in industry, agriculture and environment (Understanding)
3. Select suitable microbes for solving some environmental problems (Applying)
4. Compare various fermentation techniques applied in industry (Analyzing)
5. Assess and evaluate pollutants in environment (Evaluating)
6. Develop methods for fermentation (Creating)

Module I: Scope of Microbes in Industry and Environment (6 Hours) Module II: Bioreactors/Fermenters and Fermentation Processes (12 Hours)
Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous fermentations, components of a typical bioreactor, Types of bioreactors-laboratories, pilot scale and production fermenters; constantly stirred tank fermenter, tower fermenter, fixed bed and fluidized bed bioreactors and air-lift fermenter, a visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations

Module III: Microbial Production of Industrial Products (12 Hours)
Microorganisms involved, media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying; Hands on microbial fermentations for the production and estimation (qualitative and quantitative) of Enzyme: amylase or lipase activity, Organic acid (citric acid or glutamic acid), alcohol (Ethanol) and antibiotic (Penicillin)

Module IV: Microbial Enzymes of Industrial Interest and Enzyme Immobilization (8 Hours)
Microorganisms for industrial applications and hands on screening microorganisms for casein hydrolysis; starch hydrolysis; cellulose hydrolysis. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase)

Module V: Microbes and Quality of Environment (6 Hours)
Distribution of microbes in air; Isolation of microorganisms from soil, air and water

Module VI: Microbial Flora of Water (8 Hours)
Water pollution, role of microbes in sewage and domestic waste water treatment systems; Determination of BOD, COD, TDS and TOC of water samples; Microorganisms as indicators of water quality, check coliform and fecal coli form in water samples

Module VII: Microbes in Agriculture and Remediation of Contaminated Soils (8 Hours)
Biological fixation; Mycorrhizae; Bioremediation of contaminated soils, isolation of root nodulating bacteria, arbuscular mycorrhizal colonization in plant roots

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Suggested Readings

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LABORATORY COURSES

BOMP6026: MYCOLOGY AND PHYCOLOGY LAB (3 CREDITS-90 HOURS) (L-T-P: 0-0-3)

Course Outcomes
At the end of this course, student will be able to:
1. Learn about the vegetative and reproductive structures of some important classes of fungi and algae (Understanding)
2. Acquire knowledge and importance of mycorrhizae and lichens (Understanding)
3. Learn the techniques of isolation of fungi and algae (Applying)
4. Learn the technique of producing fungal and algal bio-fertilizers (Applying)

Expt.1. Study of thallus organization, Spore producing organs, and accessory structures of Myxomycotina, Mastigomycotina, Oomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina
Expt.2. Study of morphological and anatomical features of Crustose, Foliose and Fruticose lichens
Expt.3. Isolation and characterization of fungi up to species from soil
Expt.4. Study of range of vegetative and reproductive structures of algae in Cyanophyta, Chlorophyta, Phaeophyta, Rhodophyta, Xanthophyta, Bacillariophyta, and Euglenophyta
Expt.5. Production techniques of fungal and algal based bio-fertilizers

Mapping of COs to Syllabus

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BOBA6027: BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND ANGIOSPERMS LAB (3 CREDITS-90 HOURS) (L-T- P: 0-0-3)

Course Outcomes
At the end of this course, student will be able to:
1. Interpret the concepts of classification system and identification of few important bryophytes (Understanding)
2. Infer the concepts of classification system and identification of few important pteridophytes (Understanding)
3. Summarize the concepts of classification system and identification of few important gymnosperms (Understanding)
4. Collect, prepare and document herbarium specimens through non-destructive field collection method so as to get acquainted with herbarium technique (Applying)
5. Differentiate between monocots and dicots (Understanding)
6. Interpret sporogenesis and gametogenesis in angiosperms (Understanding)

Part 1: Bryophytes, Pteridophytes and Gymnosperms
Expt.1. Study of morphology and reproductive structures of the following bryophytes: Riccia, Marchantia, Anthoceros, Sphagnum, Polytrichum, Funaria, Porella.
Expt.2. Study of morphology and reproductive structures and observe arrangement of Sori on a receptacle of the following pteridophytes: Lycopodium, Selaginella, Marsilea, Equisetum, Azolla, Selvinia, Adiantum
Expt.3. To study the anatomy, morphology and reproductive features of the following gymnosperms: Cycas, Pinus, Cryptomeria, Thuja,

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Podocarpus, Gnetum, Zamia, Ginkgo

Part 2: Angiosperms
Expt.4. Collection, preparation and documentation of herbarium specimens through non-destructive field collection methods as to get acquainted with herbarium technique.
Expt.5. Taxonomic study of selected families of dicots and monocots of angiospermic plants with the help of analytical drawings, botanical description and identification up to the rank of species.
Expt.6. Study of various stages of sporogenesis and gametogenesis in selected species of angiospermic plants

Mapping of COs to Syllabus

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BOCB6028: CELL & MOLECULAR BIOLOGY, PLANT PHYSIOLOGY & BIOCHEMISTRY LAB (3 CREDITS-90 HOURS) (L-T- P: 0-0-3)

Course Outcomes
At the end of this course, student will be able to:
1. Get acquainted with tools and techniques of molecular biology (Remembering)
2. Perform DNA isolation of genomic DNA and understand how to calculate recombination frequencies (Understanding)
3. Learn and understand the underlying principle behind respiration, transpiration and photosynthesis. (Understanding)
4. Analyze the concept of diffusion pressure deficit and impact of organic solvent in membrane permeability (Analyzing)
5. Identify analytical instruments to carry out experiments (Applying)
6. Analyze the properties of plant biomolecules (Analyzing)

Part 1: Cell & Molecular Biology
Expt.1. Acquaintance with molecular biology laboratory and instruments
Expt.2. Practical on cytoplasmic streaming in plant cell
Expt.3. Extraction of DNA from strawberry/banana by alcohol precipitation method
Expt.4. Isolation of genomic DNA from plant materials using SDS/CTAB method
Expt.5. Calculation of recombination frequencies of genes

Part 2: Plant Physiology
Expt.6. Determination of osmotic potential in potato tuber
Expt.7. To study the effect of different organic solvents (alcohol, formalin, benzene) on the permeability of plasmamembrane of beet root
Expt.8. Determination of the effect of CO2 concentration on the rate of photosynthesis by inverted funnel method
Expt.9. Determination of the effect of intensity of light on the rate of photosynthesis
Expt.10. To study the effect of different Phytohormones on the germination of seeds

Part 3: Plant Biochemistry
Expt.11. Estimation of protein using calibration curve following the protocol of Lowry et al., method
Expt.12. Estimation of nitrate reductase activity
Expt.13. To study the effect of NR activity in presence of light and dark period
Expt.14. Preparing the calibration curve of nitrite using azo-coupling method of Snell and Snell
Expt.15. Isolation of Plant DNA and their spectrophotometric quantification

Mapping of COs to Syllabus

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BOPP6029: PLANT MICROBIOLOGY AND PLANT PATHOLOGY LAB (3 CREDITS-90 HOURS) (L-T-P: 0-0-3)

Course Outcomes
At the end of this course, student will be able to:
1. Prepare different media used in microorganism isolation (Applying)
2. Apply various techniques for identifying different microbes (Applying)
3. Develop protocols and methods for characterizing microbes (Creating)
4. Identify chemicals agents, plants pathogens and their symptoms on diseased plant (Applying)

Expt.1. Preparation of nutrient media (solid/liquid) for culture
Expt.2. Staining techniques (Grams staining, flagella staining, capsule staining and acid fast staining of bacteria)
Expt.3. Isolation and characterization of pure cultures of microbes from soil, water and plant samples
Expt.4. Estimation of bacterial growth by spectrophotometric method
Expt.5. Culturing and isolation techniques of viruses (through seminar/virus lab visit)
Expt.6. In vitro and in vivo evaluation of chemicals against plant pathogens
Expt.7. Detailed study of symptoms of representative diseases of plantation crops, Collection and dry preservation of diseased specimens of important crops

Mapping of COs to syllabus

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BOPE6030: PLANT ECOLOGY LAB (3 CREDITS-90 HOURS) (L-T-P: 0-0-3)

Course Outcomes
At the end of this course, student will be able to:
1. Gain knowledge about the population and communities characteristics in a given field
2. Gain knowledge about the concepts of analyzing edaphic characteristics
3. Gain knowledge about the analysis of physicochemical properties of water bodies

Expt.1. To determine the minimum size of the quadrat by species area-curve method.
Expt.2. To determine abundance, density, frequency, basal covers of plant communities by quadrant method.
Expt.3. To determine minimum number of quadrats required for reliable estimate of biomass in grasslands.
Expt.4. To compare protected and unprotected grassland stands using community coefficients (similarity indices).
Expt.5. Estimation of Importance Value Index (IVI) of the species in a grassland/woodland using quadrant method.
Expt.6. To estimate the above ground and below ground biomass from unit area.
Expt.7. To analyze the edaphic characteristics- Soil profile, Texture, Soil moisture, Water holding capacity, Porosity, pH, Organic matter content, and quantitative estimation of N, P, K.
Expt.8. To study the physicochemical characteristics from polluted and unpolluted water bodies: DO, COD, BOD, pH, Hardness, Alkalinity, Conductivity, Free CO2, Chloride, Nitrate and Phosphate.
Expt.9. Field Study

Mapping of CO's to Syllabus

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BOCT6031: CYTOGENETICS, MOLECULAR TECHNIQUES AND TISSUE CULTURE LAB (3 CREDITS-90 HOURS) (L-T-P: 0- 0-3)

Course Outcomes
At the end of this course, student will be able to:
1. Interpret mitosis, meiosis and chromosomal aberration (Understanding)
2. Solve problems based on gene interactions (Applying)
3. Show hybridization in self and cross pollinated crops (Applying)
4. Interpret the basics of plant tissue culture (Understanding)
5. Utilize various chromatographic techniques to separate amino acids and plant pigments (Applying)
6. Isolate biomolecules and learn to use a thermal cycler (Applying)
7. Design primers using various software and use BLAST to identify sequences of similarity (Applying)
8. Develop somatic embryos and artificial seeds (Creating)

Part 1: Cyto genetics
Expt.1. Identification of mitosis from suitable plant material (Onion and garlic root tips)
Expt.2. Identification of meiosis from suitable plant material (Onion floral buds)
Expt.3. Study of chromosomal aberrations in plant (Rhoeo)
Expt.4. Study of numerical problems involving gene interactions
Expt.5. Practice of hybridization technique in self and cross pollinated plants species

Part 2: Molecular Techniques & Bioinformatics
Expt.6. Separation of amino acids and plant pigments by paper chromatography and thin layer chromatography (TLC)
Expt.7. Isolation of plasmid/genomic DNA
Expt.8. Isolation of total RNA from plant sample using Trizol method
Expt.9. Understanding the functioning of a thermal cycler/ Amplification of a gene using PCR
Expt.10. Designing of primers and identifying regions of similarity in biological sequences using BLAST

Part 3: Tissue culture
Expt.11. Preparation of MS nutrient medium and study of the sterilization techniques
Expt.12. Induction of callus from explants
Expt.13. Study of somatic embryogenesis in Daucus carota
Expt.14. Study of embryo culture using suitable explants
Expt.15. Preparation of artificial seeds

Mapping of COs to Syllabus

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BODI6032: DISSERTATION PHASE I (4 CREDITS-120 HOURS)

Description
1. Review of literature related to the research problem assigned to the students.
2. Practicing research ethics and methodology

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3. Writing review articles related to the research problem.
4. Publishing these review articles in peer-reviewed journals.
5. Initial setting up of experiments to resolve the research problem
6. Writing and presenting the synopsis of the research problem.

BOER6033: ENVIRONMENTAL MANAGEMENT, RESEARCH METHODOLOGY AND BIOSTATISTICS & BIOCHEMICAL LAB
(2 Credits-60 Hours) (L-T-P: 0-0-2)

Course Outcomes
At the end of this course, student will be able to:
1. Apply ideas gained for experimental surveys and writing sound scientific papers (Applying)
2. Apply the concepts of statistics for interpreting scientific data (Applying)
3. Develop ideas for small scale start-ups (Creating)

Expt.1. Practicals on design of vermicompost/mushroom unit
Expt.2. Survey of environment risk prone areas
Expt.3. Scientific search engine tour for e-resources, research article, review article, scientific problems
Expt.4. Calculation of mean, median, mode, standard deviation, quartile deviation and coefficient of variation froma given dataset
Expt.5. Calculation of chi square statistic (goodness of fit & independence of attributes)
Expt.6. Calculation of student’s t-test
Expt.7. Calculation of analysis of variance (ANOVA)
Expt.8. Designing CRD for an experimental layout
Expt.9. Designing RBD for an experimental layout
Expt.10. Determination of coefficients of partial and multiple correlation
Expt.11. Determination of the regression coefficient

Mapping of CO’s to Syllabus

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BODI6034: DISSERTATION PHASE II
(12 Credits-360Hours)

Description
1. Conducting experiments to resolve the research problem
2. Writing research articles and reviewing papers related to the research problem
3. Publishing these research and review papers in peer-reviewed journals
4. Presenting, explaining and defending the dissertation
5. Writing the dissertation

BOAM6101: ALGAE AND MICROBIOLOGY LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)

Course outcomes
At the end of this course, student will be able to:
1. Differentiate between cell shapes and structures of microorganisms (Applying)
2. Able to understand reproduction and multiplication processes in microbes (Understanding)
3. Utilize and create basic identification techniques for microbes (Creating)

Practical:
Microbiology
Expt.1. Electron micrographs/Models of viruses – T-Phage and TMV. Line drawings/ Photographs of Lytic and Lysogenic Cycle
Expt.2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root nodule
Expt.3. Gram staining
Expt.4. Endospore staining with malachite green using the (endospores taken from soil bacteria)

Phycology
Expt.5. Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Volvox, Oedogonium, Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia, Prochloron through electron micrographs, temporary preparations and permanent slides
BOMP6103: MYCOLOGY AND PHYTOPATHOLOGY LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)

Course outcomes
At the end of this course, student will be able to:
1. Able to recall the general structure of fungi, allied fungi and lichens and show their reproductive structures (Remembering)
2. Able to demonstrate thallus structure of different classes of fungi (Understanding)
3. Examine the methods of reproduction in fungi (Analyzing)
4. Able to formulate control measures of deadly plant pathogens and also develop plans for preparation of herbarium (Creating)

Practical:
Expt.1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps)
Expt.2. Rhizopus: study of asexual stage from temporary mounts and sexual structures through permanent slides
Expt.3. Aspergillus and Penicillium: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photosgraphs
Expt.4. Peziza: sectioning through ascocarp
Expt.5. Alternaria: Specimens/photosgraphs and temporary mounts
Expt.6. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/ mountsof spores on wheat and permanent slides of both the hosts
Expt.7. Agaricus: Specimens of button stage and full-grown mushroom; sectioning of gills of Agaricus, fairy rings and bioluminescent mushrooms to be shown
Expt.8. Study of phaneroplasmoidum and aphanoplasmodium from actual specimens and /or photograph
Expt.9. Albugo: Study of symptoms of plants infected with Albugo; asexual phase study through section/ temporary mounts and sexual structures through permanent slides
Expt.10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and 

DEPARTMENT OF BIOSCIENCES - BOTANY
reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)

**Expt.11.** Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, fungal diseases: Early blight of potato, Black stems rust of wheat and White rust of crucifers
BOAR6104: ARCHEGONIATE LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)

Course outcomes
At the end of this course, student will be able to:
1. Infer the various morphological, anatomical and reproductive features of important bryophytes (Understanding)
2. Interpret the various morphological, anatomical and reproductive features of important pteridophytes (Understanding)
3. Demonstrate the various morphological, anatomical and reproductive features of important gymnosperms (Understanding)
4. Develop the art of preparing slides of various archegoniate specimens and identifying them under the microscope (Applying)
5. Identify different bryophytes, pteridophytes and gymnosperms in their natural habitat (Applying)

Practical:
Expt. 1. *Riccia*- Study of morphology of thallus
Expt. 2. *Marchantia*- Study of morphology of thallus, whole mount of rhizoids & Scales, vertical section of thallus through Gemma cup, whole mount of Gemmæ (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides)
Expt. 3. *Anthoceros*- Study of morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide)
Expt. 4. *Pellia, Porella*- Study of these specimens through permanent slides
Expt. 5. *Sphagnum*- Study of morphology of plant, whole mount of leaf (permanent slide only)
Expt. 6. *Funaria*- Study of morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema
Expt. 7. *Psilotum*- Study of specimen, transverse section of synangium (permanent slide)
Expt. 8. *Selaginella*- Study of morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide)
Expt. 9. *Equisetum*- Study of morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide)
Expt. 10. *Pteris*- To study the morphology, transverse section of rachis, vertical section of sporophyll, wholemount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide)
Expt. 11. *Cycas*- To study the morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide)
Expt. 12. *Pinus*- To study the morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, transverse section of stem, longitudinal section of /transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of female cone, tangential longitudinal section and radial longitudinal sections stem (permanent slide)
Expt. 13. *Gnetum*- Study of morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)

Mapping of COs to Syllabus:

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BOMA6105: MORPHOLOGY AND ANATOMY LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)
Course Outcomes
At the end of this course, student will be able to:
1. Prepare permanent slides, temporary stain mounts, macerations and museum specimens (Creating)
2. Gain the knowledge about apical meristem of root, shoot and vascular system (Understanding)
3. Apprehend the ideas of distribution and types of tissues (Understanding)
4. Gain an understanding on secondary growth and wood anatomy in plants (Applying)
5. Scrutinize the different aspects of plant adaptations (Analyzing)
6. Estimate the importance of plant secretory systems (Evaluating)

Practical:
Expt.1. Study of anatomical details through permanent slides/temporary stain mounts/ macerations/ museum specimens with the help of suitable examples
Expt.2. Apical meristem of root, shoot and vascular cambium
Expt.3. Distribution and types of parenchyma, collenchyma and sclerenchyma
Expt.4. Xylem: Tracheary elements- tracheids, vessel elements; thickenings; perforation plates; xylem fibres
Expt.5. Wood: ring porous; diffuse porous; tyloses; heart-and sapwood
Expt.6. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres
Expt.7. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular
Expt.8. Root: monocot, dicot, secondary growth
Expt.9. Stem: monocot, dicot.- primary and secondary growth; periderm; lenticels
Expt.10. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy)
Expt.11. Adaptive Anatomy: xerophytes, hydrophytes
Expt.12. Secretory tissues: cavities, laticifers and laticifers

Mapping of COs to Syllabus

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BOEB6106: ECONOMIC BOTANY LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)

Course Outcomes
At the end of this course, student will be able to:
1. Recollect the morphology and anatomy of various economically important plants (Remembering)
2. Explain the economic importance of crop plants (Understanding)
3. Execute various micro-chemical tests of cereals, legumes, sugars and starches (Applying)
4. Able to carry out qualitative and quantitative checking of crop plant products (Evaluating)

Practical:
Expt.1. Cereals: Wheat (habit sketch, L S/T.S. grain, starch grains, micro-chemical tests) Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests)
Expt.2. Legumes: Soya bean, Groundnut, (habit, fruit, seed structure, micro-chemical tests)
Expt.3. Sugars & Starches: Sugarcane (habit sketch; cane juice-micro-chemical tests), Potato (habit sketch, tubermorphology, T.S. tuber to show localization of starch grains, w. m. starch grains, micro-chemical tests)
Expt.4. Spices: Black pepper, Fennel and Clove (habit and sections)
Expt.5. Beverages: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans)
Expt.6. Oils & Fats: Coconut-T.S. Nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds
Expt.7. Essential oil yielding plants: Habit sketch of Rosa, Vetiveria, Santalum and Eucalyptus (specimens/photographs)
Expt.8. Rubber: specimen, photograph/model of tapping, samples of rubber products
Expt.9. Drug yielding plants: Specimens of Digitalis, Papaver and Cannabis
Expt.10. Tobacco: specimen and products of Tobacco
Expt.11. Woods: Tectona, Pinus: Specimen, Section of young stem.
Expt.12. Fibre yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fibre and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fibre)
**Mapping of COs to Syllabus**

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**BOGE6107: GENETICS LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)**

**Course Outcomes**

At the end of this course, student will be able to:

1. Experiment with meiosis through slide preparation (Applying)
2. Solve problems related to Mendel’s laws, probability and chi-square analysis (Applying)
3. Examine test cross data for chromosome mapping (Analyzing)
4. Analyze pedigree charts (Analyzing)
5. Demonstrate incomplete dominance and gene interaction (Evaluating)
6. Interpret blood typing and human genetic disorders (Understanding)
7. Summarize the various chromosomal aberrations and human genetic traits (Understanding)

**Practical:**

- **Expt.1.** Meiosis through temporary squash preparation
- **Expt.2.** Mendel’s laws through seed ratios. Laboratory exercises in probability and chi-square analysis
- **Expt.3.** Chromosome mapping using test cross data
- **Expt.4.** Pedigree analysis for dominant and recessive autosomal and sex-linked traits
- **Expt.5.** Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4)
- **Expt.6.** Blood Typing: ABO groups & Rh factor
- **Expt.7.** Study of aneuploidy: Down’s, Klinefelter’s and Turner’s syndromes
- **Expt.8.** Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge
- **Expt.9.** Study of human genetic traits: Sickle cell anemia, Xeroderma Pigmentosum, Albinism, red-green Colour blindness, Widow’s peak, rolling of tongue, Hitchhiker’s thumb and Attached ear lobe

**Mapping of COs to Syllabus**

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**BOMB6108: MOLECULAR BIOLOGY LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)**

**Course Outcomes**

At the end of this course, student will be able to:

1. Recall the basic knowledge on DNA as the genetic material (Remembering)
2. Grasp the procedure to isolate, purify and estimate DNA and also its various replication mechanisms (Understanding)
3. Infer the concepts of prokaryotic and eukaryotic RNA polymerases (Understanding)
4. Interpret splicing and spliceosome machinery (Understanding)
5. Prepare LB medium for growing bacterial cultures (Creating)

**Practical:**

- **Expt.1.** Preparation of LB medium and raising *E. Coli*
- **Expt.2.** Isolation of genomic DNA from *E. Coli*
- **Expt.3.** DNA isolation from cauliflower head
- **Expt.4.** DNA estimation by diphenylamine reagent/UV Spectrophotometry
- **Expt.5.** Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semidiscontinuous replication)
- **Expt.6.** Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs
- **Expt.7.** Photographs establishing nucleic acid as genetic material (Meselson and Stahl’s, Avery et al, Griffith’s,Hershey & Chase’s and Fraenkel &Conrat’s experiments)
Expt. 8. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism ingroup I & group II introns; Ribozyme and Alternative splicing

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BOPE6109: PLANT ECOLOGY AND PHYTOGEOGRAPHY LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)

Course Outcomes
At the end of this course, student will be able to:
1. Recall their basic knowledge on ecology in order to use instruments to measure microclimatic variables (Remembering)
2. Perceive the concepts of various physico-chemical properties of soil and water (Understanding)
3. Estimate the dissolved oxygen of water samples from polluted and unpolluted sources (Evaluating)
4. Utilize their knowledge to demonstrate and calculate the plant communities (Applying)
5. Fabricate the concepts of ecology and inculcating these ideas in their young minds through field visits (Creating)

Practical:
Expt. 1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
Expt. 2. Determination of pH of various soil and water samples
Expt. 3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soilsamples by rapid field tests
Expt. 4. Determination of organic matter of different soil samples by Walkley & Black rapid titration method
Expt. 5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats
Expt. 6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources
   • Study of morphological adaptations of hydrophytes and xerophytes (four each)
   • Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanche) Epiphytes, Predation (Insectivorous plants)
Expt. 7. Determination of minimal quadrat size for the study of herbaceous vegetation by species area curve method(species to be listed)
Expt. 8. Quantitative analysis of herbaceous vegetation for frequency and comparison with Raunkiaer’s frequency distribution law
Expt. 9. Quantitative analysis of herbaceous vegetation for density, abundance and IVI
Expt. 10. Field visit to familiarize students with ecology of different sites

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BOPS6110: PLANT SYSTEMATICS LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)

Course outcomes
At the end of this course, student will be able to:
1. Interpret the vegetative characters and systematic position of various angiospermic plants (Understanding)
2. Utilize their knowledge on angiosperms to study the floral characters through slide preparation (Applying)
3. Apply the ideas of plant taxonomy and systematics in identifying different plant specimens in their natural habitat(Applying)
4. Develop the art of preparing herbarium of plant specimens (Creating)

Practical:
Expt. 1. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker’s system of classification): Ranunculaceae- Ranunculus, Delphinium Brassicaceae- Brassica, Alyssum / Iberis Myrtaceae- Eucalyptus, Callistemon Umbelliferae- Coriandrum /
Anethum / Foeniculum Asteraceae- Sonchus / Launaea, Vernonia / Ageratum, Eclipta/ Tridax Solanaceae- Solanum nigrum / WithaniaLamiaceae- Salvia / OcimumEuphorbiaceae- Euphorbia hirta/ E. mili, Jatropha Liliaceae- Asphodelus / Lilium / AlliumPoaceae- Triticum / Hordeum / Avena

Expt.2. Field visit (local) – Subject to grant of funds from the university.
Expt.3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book)

Mapping of COs to Syllabus

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**BOBV6111: BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE) LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)**

Course outcomes
At the end of this course students will be able to:
1. Interpret bacteria and viruses (Understanding)
2. Dissect the steps involved in gram staining (Analyzing).
3. Illustrate the unique features of algae and fungi (Understanding).
4. Compare lichens with mycorrhiza (Understanding).
5. Interpret the distinguishing characters of bryophytes, pteridophytes and gymnosperms (Understanding)

Practical:
Expt.1. EMs/Models of viruses – T- Phage and TMV. Line drawing/Photograph of Lytic and Lysogenic Cycle
Expt.2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule
Expt.3. Gram staining
Expt.4. Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Oedogonium, Vaucheria, Fucus* and Polysiphonia through temporary preparations and permanent slides (*Fucus - Specimen and permanent slides)
Expt.5. Rhizopus and Penicillium: Asexual stage from temporary mounts and sexual structures through permanent slides
Expt.6. Alternaria: Specimens/photographs and tease mounts
Expt.7. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/teasmounts of spores on Wheat and permanent slides of both the hosts
Expt.8. Agaricus: Specimens of button stage and full-grown mushroom; Sectioning of gills of Agaricus
Expt.9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
Expt.10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
Expt.11. Marchantia: Morphology of thallus, Wm rhizoids and scales, vs thallus through gemma cup, Wm. gemmae(all temporary slides), vsantheridiophore, archegoniophore, LS sporophyte (all permanent slides)
Expt.12. Funaria: Morphology, Wm leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, LS capsule and protonema
Expt.13. Selaginella: Morphology, Wm leaf with ligule, TS stem, Wm strobilus, Wm microsporophyll and megasporophyll (temporary slides), LS strobilus (permanent slide)
Expt.14. Equisetum: Morphology, TS internode, LS strobilus, TS strobilus, Wm sporangiophore, Wm spores (wet and dry) (temporary slides); TS rhizome (permanent slide)
Expt.15. Pteris: Morphology, TS rachis, vs sporophyll, Wm sporangium, Wm spores (temporary slides), TS rhizome, Wm prothallus with sex organs and young sporophyte (permanent slide)
Expt.16. Cycas: Morphology (coralloid roots, bulbil, leaf), TS coralloid root, TS rachis, vs leaflet, vs microsporophyll, Wm spores (temporary slides), LS ovule, TS root (permanent slide)
Expt.17. Pinus: Morphology (long and dwarf shoots, Wm dwarf shoot, male and female, Wm dwarf shoot, TS needle, TS stem, LS/Ts male cone, Wm microsporophyll, Wm microspores (temporary slides), LS female cone, TS & LS stem (permanent slide)

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BOPT6112: PLANT ECOLOGY AND TAXONOMY LAB (2CREDITS: 60 HOURS) (L-T-P: 0-0-2)

Course Outcomes
At the end of this course, student will be able to:
1. Interpret the working principle of basic equipments used in ecological research (Understanding)
2. Infer the physiochemical characteristics of soil and water (Understanding)
3. Compare hydrophytes with xerophytes (Understanding)
4. Explain ecosystem structure (Understanding)
5. Utilize the knowledge of plant systematics to study the vegetative and floral characters of various angiospermic plants (Applying)
6. Develop the art of preparing herbarium of plant specimens (Creating)

Practical:
Expt.1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter
Expt.2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test
Expt.3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats
Expt.4. Study of morphological adaptations of hydrophytes and xerophytes (four each). Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
Expt.5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (Species to be listed)
Expt.6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer’s frequency distribution law
Expt.7. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, ADBU| Regulations and Syllabus|2021-22| 481
floral formula/e and systematic position according to Bentham & Hooker's system of classification): Brassicaceae – *Brassica*, *Alyssum* / *Iberis*; Asteraceae- *Sonchus/Launaea*, *Vernonia/Ageratum*, *Eclipta/Tridax*; Solanaceae – *Solanumnigrum*, *Withania*; Lamiaceae - *Salvia*, *Ocimum*, Liliaceae *Asphodelus* / *Lilium* / *Allium*

**Expt.8.** Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book)

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**BOEB6113: ENVIRONMENTAL BIOTECHNOLOGY LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)**

**Course Outcomes**

At the end of this course, student will be able to:

1. Understanding the basic knowledge about DO, salinity, pH, chloride, total hardness, alkalinity, acidity, nitrate, calcium, Magnesium and phosphorus (Remembering)
2. Grasp the idea about Gravimetric Analysis- Total solid, dissolved solid, suspended solid in an effluent (Understanding)
3. Utilize the concepts of DO, salinity, pH, chloride, total hardness, alkalinity, acidity, nitrate, calcium, Magnesium and phosphorus in analyzing soil and water (Applying)
4. Scrutinize the concepts of gravimetric analysis (Analyzing)

**Practical:**

- **Expt.1.** Water/Soil analysis - DO, salinity, pH, chloride, total hardness, alkalinity, acidity, nitrate, calcium, Magnesium and phosphorus
- **Expt.2.** Gravimetric analysis-Total solid, dissolved solid, suspended solid in an effluent
- **Expt.3.** Microbial assessment of air (open plate and air sample) and water

### Mapping of COs to Syllabus

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**BOBB6114: ECONOMIC BOTANY AND PLANT BIOTECHNOLOGY LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)**

**Course Outcomes**

At the end of this course, student will be able to:

1. Recall the basic knowledge about economically important plants and plant tissue culture (Remembering)
2. Explain the working principle of plant tissue culture methods and molecular biology equipment (Understanding)
3. Apply and build advanced protocols for plant tissue culture and quality test of plant products (Applying)

**Practical:**

- **Expt.1.** Study of economically important plants: Wheat, Gram, Soybean, Black pepper, Clove, Tea, Cotton, Groundnut through specimens, sections and microchemical tests
- **Expt.2.** Familiarization with basic equipment in tissue culture
- **Expt.3.** Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micro-propagation
- **Expt.4.** Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE

### Mapping of COs to Syllabus

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**BORA6115: REPRODUCTIVE BIOLOGY OF ANGIOSPERMS LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)**

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Course Outcomes
At the end of this course, student will be able to:
CO1: Tell and show various reproductive parts of Angiosperm (Remembering)
CO2: Develop pollin viability test and calculation of germination percentage (Applying)
CO3: Examine various types of ovules, the female gametophyte and intra-ovarian pollination (Evaluating)
CO4: Explain and infer endosperm and embryogenesis (Understanding)
CO5: Dissect developing seeds to determine stages of growth (Analyzing)
CO6: Develop or modify protocols for analysis of seed germination, pollination and embryogenesis (Creating)

Practical:
Expt.1. Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrad, uninculate, bi- celled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation
Expt.2. Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, pseudomonads, polyads, pollinia (slides/photographs, fresh material), ultra-structure of pollen wall (micrograph); Pollen viability: Tetrazolium test germination: Calculation of percentage germination in different media using hanging drop method
Expt.3. Ovule: Types-anatropous, orthotropous, amphi tropous / campylotropous, circinotropous, unitegmic, bitegmic; tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs)
Expt.4. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus
Expt.5. Intra-ovarian pollination; Test tube pollination through photographs
Expt.6. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria
Expt.7. Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs

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BOPP6116: PLANT PHYSIOLOGY LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)

Course outcomes
At the end of this course, student will be able to:
1. Memorize the basic concept of transpiration and stomata (Remembering)
2. Interpret the concepts of osmotic and water potential (Understanding)
3. Infer the ideas behind seed germination, amylase activity and the effect of different concentrations of plant growth hormones like IAA. (Understanding)
4. Calculate stomatal index and frequency and also area and percentage of stoma using the basic knowledge on stomata (Applying)
5. Examine suction pressure due to transpiration, fruit ripening or rooting from cuttings and bolting (Analyzing)

Practical:
Expt.1. Determination of osmotic potential of plant cell sap by plasmolytic method
Expt.2. Determination of water potential of given tissue (potato tuber) by weight method
Expt.3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf
Expt.4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte
Expt.5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces)
Expt.6. To study the phenomenon of seed germination (effect of light)
Expt.7. To study the effect of different concentrations of IAA on Avenacoleoptile elongation (IAA Bioassay)
Expt.8. To study the induction of amylase activity in germinating barley grains

Demonstration experiments
Expt.1. Demonstration of suction due to transpiration
Expt.2. Fruit ripening/Rooting from cuttings (Demonstration)
Expt.3. Bolting experiment/Avenacoleoptile bioassay (demonstration)
BOAP6117: ANALYTICAL TECHNIQUES IN PLANT SCIENCES LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)

Course outcomes
At the end of this course, student will be able to:
1. Infer the various blotting techniques as well as PCR (Understanding)
2. Experiment with ELISA and also utilize paper chromatography and TLC to separate sugars and nitrogenous bases (Applying)
3. Make use of centrifugation and chromatographic techniques for chloroplast isolation and separation (Applying)
4. Apply various biochemical and molecular techniques for protein estimation and separation (Applying)
5. Apply molecular techniques for separation of DNA markers (Applying)
6. Compare different microscopic techniques (Applying)
7. Construct permanent slides (Creating)

Practical:
Expt.1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs
Expt.2. Demonstration of ELISA
Expt.3. Separation of nitrogenous bases by paper chromatography
Expt.4. Separation of sugars by thin layer chromatography
Expt.5. Isolation of chloroplasts by differential centrifugation
Expt.6. Separation of chloroplast pigments by column chromatography
Expt.7. Estimation of protein concentration through Lowry’s methods
Expt.8. Separation of proteins using PAGE
Expt.9. Separation of DNA (marker) using AGE
Expt.10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH)
Expt.11. Preparation of permanent slides (double staining)

BOBS6118: BIOSTATISTICS LAB (2 Credits-60 Hours) (L-T-P: 0-0-2)

Course outcomes
At the end of this course, student will be able to:
1. Tell the definitions of various statistical terms (Remembering)
2. Make use of statistical calculations for data interpretation (Applying)
3. Analyze any given biological data to see their accuracy and importance (Analyzing)

Practical:
Expt.1. Calculation of mean, standard deviation and standard error
Expt.2. Calculation of correlation coefficient values and finding out the probability
Expt.3. Calculation of ‘F’ value and finding out the probability value for the F value

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484 | ADBU | Regulations and Syllabus | 2021-22
Course Outcomes | Expt. 1 | Expt. 2 | Expt. 3 |
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CO1 | H | | |
CO2 | H | H | |
CO3 | H | H | H

**BOPM6119: PLANT METABOLISM LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)**

**Course outcomes**
At the end of this course, student will be able to:
1. Utilize the knowledge to separate photosynthetic pigments (Applying)
2. Demonstrate Hill’s reaction (Understanding).
3. Interpret the effects of light and carbon dioxide on respiration and compare the rate of CO4: respiration in various plant materials (Understanding)
4. Demonstrate nitrate reductase activity (Understanding)
5. Infer the activity of lipases (Understanding)
6. Demonstrate the fluorescence and absorption spectrum of photosynthetic pigments (Understanding)

**Practical:**
Expt. 1. Chemical separation of photosynthetic pigments
Expt. 2. Experimental demonstration of Hill’s reaction
Expt. 3. Study of the effect of light intensity on the rate of photosynthesis
Expt. 4. Effect of carbon dioxide on the rate of photosynthesis
Expt. 5. Comparison of the rate of respiration in different parts of a plant
Expt. 6. Demonstration of activity of Nitrate Reductase in germinating leaves of different plant sources
Expt. 7. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination
Expt. 8. Demonstration of fluorescence by isolated chlorophyll pigments
Expt. 9. Demonstration of absorption spectrum of photosynthetic pigments

**Mapping of COs to Syllabus**

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**BOPB6120: PLANT BIOTECHNOLOGY LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)**

**Course outcomes**
At the end of this course, student will be able to:
1. Study various media used in Plant tissue culture Laboratory (Remembering)
2. Explain/demonstrate different molecular biology techniques in tissue culture (Understanding).
3. Analyze modern DNA techniques used in plant improvement (Analyzing)
4. Evaluate and compare techniques in plant tissue culture (Evaluating)
5. Design restriction map of circular and linear DNA (Creating)

**Practical:**
Expt. 1. a) Preparation of MS medium, b) Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura, Brassica* etc
Expt. 2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seedsthrough photographs
Expt. 3. Isolation of protoplasts
Expt. 4. Construction of restriction map of circular and linear DNA from the data provided
Expt. 5. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
Expt. 6. Study of steps of genetic engineering for production of *Bt* cotton, *Golden rice, FlavrSavr* tomato through photographs
Expt. 7. Isolation of plasmid DNA
Expt. 8. Restriction digestion and gel electrophoresis of plasmid DNA
Mapping of COs to Syllabus

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BORM6121: RESEARCH METHODOLOGY FOR BOTANY LAB
(2 Credits-60 Hours)[L-T-P: 0-0-2]

Course outcomes
At the end of this course, student will be able to:
1. Utilize concepts to solve common chemical calculations (Applying)
2. Interpret various cytological and microtechnique experiments (Understanding)
3. Utilize concepts to present posters and write scientific articles (Applying)

Practical:
Expt.1. Experiments based on chemical calculations
Expt.2. Plant microtechnique experiments
Expt.3. The art of imaging of samples through microphotography and field photography
Expt.4. Poster presentation on defined topics
Expt.5. Technical writing on topics assigned

Mapping of COs to Syllabus

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BOIE6122: INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY LAB (2 CREDITS-60 HOURS) (L-T-P: 0-0-2)

Course outcomes
At the end of this course, student will be able to:
1. Tell the principles of laboratory instruments (Remembering)
2. Explain different sterilization techniques and culture media preparation (Understanding)
3. Apply sterilization techniques in laboratory (Applying)
4. Compare and select best sterilization methods (Evaluating)

Practical:
Expt.1. Principles and functioning of instruments in microbiology laboratory
Expt.2. Hands on sterilization techniques and preparation of culture media

Mapping of COs to Syllabus

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SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

DEPARTMENT OF SOCIAL WORK
MASTER OF SOCIAL WORK
Course Structure of MSW Programme

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### DEPARTMENT OF EDUCATION

**BACHELOR OF ARTS - HONOURS IN EDUCATION**

**Course Structure of BA Programme**

#### SEMESTER I

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**Total Credits 20**

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**Total Credits 20**

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490 | ADBU | Regulations and Syllabus| 2022-23
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**Total Credits**: 26

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**Total Credits**: 26

### SEMESTER VI

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**Total Credits**: 24

**TOTAL PROGRAMME CREDITS**: 140

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**MASTER OF ARTS IN EDUCATION**

**Course Structure of MA Programme**

### SEMESTER I

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# COURSE STRUCTURE

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**Total Credits**

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**Specialisation Courses: One area of Concentration to be opted (Educational Leadership/Educational Psychology)**

| DC   | EDEL0019 | Developing Educational Leadership | 3(3-0-0) 591 |
| DC   | EDDL0020 | Human Development and Learning | 3(3-0-0) 592 |

### Elective Group I

- - - - 3(3-0-0)

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**Total Credits**

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<td>EDTE0023</td>
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**SPECIALIZATION COURSES**

### Educational Leadership

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<td>Financial Management and Accounting</td>
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### Educational Psychology

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**Practicum**

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**Total Credits**

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## SEMESTER IV

### Theory

**SPECIALIZATION COURSES**

#### Educational Leadership

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<td>Ethics and Social Responsibility in Education</td>
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COURSE STRUCTURE

Educational Psychology
DC  EDSP0032  Counselling Skills for Educational Psychologists  3  602
DC  EDCA0033  Child and Adolescent Mental Health  3  602

Practicum
DC  EDDI6007  Dissertation Phase II  4  605
DC  EDIN6008  Internship  3  607

Total Credits  13

Total Programme Credits  83

LIST OF VALUE ADDED COURSES

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DEPARTMENT OF ENGLISH

BACHELOR OF ARTS - HONOURS IN ENGLISH

Course Structure of BA Programme

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| Theory | Core Course 4 | EGBR0114 | British Romantic Literature | 6(5-1-0) | 6 | 620 |
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| Theory | Service Learning | EGSL0200 | Language Communication | 2 | 2 | 656 |

| SEMESTER III | Theory | Core Course 5 | EGLE0104 | British Literature: 19th Century | 6 | 617 |
| Theory | Core Course 6 | EGEQ0115 | British Literature: The Early 20th century | 6 | 621 |
| Theory | Core Course 7 | EGCL0116 | European Classical Literature | 6 | 621 |
| Theory | SEC 1 | EGCL0116 | Creative Writing | 2(2-0-0) | 2 | 622 |
| Theory | SEC 2 | EGSS0118 | Soft Skills | 623 |

| SEMESTER IV | Theory | Core Course 8 | EGIC0120 | Indian Classical Literature | 6(5-1-0) | 6 | 624 |
| Theory | Core Course 9 | EGAM0121 | American Literature | 6(5-1-0) | 6 | 625 |
| Theory | Core Course 10 | EGME0122 | Modern European Drama | 6(5-1-0) | 6 | 625 |
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| Theory | SEC 2 | EGTS0124 | Translation Studies | 627 |

Generic Elective Course (GEC) 1
Generic Elective Course (GEC) 2
Generic Elective Course (GEC) 3
Generic Elective Course (GEC) 4

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### Course Structure

**Semester V**

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### Master of Arts in English

**Course Structure of MA Programme**

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Total Credits: 20

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**Specialisation Course: Language and Linguistics**

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**Specialization Paper: European Literature**

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**Total Credits** 21

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**Specialization Paper: European Literature**

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**Specialization Paper: African Literature**

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**Total Credits** 19

**Total Programme Credits** 80

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### DEPARTMENT OF ECONOMICS

**BACHELOR OF ARTS - HONOURS IN ECONOMICS**

**Course Structure of BA Programme**

### SEMESTER I

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**Total Credits** 20

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| Theory | Core Course 5 | ENIM0032 | Intermediate Microeconomics-I | 5-1-0 | 6 |
| Theory | Core Course 6 | ENIC0033 | Intermediate Macroeconomics-I | 5-1-0 | 6 |
| Theory | Core Course 7 | ENSM0034 | Statistical Methods for Economics | 5-1-0 | 6 |
| Theory & Practical | Skill Enhancement Course (SEC) – I | ENPD0035 | Data Collection and Presentation | 2-0-0 | 2 |
| Theory | Generic Elective Course (GEC) III | | | | |
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#### SEMESTER IV

| Theory | Core Course 8 | ENMI0039 | Intermediate Microeconomics-II | 5-1-0 | 6 |
| Theory | Core Course 9 | ENMA0040 | Intermediate Macroeconomics-II | 5-1-0 | 6 |
| Theory | Core Course 10 | ENIS0041 | Introductory Econometrics | 5-1-0 | 6 |
| Theory & Practical | Skill Enhancement Course (SEC) – II | ENSD0042 | Statistical Data Analysis | 2-0-0 | 2 |
| Theory | Generic Elective Course (GEC) IV | | | | |
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#### SEMESTER V

| Theory | Core Course 11 | ENIE0021 | Indian Economy-I | 5-1-0 | 6 |
| Theory | Core Course 12 | ENDE0046 | Development Economics-I | 5-1-0 | 6 |
| Theory | Discipline Specific Elective Course (DSE) (Any two from the list) | ENHE0047 | Economics of Health and Education | | 687 |
| | | ENAE0048 | Applied Econometrics | | 688 |
| Theory | Economic History of India (1857-1947) | ENHI0044 | | | 684 |
| Theory | Topics in Microeconomics-I | ENTM0049 | | | 689 |
| Theory | Political Economy-I | ENPO0050 | | | 689 |
| Theory | Money and Financial Markets | ENFM0051 | | | 690 |
| Theory | Public Economics | ENPF0020 | | | 666 |
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#### SEMESTER VI

| Theory | Core Course 13 | ENIY0025 | Indian Economy-II | 5-1-0 | 6 |
| Theory | Core Course 14 | ENDE0052 | Development Economics-II | 5-1-0 | 6 |
| Theory | Discipline Specific Elective Course (DSE) 3 & 4 (Any two from the list) | ENPC0053 | Political Economy-II | | 692 |
| | | ENCC0054 | Comparative Economic Development (1850-1950) | 5-1-0 | 6 x 2 = 12 |
| | | ENFI0055 | Financial Economics | | 694 |
| | | ENTM0056 | Topics in Microeconomics-II | | 695 |
| | | ENEE0026 | Environmental Economics | | 669 |
| | | ENIE0024 | International Economics | | 669 |
| | | ENDI6001 | Dissertation/Project | | 695 |
| | | | Total Credits | 24 |
| | | | Total Programme Credits in BA Economics | 140 |
### MASTER OF ARTS IN ECONOMICS

#### Course Structure of MA Programme

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**Total Programme Credits 83**

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### MA Economics - LIST OF VALUE ADDED COURSES

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## DEPARTMENT OF MASS COMMUNICATION

### BACHELOR OF ARTS - HONOURS IN MASS COMMUNICATION

**Course Structure of BA Programme**

*Wherever there is a practical there will be no tutorial and Vice versa*

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## MASTER OF ARTS IN MASS COMMUNICATION

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**Total Credits 21**

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**Total Credits 16**

**Total Programme Credits 82**

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500 | ADBU | Regulations and Syllabus | 2022-23
## DEPARTMENT OF PSYCHOLOGY
### BACHELOR OF ARTS – HONOURS IN PSYCHOLOGY
#### Course Structure of BA Programme

*Wherever there is a practical there will be no tutorial and Vice versa*

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**Total Credits**: 26

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**Total Credits**: 24

**Total Programme Credits**: 140

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**MASTER OF SCIENCE PSYCHOLOGY (Clinical/Counselling Psychology)**

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TOTAL PROGRAMME CREDITS: 88

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DEPARTMENT OF PUBLIC ADMINISTRATION

BACHELOR OF ARTS – HONOURS IN PUBLIC ADMINISTRATION

Course Structure

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**Total Credits**: 24

**Total Programme Credits**: 140

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**MA PUBLIC ADMINISTRATION**

**COURSE STRUCTURE - MA Public Administration**
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| Total Credits | 18 |

| Total Programme Credits | 77 |

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### MA ECONOMICS

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### Practicum

- MCBP0139 Basics of Photography
- MCPY0140 Photography

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### MA Public Administration

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DEPARTMENT OF SOCIAL WORK
MASTER OF SOCIAL WORK - MSW

VISION
To be a centre of excellence in Social Work teaching, learning, research and practice which promotes commitment to social justice, fosters social consciousness and sensitivity, and upholds the dignity and worth of all.

MISSION
The Social Work Department of Assam Don Bosco University seeks to:
• Promote rights based approaches to development based on the International declaration of human rights
• Achieve excellence in teaching, learning, research, practice, outreach programmes and extension services
• Promote critical thinking and innovative intervention in response to societal and environmental problems
• mould professionally competent individuals who are sensitive and committed to the values, principles and ethics of social work
• Create and foster an environment of justice and respect for all by promoting social consciousness, courage of conviction, appreciation for diversity and caring for creation.

PROGRAM OUTCOMES – MSW PROGRAMME
PO 1: Critical Thinking and Professional Judgment: Apply theoretical knowledge to make a critical analysis, intervene using innovative frameworks and evaluate and follow up.
PO 2: Effective Communication: Engage in inter-personnel, behavioral change communication and be proficient in Information Communication Technology.
PO 3: Gender Sensitization, Social Commitment and Social Interaction: Work in teams and partnerships at local, national and transnational projects and settings with focus on gender equity and cultural sensitivity
PO 4: Effective Citizenship: Engage in service learning and community engagement programmes for contributing towards achieving of local, regional and national goals.
PO 5: Ethics: To engage in social work practice as per National Association of Social Worker’s ethical framework.
PO 6: Environment and Sustainability: Participate and promote World sustainable development goals 2030.
PO 7: Self-directed and Life-long Learning: Engage in continuous learning for professional growth and development.
PO 8: Scientific Temper: - Gaining aptitude for research for contribution to knowledge enterprise and documentation of social work theory and practice.

PROGRAM SPECIFIC OUTCOMES
PSO 1: PSO 1: Conceptual clarity: Students get familiarized and attain conceptual clarity in social work theories, perspectives, models, methods and processes of social work practice.
PSO 2: PSO2: Attaining procedural skills: Students attain knowledge of different steps of doing a work/intervention as per local, national and international protocols- norms, legal bindings and regulations.
PSO 3: PSO3: Strategic intervention skills: Learn what should be done when, and how it should be done when it comes to social work interventions in the fields of children, women, families, community development, health and mental health, development projects, and other welfare activities.
PSO 4: PSO4: Attitudinal change: Working with the personal self for meaningful and enriching social work professional career.

LIST OF COURSES

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3.1 Social Justice, Human Rights & Para-legal Education
3.2 Emerging Social Work Perspectives and Integrated Approach
3.3 Computer Applications for Social Sciences (Lab)
3.4 Community Development: Rural, Tribal and Urban
3.5 Governance and Community Development
3.6 Family Centered Social Work Practice
3.7 Social Work Practice with Children
3.8 Medical Social Work
3.9 Mental Health and Social Work
3.10 Organisational Structure, Behaviour and Development
3.11 Policies For Development Organisations – Urban, Rural and Tribal Communities
3.12 Introduction to Child Psychology and Development
3.13 Rights of the Child – Legal Framework, National and International Instruments
3.14 Continuous Field Work I
4.1 Social Development and Social Policy
4.2 Project cycle Management and Resource Mobilisation
4.3 Dissertation (Research Phase I and Research Phase II)
4.4 Community Health and Population Management
4.5 Community Development Practice with Disempowered Communities
4.6 Development Concerns and Women Empowerment
4.7 Families With Special Needs
4.8 Psychiatric Social Work
4.9 Community Health and Services
4.10 Human Resource Management: Social Work Perspective
4.11 Corporate Social Responsibilities – Concepts & Ideologies
4.12 Children with Special Needs
4.13 Child Centered Social Work Practice
4.14 Continuous Fieldwork II
4.15 Internship

VALUE ADDED COURSES
4.16 Results Based Management of Projects and Programmes
4.17 Academic Writing, Research Proposal Development and Dissertation Writing Course
4.18 Working with Diversity

### Mapping of Pos and PSOs.

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510|ADBU| Regulations and Syllabus|2022-23|
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THEORY COURSES

SWHI0035: HISTORY, IDEOLOGIES AND FIELDS OF SOCIAL WORK
(3-0-0) (3 Credits - 45 hours)

Course Outcomes:
- Introduce the basic concepts of social work to the students. (Understanding)
- Introduce to the students the history and philosophy of social work, its methods and fields (Remembering)
- Introduce social work as a profession (Applying)
- Motivate the students to appreciate social work as a profession and to recognize the need and importance of social work education, training and practice. (Creating)

Module I: Introduction to Social Work (11 hours)

Module II: History and Ideologies of Social Work (11 hours)
Historical development of Social Work in UK, USA and India: The Elizabethan poor law (1601); Charity Organization Society (1869);The Settlement House Movement, (USA); The Poor Law Commission of 1905; The Beveridge Report (1941); Social Reforms and Social Movements; Gandhian Philosophical Foundation to Social Work in India.

Module III: Social Work Profession (11 hours)
Social Work Theories; Professional organizations; Indian Association of Professional Social Workers; National Association of Social Workers; International/Indian Council of Social Workers; International Association of Schools of Social Work

Module IV: Fields of Social Work Practice (12 hours)

Suggested Readings
2. Jainendra Kumar Jha, Practice of Social work, Anmol Publications, New Delhi, 2002,

Mapping of COs to Syllabus

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SWGD0036: HUMAN GROWTH AND DEVELOPMENT
(2-0-0) (2 Credits - 30 hours)

Course Outcomes
- Introduce the basic concepts of human growth and development. (Remembering)
- Introduce the Personality theories (Understanding & Applying)
- Introduce the Concept of Mental Health and discuss the role of social worker in promoting it. (Understanding and Creating)
• Introduce the concept of health, causes, symptoms, treatment and prevention of communicable and non-communicable diseases (Understanding, Applying, Analyzing and Evaluating)

Module I: Meaning of Growth and Development (8 hours)
a. Meaning of growth, development and maturity, Principles of human development
b. Approaches to the study of human development: biological, maturational, psychoanalytic, behavioural, cognitive-developmental, ecological, Social
c. Influence of socialization and development - family, social groups, institution, community and culture.

Module II: Developmental Stages and Personality Theories (10 hours)
a. Physical, Emotional, Cognitive and Social aspects of the following developmental stages with special reference to Indian conditions – Infancy, Babyhood, childhood, adolescence, adulthood, old age.
b. Personality theories – Freud, Jung, Adler, Erikson, Rogers, Maslow

Module III: Mental health (5 hours)
a. Concept of Normalcy and abnormality - Symptoms, Causes and treatment of neuroses and psychoses, personality disorder and mental retardation.
b. Role of Social Workers in Promoting Mental Health

Module IV: Physical Health (7 hours)
a. Concept of health, hygiene, WHO definition of health; nutrition, malnutrition and its impact on growth
c. Institutions and agencies intervening in human growth and development- family, education, Health care systems

Suggested Readings
13. WHO, The ICD – 10 Classification of Mental and Behavioural Disorders, Diagnostic Criteria for Research, AITBS Publishers and Distributors (Regd.). Delhi: 2004

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SWIS0037: INTRODUCTION TO INDIAN SOCIETY, ECONOMICS AND POLITY
(2-0-0) (2 Credits- 30 hours)

Course Outcomes
• Understand the concept of society& culture, major social institutions, structure, stratification, different approaches to the study of society and to develop an understanding on social change and social mobility; (Remembering and Understanding)
• Understand and define basic concepts of economic and political theories ; (Remembering and Understanding)
• Explain how the economic and political institutions are organized, and how they have a bearing on human society ; (Applying)
• Identify and evaluate the political institutions, processes and experiences of India, with special reference to North East India (Evaluating and Creating)

Module I: Basic Sociological Concepts (10 hours)
a. The concept of society – Meaning, definition and characteristics of society;
b. The concept of culture - Meaning, definition, elements & characteristics;
c. Social structure and stratification - Caste, Class, Tribes, Gender & Religion;
d. Approaches to the study of society - Structural Functionalism approach; Conflict/ Dialectical approach; Symbolic Interactionism;
e. Social institutions - Marriage, Family, Education & Religion;
f. Social change and social mobility; Social Work and society

Module II: Basic Concepts in Economics (10 hours)
a. Concept and definition: economy, micro and macroeconomics; market, demand and supply, national income, national income indicators; per-capita income, standard of living, poverty and its measurement in India
b. Economic systems: capitalism, socialism, communism, mixed economy, neoliberalism
d. Globalisation and Indian economy: Special Economic Zones and MNCs
e. Growth, development and social justice
f. Social work and economics

Module II: Basic Concepts in Politics (10 hours)
a. The concept of state – Meaning and definition, and elements; Nationalism and Nation State;
b. Perspectives of the state – Liberal, Marxist, Feminist, Gandhi, and Ambedkar
c. Key concepts - Liberty, Equality, Justice, Power, Legitimacy, Authority, Sovereignty;
d. The Constitution of India, and the Federal characteristic of Indian state;
e. Citizenship: rights and duties;
f. North East India: Decentralised governance & political movements

Suggested Readings

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SWCS0070: SOCIAL WORK WITH COMMUNITIES AND SOCIAL ACTION
(3-0-0) (3 Credits – 45 hours)

COURSE OUTCOMES
DEPARTMENT OF SOCIAL WORK

- Define and spell community organisation and social action as methods in social work education and practice. (Remembering)
- Explain the concepts related to community organisation and social action as methods of social work education and practice. (Understanding)
- Apply the understanding of the concepts of community organisation and social action in the fields of practice. (Applying)
- Analyze various field situations and apply therelevant methods to address social concerns. (Analyzing)
- Assess and choose community organisation or social action strategies to address social issues. (Evaluating)
- Combine effectiveness of community organisation or social action models and strategies and make modification if required for effective intervention in communities. (Creating)

Module I: Concepts of Community (11 hour)
Understanding Community: Definition, Concept, Types (Urban, Rural, Tribal and Open Communities), Structure and Functioning; Community Power Structure and Leadership; Community Dynamics.

Module II: Community Organization (11 hours)
Community Organization: Definition, Scope, Philosophy, Principles; Community Organization and Community Development; Approaches to Community Organization; Role and Skills of Social Worker in the Community; Techniques and Strategies of Community Organization.

Module III: Phases of Community Organization (11 hours)

Module IV: Models of Community Organization, Community Development and Social Action (12 hours)
Models of Community Organization; Social Action – Principles and Process of Social Action and its Scope in India; Approaches to Social Action: Radical and Right based; Models of Community Development: Locality Development, Social Planning Model, Social Action Model, Saul Alinsky Model.

Suggested Readings

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SWEM0038: ENVIRONMENT STUDIES AND DISASTER MANAGEMENT (3-0-0)
(3 Credit- 45 hours)

Course Outcome:
- Understand the interrelatedness of human life and environment (Understanding)
- Develop an understanding of problems arising out of environmental degradation and globalization (Analysing)
• Understand the roles of State in disaster management (Evaluating)
• Study the role of social work practice in tracking environmental issues and disaster management (Creating)

**Module I: Environment and Sustainable Development (11 hours)**

Concepts: Environment and Ecology; the Interrelatedness of living organisms and natural Resources; Global Environmental Crisis and its linkages to the development process. Global warming, Environmental politics and resource development regimes; Sustainable development: Management and Conservation changes

**Module II: The State and the Environment (11 hours)**


**Module III: Concept of Disaster and Models of Disaster Management (11 hours)**

Disaster: Definition, Natural and Human made disasters; multiple causes and effects; Stages of disaster; Development and Disaster; Preventive Measures; Models of Disaster: Crunch Model and Release Model

**Module IV: Roles of Organizations in Disaster Management (12 hours)**


**Suggested Readings**

7. Shukla S.K., Srivastava P.R., Environmental Pollution and Chronic Diseases.

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SWGS0039: GENDER STUDIES (3-0-0)  
(3 Credit- 45 hours)

Course Outcomes

- Understand the concept of gender, patriarchy, gender roles and relationships. (Remembering and Understanding)
- Study the feminist theories, women’s movements, and women’s development (Remembering and Understanding)
- Critically study the intersectionality i.e. how race/ethnicity, sexuality, class, age, citizenship, and other identities crosscut and shape gender identities and roles (Applying and Analysing)
- Critically understand concerns of gender issues, and aim to analyze everyday gendered experiences from Social Work perspectives. (Evaluating and Creating)

Module I: Understanding gender, gender and society, gender studies (11 hours)
Introduction – Gender, Sex, Sexuality, Gender Perspectives of Body, Social Construction of Femininity, Social Construction of Masculinity, Patriarchy, LGBTQ, Gender roles, Gender Lens: Political and Legal Systems, Gender and Education, Inter-sectionalities, Social Dynamics of Gender, Women’s Studies and Gender Studies

Module II: History, Theory and Women’s Movement (11 hours)
Historical Overview of Feminist Movements, Feminist Movement in Europe and the US, Women’s Movement in India, Changing profile of women in India- pre and post independent India, History of women’s education; Theory- Feminism and types of feminism, Gender Schema theory, Queer theory; Approaches to understanding women and development

Module III: Gender Concerns (11 hours)
Violence against women, conflict, poverty, displacement, migration, disaster –impact on women, women working in organized and unorganized sector, reproductive health, social, cultural and political determinants of health

Module IV: Constitutional Rights of Women, Policies and Programmes (12 hours)

Suggested Readings

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SWPF0040: SOCIAL WORK PRACTICE WITH INDIVIDUALS AND FAMILIES (3-0-0)  
(3 Credits – 45 hours)
Course Outcomes:
- Introduce the concept of social casework as a method of social work practice and the tools used in Casework. (Remembering, Understanding & Applying)
- Introduce the approaches to Case work. (Remembering, Understanding & Applying)
- Introduce Casework process and the techniques used. (Understanding, Applying, Analyzing & Evaluating)
- Discuss the application of social casework in different settings. (Understanding, Analyzing, Evaluating & Creating)

Module I: Introduction to Nature and Development of Social Casework (11 hours)

Module II: Approaches to Casework Practice (11 hours)
Diagnostic and Functional approach; Psycho-social approach; Problem solving approach; Task centered approach; Client centered approach; Pearlman approach

Module III: Process and technique of social casework (11 hours)
Phases of casework intervention: Intake, Problem identification, Diagnosis of the problem, Treatment, Assessment, Monitoring and Evaluation, Termination/ Follow up; Techniques of Casework Intervention -Supportive Techniques, Enhancing Resources Techniques; Casework recording: Types and Principles of recording

Module IV: Social Casework Practice (12 hours)
Application of Social Case Work in different settings and Clientele groups- Casework with Children, Correctional Settings, Clinical Settings, Geriatric Care, the Terminally Ill people, and Crisis Situations; Discussion of Case Records in differentAgency Settings, Relations of Casework with other methods of social work.

Suggested Readings
7. Mathew Grace, An Introduction to Social Case Work, Tata Institute of Social Sciences, Bombay, 1992

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SWPG0041: SOCIAL WORK PRACTICE WITH GROUPS (3-0-0) (3 Credits- 45 hours)

Course Outcomes
- Understand the concept of groups and its importance and influence on individuals (Remembering and Understanding)
- Understand social group work as a method of social work (Remembering and Understanding)
- Develop skills to apply group work methods in various settings (Creating and Evaluating)
- Identify and acquire the skills needed to work with groups effectively (Applying and Analysing)

Module I: The Concepts (11 hours)
Concept of group: definition, characteristics, Classification of different social Groups, Functions of Groups and Group as a medium of Social change.

Module II: Methods of Social Group Work (11 hours)
Social group work as a method of social work: definition, values, principles, assumptions, ethics, and functions of social group work; Techniques and skills used in Social Group work practice, Roles of Social group workers.

Module III: Process and Phases of Social Group Work (11 hours)
Group work process; Identification of the needs and interest; Program Planning and Program Development; Criteria of Social group work as a method of social work: definition, characteristics, Classification of different social Groups, Functions of Groups and Group as a medium of Social change.

Module IV: Social Group Work Practice in Agency Settings (12 hours)
Social Group Work in Different Settings: Self Help Groups, Groups in community setting, Groups in institutional settings (Hospitals, Rehabilitation Centers, Children’s Home, Old Age Homes and Educational Settings); Discussion of Group records.

Suggested Readings
7. Toseland, W. and Rivas, R.S. An Introduction to Groups Work Practice, Boston: Allyn and Bacon, 2000

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SWRS0042: SOCIAL WORK RESEARCH AND STATISTICS(3-0-0)
(3 Credits- 45 hours)

COURSE OUTCOMES
- Define and show social science research and social work research and the application of statistics in social work practice. (Remembering)
- Explain and discuss social work research as a method of social work and it application in addressing social issues. (Understanding)
- Apply the knowledge, skills for interpretation, documentation and presentation of results of social work research and statistics in carrying out applied research in addressing social issues. (Applying)
- Analyze various social issues and use research methods, strategies and data to suggest solutions. (Analyzing)
- Assess relevant research methods and techniques in carrying out social work research. (Evaluating)
- Create critical methods to carry out research in social work practice and suggest solutions to social issues. (Creating)

Module I: Introduction to Social Work Research (7 hours)
- Research and Social Work Practice- Philosophical Foundations of Research.
- Natural and social science research - characteristics and scientific attitude.
- Social work research as a social research - relevance, ethics and values. Scope of social work research - basic and applied research.

Module II: Research designs, approaches and types (7 hours)
- Research designs: Descriptive, Exploratory and Experimental: meaning, scope, characteristics, application in social work setting.
- Research Approaches: Qualitative and Quantitative Research: meanings, scope, methods, steps, sampling, data...
collection, analysis, interpretation and reporting. Strengths and weaknesses.

c. Evaluative research: Programme and projects evaluation: concept, types, steps, reports.
d. Participatory research and action research: concepts, scope, application and steps.

Module III: Steps in Research Process (12 hours)
a. Problem Formulation: Identifying research issue, formulating research topic and problem, review of literature (library work), theoretical framework, formulating objectives, clarifying concepts, variables - conceptual and operational, formulating hypothesis.
b. Population and Sampling: Inclusion and exclusion criteria of population, the logic of sampling size and techniques: probability and non-probability sampling.

Module IV: Introduction to Statistics (12 hours)
a. Statistics: Definitions, Uses and Limitations. Classification and tabulation of data, univariate and bivariate, diagrammatic and graphical presentations. Measures of central tendency, Mean, Median and Mode and their uses; Measures of variability - range, variance and standard deviation.
b. Correlation: Meaning and computation of coefficient of correlation as product moment, Spearman’s Rank Correlations, interpretation of correlations.
c. Test of Hypotheses: Basics, Probability distribution, normal distribution. t-test, Chi-Square Test

Module V: Application of Statistics and Reporting Research (7 hours)
b. Ethical guidelines in social work research.
c. Professional writing.
d. Introduction to software packages for statistical analysis.

Suggested Readings
1. Ahuja, Ram, Research Methods, Rawat, Jaipur, 2001
10. Jacob, K.K., Methods and Fields of Social Work in India, Asia Publishing, Bombay, 1996

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SWWA0043: SOCIAL WELFARE ADMINISTRATION (3-0-0)  
(3 Credits- 45 hours)  

Course Outcome:  
- Develop an understanding of social welfare administration as a method of social work (Remembering)  
- Understand the various components of social welfare administration (Understanding)  
- Understand the concept and theories of Development (Analysing)  
- Familiarize the students with the concepts of Management of Organisations and its principles (Evaluating)  

Module I: Social Welfare Administration (11 hours)  

Module II: Management of an Organization (11 hours)  

Module III: Strategies and Mechanisms of Administration (11 hours)  
Processes related to Registration of Societies, Trust and Non-Profit Organization: Societies Registration Act 1860, Trusts and Non-Profit Organizations under Indian Companies Act; Foreign Contribution Regulation Act 1976 and Income Tax Rules applicable to Development / Charitable Organisations under Income Tax Act 1961; Role of Social Workers in Decision Making Process, Communication and Networking, and Sustainability of Programme  

Module IV: Social Welfare Programmes (12 hours)  
Social Welfare Programmes and Policies: Children, Youth, Women, Widows, Elderly and Differently- able and marginalized Groups; Recent trends and Changes in Social Welfare Administration  

Suggested Readings  
1. Chowdry, Paul, Social Welfare Administration, Atma RRam and Sons, Delhi, 1992  
3. Kulkarni, P.D., Social Policy and Social Development in India Association of schools of social work in India  
4. Fred, Luthans, Organization Behaviour, III and IV edition  
5. Rao, Subba, GCV. Family Law in Law, S. Goga and Company, Hyderabad, 1999  

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SWDS0044: INTRODUCTION TO DISABILITY STUDIES(3-0-0)  
(3 Credits- 45 hours)  

Course Outcome:  
- Introduce the concept and different types of disabilities. (Remembering, Understanding & Applying)  
- Introduce the Legislations for Persons with disabilities. (Remembering, Understanding & Applying)  
- Introduce the concept of Inclusive Education in India. (Understanding, Applying, Analyzing, Evaluating and Creating)  
- Discuss the Preventive Measures and government programs for Persons with Disabilities. (Understanding, Applying, Analyzing, Evaluating & Creating).  

Module I: Understanding Disability (11 hours)  
Disability: Definition, Causes, Types of Disabilities; Magnitude of various disabilities and their impact on persons with disability and their families; Needs and problems of persons with disability and their families across the life span; Social attitudes towards persons with disability.  

Module II: Legislation, Programme and Schemes for PWD (11 hours)  
Legal instruments related to PWDs: Persons with Disability Act-1995; Rehabilitation Council of India Act – 1992; National
Trust Act-1999; Mental health Act; Rights of the Person with Disability Act 2016,

Module III: Inclusive Education (11 hours)
Concept and Meaning, Needs and importance; issues and challenges in implementing Inclusive education in India; Planning and managing an inclusive curriculum in schools; Measures for implementing Inclusive Education.

Module IV: Management of Disability and Policies (12 hours)
Prevention and Management of Disabilities at Primary, Secondary and Tertiary levels; Models -Social, Medical, Educational and Institutional; National Policy on Persons with Disabilities, UN Conventions and Declarations on Persons with Disabilities; Different Government Schemes and programmes for Persons with Disabilities.

Suggested Readings

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SWSJ0045: SOCIAL JUSTICE, HUMAN RIGHTS AND PARALEGAL EDUCATION(3-0-0)
(3 Credits–45 hours)

Course Outcomes
- Provide an understanding on social legislation and social action with relevance to social work practice (Remembering and Understanding)
- Develop an understanding about various social welfare legislations with specific reference to different groups of people; 9 Evaluating and Creating)
- Understand the provisions of the legal system and the mechanisms available in the country for addressing issues of social change. (Understanding, Applying and Analysing)

Module I: Social Justice and Human Rights (7 hours)
a. Meaning of Justice, Forms of Justice, Theories of Justice,

Module II: Social Legislation and Social Work (7 hours)
a. Understanding concepts of law, social justice and social legislation, Legislation as an instrument of social justice and control.
b. The Constitution of India: preamble and fundamental rights; Directive Principles of State Policy
c. Classification of law: civil and criminal law. Relevance of law and legal systems to social work practice, partnership and interface between social workers and legal systems.

Module III: Reformatory Law and Laws related to Protection of Human Rights (7 hours)
b. Major provisions in Indian Penal Code (IPC) related to family violence, murder, suicide, rape.
c. Meaning of cognizable and non-cognizable offences and conditions and procedures for bail; Importance and Procedures for filing a First Information Report (FIR)

Module IV: Social legislations: Major Provisions (20 hours)
a. Laws Related to Children: Juvenile Justice Act, Laws relating to Adoption and Guardianship, Child Marriage Restraint

b. Protection of Children from Sexual Offences Act (POCSO) and Sexual harassment of women in workplace act.

Module V: Justice System and Legal Aid provisions (4 hours)
a. Agencies of the justice system: police, judiciary, correctional systems, their structure and functions
b. Structure and jurisdiction of courts: district and sessions courts, high court, Supreme Court. Distinction between civil and criminal courts; Consumer courts Special courts/tribunals- accident, corruption
c. Concept of legal aid, Lok Adalat; Public Interest Litigation (PIL)

Suggested Readings
3. Ahuja, Ram: Criminology, Jaipur: Rawat Publications
8. Galanter, Marc, Law and Society in Modern India, Delhi: Oxford University Press, 1992

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SWES0046: EMERGING TRENDS AND PERSPECTIVES IN INTEGRATED SOCIAL WORK PRACTICE (3-0-0)
(3 credits - 45 hours)

Course Outcomes
- Define, identify and explain the meaning and concept of a social work perspectives (Remembering and Understanding)
- List, define and classify the perspectives that have prominently informed social work practice ; (Applying and Analysing)
- Locate and critically evaluate the relevance of perspectives in social work fields of practice ; (Applying and Creating)
- Apply social work perspectives in practice settings (Applying)

Module I: Perspectives on Social Problems (11 hours)
Meaning and concept of Social Work Perspective: its importance and implications for practice; Social problems, human systems and social work response- structural-functionalist perspective, Conflict perspective, symbolic interactionist perspective

Module II: International Social Work Perspectives (11 hours)

Module III Radical Social Work Perspectives (11 hours)
Marxist approaches- Critical and Structural Social Work; Freirian and Liberation theological perspectives-Conscientization and adult education; Feminist approach; Anti-discriminatory and anti- oppressive perspectives

Module IV Indian Social Work Perspectives (12 hours)
Gandhian Social Work Principles; Ambedkarite Social Work practice: Anti-caste intervention framework in India; Tribal/Indigenous Social Work Perspective; Social Work Practice in North East India

Suggested Readings:

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SWRT0048: COMMUNITY DEVELOPMENT: RURAL, TRIBAL AND URBAN(3-0-0)
(3 credits - 45hours)

Course Outcomes
- Define the concepts, approaches, policies and strategies of community development (rural, tribal and urban) (Remembering)
- Discuss and explain the development issues of communities – tribal, rural and urban (Comprehension)
- Apply the knowledge and skills acquired in social work education to address issues of marginalisation, exclusion and oppression. (Application)
- Able to analyse various developmental issues and address them by applying relevant empowerment and development models and approaches in social work practice (Analyse)
- Able to assess development concerns, and adopt and apply models and approaches of development for alleviation and reduction of community inequities (Evaluating)
- Able to design development practice for effective community development experiences (Creating).

Module I: Community and Community Development (11 hours)
Understanding Communities – Urban, Rural and Tribal; Concept, Definition and Objectives of Community Development; Aspects of Community Development – Social, Cultural, Economic, Political and Environment; Approaches of Rural, Tribal and Urban Development.

Module II: Rural and Tribal Community Development (11 hours)
Rural Demography, Sociology and Economy; Tribal Identity and Ethnicity; Rural and Tribal Development Policies; Rights and Positive Discrimination; Governance Structures and Functions of Rural and Tribal Communities; Rural Reconstruction Experiments – Pioneering Period Sririkhetan, Marthandam, Gurgaon; Probation period: Firka, Nilokheri and Etawah Projects.

Module III: Urban Community Development (11 hours)
Urban, Urbanization, Urbanism, Industrialization and Development; Urban Development Authority; Urban Governance; Urban Ecology and Growth of Cities; Concepts of Metropolis, Megapolis, Satellite Towns, Commuter Town / Bedroom Community, Suburbs, Metropolitan; Leisure Time Theories and Leisure Time in Cities.

Module IV: Issues of Rural, Tribal and Urban Development and Social Work Intervention (12 hours)
Rural and Tribal Development Concerns – Poverty, Migration, Education, Unemployment, Development Induced Displacement, Health and Livelihoods; Urban Development Concerns – Poverty, Migration, Slums, Homelessness, Eviction, Traffic Congestion and Accidents, Health, Human Trafficking and Crimes; Role of Social Worker in Rural, Tribal and Urban Development.

Suggested Readings
2. Narang, A., Indian Rural Problems, Murari Lal and Sons, New Delhi, 2006
3. Shah, Dilip., Rural Sociology, ABD Publisher, India, 2005
5. Lornis and Beegle, Rural Sociology (The Strategies of change), Englewood, Cliff's, New Jersey : Prentice Hall, Inc, 1957
6. Sharma, K Rajendra, Rural Sociology, Atlantic Publishers and Distributors, New Delhi, 2004
10. Bhanti, Raj, Social Development (Analysis of some social work and field), Himanshu Publication, New Delhi, 2001
11. Dasgupta, Bilap, Village Society and Labour Use, Oxford University Press, New Delhi
17. Mishra, Anil Kant, Rural Tension in India, Discovery Publishing House, New Delhi, 1998
18. Mishra, Omprakash (Ed.), Forced Migration, Manak Publication, Delhi, 2004

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SWGC0049: GOVERNANCE AND COMMUNITY DEVELOPMENT (3-0-0) (3 Credits- 45 hours)

Course Outcomes
- Understand the context, meaning and relevance of decentralised governance for urban, rural and tribal areas. (Remembering and Understanding)
- Develop knowledge about the structure and functioning of governing bodies at various levels. (Creating and Evaluating)
- Develop an understanding to the various constitutional amendments for better governance and development (Creating and Evaluating)
- Understand contemporary issues and challenges in accessing governance bodies for people’s development. (Applying and Analysing)

Module I: Rural Governance (11 hours)
Democratic Decentralization: Meaning, objectives and Importance, Governance: Meaning and Structures; Concept and Evolution of Panchayati Raj: Historical Development of the Concept, National level Committees in the evolution of Panchayati Raj (Balwantrai Mehta, Ashok Mehta, Singhvi committees)

Module II: The Functions of Panchayati Raj Institutions/Traditional Institutions (11 hours)
Panchayati Raj/Traditional Institutions: Structure, Functions and Powers at each level; Revenue Sources at each level; its...
Module III: Urban Governance: Urban Local Self-Government in India (11 hours)

Types of Urban Local Self-Government in India; Municipal Corporation, Municipalities, Municipal Council/Nagar Palika; Structures, Functions and Powers at each level; Sources of Revenue at each level; System of Elections to Urban Local Self-Government; Relation of Urban Local Self-Government with bodies of Governance at the State level issues; Challenges in Developing Partnerships between Elected Bodies, Bureaucracy and Civil Society.

Module IV: Constitutional Amendments (12 hours)

The 73rd Constitutional Amendment; PESA (Panchayat Extension in Scheduled Areas): Context of its Emergence and its Significance; Issues and Challenges in its implementation; 74th Constitutional Amendment

Suggested Readings

1. Chahar, S.S. (Ed.), Governance of Grassroots Level in India, Kanishka Publishers, New Delhi, 2005
5. Singh, Amita (Ed.), Administrative Reforms (towards sustainable practice), Sage Publications, New Delhi, 2005
6. Baluchamy, S. Panchayat Raj Institutions, Mittal Publication, New Delhi, 2004

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SWCS0050: FAMILY CENTERED SOCIAL WORK PRACTICE (3-0-0)

(3 credits - 45 hours)

Course Outcomes:

- Define family and marriage, and theories associated with these concepts in the context of prevalent customary, legal instruments and social processes and explain how the differential structure of families affect its dynamics and processes (Remembering and Understanding)
- Assess and present the gender relations in society in the context of patriarchal social structure (Evaluating and Creating)
- Apply social work theoretical models for conceptualizing intervention plans that are best-suited for addressing problems located in different family structures (Applying and Analysing)
- Identify and evaluate the different plans and schemes of the government of India pertaining to family development and welfare (Evaluating)

Module I: Concept and Forms of Family and Marriage (11 hours)

Concept of family- Origin, Traditional Forms Family; Concept of marriage- Types of Marriage; Alternative Forms of Family and Marriage Patterns and Structures- Dual earner/Career Families; Single Parent families, Reconstituted/Step families; Childless Families; Same-sex Families, Adoptive family & Foster Family.

Module II: Theories and Dynamics of Family (11 hours)

Family theories – Developmental theory, Systems theory, Social Exchange theory, Structural Functionalist theory, Feminist theory, Ecological theory; Family Dynamics – Power, Myths, Role, Relationships;Gender and Patriarchy; Implications of...
Patriarchal Social Structure in Families- Global, National and Local.

Module III: Social Processes and Changes in Family Structure (11 hours)
Social Processes and Factors for Change- Industrialisation, Urbanisation, Modernisation, and Globalisation; Technology and Media; Migration; Displacement and Disaster (War, Conflict, riots and Natural Calamities)& Pandemics; Changes in the Family Structure - Family Demography&Determinants of Change in Family Structure- Fertility change, Change in at marriage & age at first birth, Change in size and structure of the households, Change in Marital Unions, Marital Dissolution, Widowed, Remarriages, Non-Marital Unions & Sexual Behaviours, and Alternative family formation behaviours

Module IV: Social Work with Families- Interventions, Techniques and Skills (12 hours)

Suggested Readings
3. Coontz, S., Marriage, a history: how love conquered marriage, New York: Penguin, 2005

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SWPC0051: SOCIAL WORK PRACTICE WITH CHILDREN (3-0-0)
(3 Credits- 45 hours)

Course Outcomes:
• Understand the process of socialization of a child (Remembering and Understanding)
• Understand health and children’s health i.e. Both mental and physical well-being. (Remembering and Understanding)
• Analyze the difficult situations faced by children in the present context. (Analysing)
• Know the national and international efforts for child welfare and the child related laws. (Remembering and Understanding)
• Understand and acquire the skills for working with children. (Applying and Analysing)

Module I: Understanding Child and Childhood (11 hours)
Module II: Concerns and Issues faced by Children (11 hours)

Module III: Child Rights, Policies and Programmes (11 hours)

Module IV: Fields of SWP and Skills for working with Children (12 hours)

Suggested readings
5. Bhalla, M. M., Studies in Child Care, Delhi: Published by NIPCCD, 1985

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SWMS0052: MEDICAL SOCIAL WORK(3-0-0)
(3 credits-45 hours)

Course Outcome:
- Introduce the historical development of medical social work in western countries and in India. (Remembering)
- Students will develop an insight on the impact of disease on the individual and his/her social system. (Understanding)
- Students would learn to implement social work intervention strategies in medical and psychiatric settings. (Applying)
- Students will develop competencies in the roles and functions of medical social workers in various settings.

Module I: Historical overview (11 hours)
Medical Social Work: Historical development of Medical Social Work in Western Countries and in India; Social Workers in General Health Care System in India; Challenges in the field of Medical Social Work in India.

Module II: Disease, Illness and Sickness and Concept of Care (11 hours)
Illness as a social problem and its effect on the individual, family and community, the concept of Patient as a Person; Social and Emotional factors involved in disease; Social Work with terminally ill, Social Work with dying and bereaved, Palliative Care, Hospitalization and its implications on patient and the family members; Rights of Patients; Modern trends in treatment of illness; Care in different Medical Settings – Hospitals, Outpatient Departments, Emergency, Crisis care, Hospice, Special Clinics.

Module III: Skills (11 hours)
Skills and Qualities of Medical Social Worker; Teamwork and multidisciplinary approach in the treatment of illness; Role and functions of a Medical Social Worker, Organization and Administration of Medical Social Work Department in Hospitals; Assessment and Diagnosis - Interviews, Reporting and Record maintenance; Medical Social Worker and Public Relations.

Module IV: Medical Social Work in different Departments in Hospitals (12 hours)
Medical Social Work in different Departments in Hospitals: Oncology, Nephrology; Reproductive Health, Family Welfare and Family Planning; Sexual Health (STD, HIV/AIDS); Geriatrics, Diabetology, Cardiology, Accident, Disability and Burns Department.

Suggested Readings

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SWHS0053: MENTAL HEALTH AND SOCIAL WORK (3-0-0)
(3 credits-45 hours)

Course Outcome:
- Introduce the concept of mental health, normal and abnormal behaviour, meaning of psychiatry and its history. (Remembering)
- Students will develop the skills of assessment of mental illness. (Applying)
- Students will learn about various mental illnesses affecting people. (Applying)
- Introduce the concept of Community Psychiatry and significance of community mental health. (Analyzing)

Module I: Understanding mental health and mental illness (10 hours)

Module II: Psychiatric assessment (10 hours)
Assessment in psychiatry. Psychiatric interviewing, case history recording and mental status examination (MSE). Classification in psychiatry - need, types - ICD and DSM.

Module III: Major Psychiatric disorders (15 hours)
Prevalence, etiology, clinical manifestation, course and outcome and different treatment modalities of the following disorders:
- Neurotic and somatoform disorders – Phobia, anxiety disorders, Obsessive compulsive disorders, dissociative
Module I: General Psychiatry (24 hours)

(a) Conversion disorders, somatoform disorders

(b) Mood (affective) disorders

(c) Organic mental disorders – dementia, (Alzheimer’s), Amnesic syndrome, delirium

(d) Schizophrenia and Delusional disorders

(e) Disorders of adult personality and behaviour – paranoid, schizoid and histrionic personality disorders. Gender identity disorders, disorders of sexual preference

(f) Disorders of psychological development – developmental disorders of speech and language and scholastic skills; learning disability, mental retardation, pervasive developmental disorders – autism, Rett’s and Asperger’s syndrome

(g) Behavioural and emotional disorders in childhood and adolescence – Hyperkinetic and conduct disorders, anxiety, phobia and depression

(h) Disorders due to substance use

Module IV: Community Mental Health (10 hours)

Community psychiatry – concept and meaning, evolution of community psychiatry; Community mental health in India, Social – cultural factors in psychiatric disorders with special reference to India, culture bound syndrome.

Suggested Readings

3. Chaudhry S.P., Abnormal Psychology, Educational Publishers
7. Fernald/Fernald, Munn’s Introduction to Psychology, 5th Edition, AITBS Publishers, India
10. Kumar Updesh, Mandal, Manas (Editors), Suicidal Behaviour, Assessment of People-at-Risk, Sage Publications India Pvt. Ltd, New Delhi, 2010
20. World Health Organization, the ICD 10 Classification of Mental and Behavioural Disorders, Clinical Description and Diagnostic Guidelines, Oxford University Press, Geneva, 1992

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SWOD0054: ORGANISATIONAL STRUCTURE, BEHAVIOUR AND DEVELOPMENT (3-0-0)
(3 credit: 45 hours)

Course Outcome

- Understanding the structure and functioning of an organization (Remembering and Understanding)
- To develop the skills for Organisation Development Process (Evaluating and Creating)
- To establish and manage any development organisation. (Evaluating and Creating)
- To introduce the students to organisational structure and management (Remembering and Understanding)
- To familiarize the students with the skills and legal base for managing the workforce of an organisation. (Applying)
Module I: Organizational Structure (10 hours)
Organizational Structure: Definition, Concept and Nature Formation of Organizational Structure

Module II: Basic concepts in Organisational Behaviour (10 hours)
Organizational Behaviour: concept and theories; Models of Organizational Behavior: Development and Types; Organisation Climate, Culture and Team building; Employee counseling, Work life balance, managing occupational stress

Module III: Basic skills for Organisational Development (10 hours)
Leadership - traits, typology and theories; Motivation: need, significance, theories, methods and practices; Communication - concept, significance, modes, channels, impact

Module IV: Legal Base for Practice (15 hours)

Suggested Readings

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SWDO0055: POLICIES FOR DEVELOPMENT ORGANISATIONS - URBAN, RURAL AND TRIBAL COMMUNITIES (3-0-0)
(3 credits- 45 hours)

Course Outcomes
- Develop an understanding about the social policies and decision making process of the government in planning for development in India. (Evaluating and Creating)
- Understand the Governmental efforts for development of Rural, Tribal and Urban communities (Remembering and Understanding)
- Understand and analyze Governance issues at local, regional, state and national levels (Applying and Analysing)

Module I: Introduction to Social Policies (8 hours)
Meaning and Definition of Policy and social policy; History and process of Social Policy development in India; Evolution of planning – Planning commission, NITI Aayog.

Module II: Policies and Schemes in Urban Areas (8 hours)
Challenges for urban development; urban poverty management; urban governance systems; Government schemes and policies
Module III: Policies and Schemes in Rural Areas (8 hours)
Challenges for rural development; rural poverty management; rural governance systems - decentralization processes; Government schemes and policies

Module IV: Policies and Schemes in Tribal Areas (8 hours)
Challenges for tribal development; Poverty management; Governance systems; Government schemes and policies

Module V: Issues of Governance and Planning (13 hours)
Issues of Development and Displacement; Diversity and Citizenship Issues

Suggested Readings

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SWCP0056: INTRODUCTION TO CHILD PSYCHOLOGY AND DEVELOPMENT (3-0-0)
(3 Credits- 45 hours)

Course Outcomes
- Introduce and help students understand the psychological, legal and cultural definitions of child and childhood (Remembering and Understanding)
- Introduce students to the major personality theories of psychology thus enabling them to understand human behaviour. (Applying and Analysing)
- Help students discover the different factors that influence development and behavior of children (Evaluating and Creating)
- Understand the principles, values and code of ethics for working with children (Remembering and Understanding)

Module I: Introduction to Child and Childhood (11 hours)

Module II: Theories on Child Development (11 hours)
Theories of Child Behavior; Emotional Theories; Learning Theories; Intellectual Theories; Psycho-Social Theories; Personality Theories; Moral Theories; Implications of Theories

Module III: Situational Child Psychology (11 hours)
Factors Determining Well-Being and Development of Children – Adult Child Relationships- Age, Gender, Caste, Class, Education, Social and Cultural Practices, Ethnicity, Religion, Region, Language, Influence of Technology on Family Relationships; Family dynamics, Peer relationships, Sibling relationships and birth order; Effects of separation, divorce, bereavements; Power Dynamics- Protection, Care and Support; Punishments and Threats; General Adult Attitudes; Effect of Cultural Practices; Laws and Institutional Practices; Representation in Literature and Media; Factors enabling Healthy Adult Child Relationships

Module IV: Values and Principles of Working with Children (12 hours)
Code of ethics- Responsibility for Self, Responsibility to Children, Young People and their Families, Responsibility to Colleagues, Responsibility to Employers, Responsibility to the Profession, Responsibility to Society; Principles and Values-Seven International Ethical Principles for People Working with Children and Young People; Psychiatric rehabilitation principles and values by Psychiatric Rehabilitation Association (PRA)

Suggested Readings:
1. Ahuja, N., A Short textbook of Psychiatry, Himalaya Publishing House, New Delhi, 2005
18. WHO, the ICD – 10 Classification of Mental and Behavioural Disorders, Diagnostic Criteria for Research, AITBS Publishers and Distributors (Regd.), Delhi, 2004

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SWRC0057: RIGHTS OF THE CHILD – LEGAL FRAMEWORK, NATIONAL AND INTERNATIONAL INSTRUMENTS (3-0-0)
(3 Credits - 45 hours)

Course Outcomes:
- Make the students well abreast of the International. National and other relevant instruments on Child Rights and get to know the legal sanctions and safeguards regarding children’s rights (Remembering and Understanding)
- Get to know the provisions enshrined in the Indian constitution which safeguard the rights of children and ensures a life of dignity for them (Remembering and Understanding)
- Make the students understand the role, functions and powers of the UN agencies and their mandate in working towards the cause of children (Analysing)
- Familiarize the students with the working of the statutory bodies and their role in providing justice to children. (Evaluating and Creating)

Module I: Introduction to Human Rights and Children’s Rights (11 hours)

Module II: Legislations relating to Children in India (11 hours)

Module III: Child Protection (11 Hours)
The Legal Foundation of Child Protection, Defining Child Protection; Concept and definition of vulnerability, Settings or Habitats of Children and its Effect on Vulnerability: (Family, Streets or Public Places, Institutions); Magnitude of Abuse, Neglect, Violence and Exploitation Cases Child in need of care and protection or vulnerable groups- Child Labour, street Children, abused Children, Children With disability, Trafficked Children, Children in Institutions and Children in “Families At Risk”. Child Poverty: Multi-dimensional Deprivation; Children and the Law- Children in Conflict with the Law, A System’s

Module IV: Child Rights, Protection and its Applications (12 hours)
Role of duty bearers in ensuring child rights and protection - Role in Protection, Prevention, Intervention and Rehabilitation by Family, Community, Civil Society, Media, and State; Structure, Functions and Role of UN and its specialized agencies for the protection of child rights, UNICEF, WHO, Red Cross; National and State Commissions for Protection of Child Rights - Their role and Functions; Government Schemes: Integrated Child Protection Scheme, Integrated Child Development Scheme; Programs and interventions for Child Protection - Family strengthening, Institutional Services and Non-Institutional services, Alternative Care

Suggested Readings
2. Ahuja, R., Criminology, Jaipur, Rawat Publications
5. Nirmal C. J., Human Rights in India: Historical, Social and Political Perspectives (Oxford University Press, India)
7. Leister Erich and Nanda Sujata, Human Rights of Children, Kalinga, New Delhi, 2009
10. Sinha Santa, Child Labour and Education Policy in India, Administrator Vol XII, July-September, 1996
15. Sastry, T. S. N, India and Human Rights, Delhi, Concept Publishing Company, 2005

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SWSP0058: SOCIAL DEVELOPMENT AND SOCIAL POLICY(3-0-0-0)
(3 Credits- 45 hours)

Course Outcomes
- Understand the key concepts and issues related to Social Development (remembering and Understanding)
- Promote alternative paths of Social Development that promotes the wellbeing of individuals, families and communities (Creating and Evaluating).
- Develop an understanding of social policy in the perspective of the national goals as stated in the constitution. (Creating and Evaluating)
- Develop the capacity to recognize the linkage between the developmental issues and social policy, plans and programmes related to social work practice. (Applying and Analysing)

Module I: Social Development (11 hours)
Definition, meaning and concepts; Approaches to Social Development; Developmental Indicators; Measurement of Development; Models of Development; Economic growth and Social Development; Human Development; Relationship between Social Development and Sustainable Development.

Module III: Theories of Social Development (11 hours)
Baran’s Theory; World System Theory; Dependency Theory; Theory of Unequal Exchange; Theory of Economic Growth; Theory of Positivistic Development; Theory of Realistic Development.

Module III: Social Policy (11 hours)
Concept and Objectives; Values underlying Social Policy based on Constitutional provisions (i.e. Directive Principles of State Policy, Fundamental Rights and Fundamental Duties); Instruments of Social Policy; Approaches to Social Policy – Residual Welfare, Unified, Integrated, Sectoral; Models: Industrial achievement and Institutional Redistributive Model and their applicability to the Indian situation.

Module IV: Evolution of Social Policy (12 hours)
Suggested Readings
2. Bogo Marion, Social Worker Practice: concept, processes and interviewing, New Delhi, Rawat, 2007
10. Kulkarni, P.D., Social Policy in India, Tata Institute of Social Sciences, Bombay, 1965

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SWPM0059: PROJECT CYCLE MANAGEMENT AND RESOURCE MOBILISATION(3-0-0-0)
(3 Credits-45 hours)

Course Outcomes
- Understand the importance and process of planning, methodology for planning and formulating projects using the Logical Framework Analysis (Remembering and Understanding)
- Develop an understanding of the problems and issues faced by the poor and the marginalized (Creating)
- Develop an insight into the different strategies and approaches commonly adopted by Development Organisations for Project Management (Applying and Analysing)
- Learn Skills to develop project proposals, implement, monitor and evaluate project, enhance process documentation and reporting skills (Evaluating and Creating)

Module I: Overview (7 hours)
Concept of Results Based Management; Planning and its importance for PCM; Overview of Project Cycle Management: Identification, Design, Implementation, Monitoring, Evaluation, Identification of the best practices.

Module II: Project Identification (8 hours)
Needs assessment: Situational analysis; Capacity assessment: Human, Social, Natural, Physical, Economic and Cultural; Stakeholders analysis, types: Primary and Secondary Stakeholders and mapping of Stakeholders; Importance of Stakeholder participation and different levels of participation.

Module III: Project Design (10 hours)
Problem Tree analysis; Objective Tree analysis and formulation of objectives; Hierarchical results: Impact, outcome, Outputs, Inputs; Assumptions, Indicators, Means of Verification; Activities and scheduling; Budget preparation

Module IV: Monitoring and Evaluation (10 hours)
Concept and definition of monitoring and evaluation; Difference in Monitoring and Evaluation; Learning the lessons; documentation and reporting; PERT and Critical Path Method (CPM) of Monitoring

Module V: Resource Mobilization (10 hours)
Internal and External Resources; Fundraising – principles, sources, ethics, methods and their implications. International sources for Funding – Concept note; application, procedure and FCRA, record keeping, documentation and legal compliance

Suggested Readings
1. Lukose P J, A to Z in Projects Cycle Management: A Results Based Approach, Media House, Publications, New Delhi, 2015

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SWHP0060: COMMUNITY HEALTH AND POPULATION MANAGEMENT (3-0-0) (3 credit- 45 hours)

Course Outcomes
- Define health, disease, epidemiology, health policies, health education and related terms of community health and population studies (Remembering)
- Explain the concepts of health, health indicators and relevance of social work in health (Understanding)
- Apply and knowledge and understanding of the concepts of community health in social work practice for development (Application)
- Able to analyse various health issues in communities, and suggest and apply solutions to community health concerns (Analyse)
- Able to assess and choose health intervention plans and policies for community needs (Evaluate)
- Able to combine effectiveness of health interventions, approaches, policies and programmes for effective intervention for healthy communities (Creating).

Module I: Health, Disease and Epidemiology (11 hours)
Meaning and Scope of Health and Epidemiology; Concepts and Models of Health and Disease; Factors associated with health and diseases; Concepts of sickness, illness and diseases; Environmental Health, Nutritional Health, Occupational Health, Mental Health and Reproductive Health, Tribal Health.

Module II: Health Indicators, Health Statistics and Management System (11 hours)
Health Statistics and Health Indicators – Morbidity and Mortality: MMR, IMR, TFR; Communicable and Non-communicable diseases; HMIS – Computer systems, Data sources, Collection, Analysis and uses; Primary, Public and Community Health Care Services: Structure, Organization, and Community Participation; Physical and psychological aspects of Community Health; Preventive and Promotive Health care in Indian context. Community Health Concerns: Drugs and Alcoholism.

Module III: Health and Population Policies (11 hours)
Health and Population Policies: Health Policy; Alma Ata Declaration, National Health Policy; Mental Health Act; NRHM, Assam Public Health Act; Population Policy; Population Dynamics- National and the North East Context.

Module IV: Health Education and Role of Social Worker in Health Service (12 hours)
Health Education, Consumer Health and Health Products; Meaning, importance, principles and components of health education; IEC for health: mass media, audio-visual; Agencies for Health Education Programmes-Voluntary and Government; Analysis of Health Education in India. Formal and Informal health care provider; Modern and traditional practices, safe and risk health behavior and practices. Quackery, Consumer Law on health, consumer agencies; Role of Social Work in Preventive, Promotive and Rehabilitative Programmes in Communicable and Non-Communicable Diseases.

Suggested Readings
2. AIDS Prevention through Health promotion by WHO, end of pub.
10. Park, K., Park’s Textbook of Preventive and Social Medicine, 20th edition, Bhanot, 2009

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SWDC0061: COMMUNITY DEVELOPMENT PRACTICE WITH THE DISEMPOWERED COMMUNITIES (3-0-0) (3 credits- 45 hours)

Course Outcomes:
- Understand the issues of marginalization, oppression and disempowerment of vulnerable communities such as the dalits, tribes and the indigenous peoples and women ;(Remembering and Understanding)
- Build capacity among the students for critical reflection and analysis of community development issues pertaining to the disempowered ;(Applying and Analysing)
- Build upon the existing understanding of community dynamics, structures and experiences ;(Evaluating and Creating)
- Strengthen skills and capacity of the students for intervention at different levels taking an “empowerment” and anti-oppressive stance. (Applying)

Module I: Power, Privilege and Oppression (11 hours)
Conceptual Frameworks and Theoretical Perspectives; Systems Theory; Critical Theories; Understanding oppression, privilege and oppression in Indian context.

Module II: Political Economy of the Dalit Development (11 hours)
Social stratification; Caste; Casteism; Colonialism and State; Ambedkar and the Annihilation of Caste

Module III: Political Sociology of the Tribes and Tribal Development (11 hours)
Perspectives on Tribes; History of Tribes/Adivasis in India; Evolution of Tribal Policy; Administration and Local Governance; Politics of Tribal Welfare and Development; Critical Social Work; Anti-oppressive Approach; Structural Social Work

Module IV: Specific Identity Constructs and Populations at Risk (12 hours)
Gender and Sexism; Gender, Culture, and Society; Race, Sexuality, and Culture (Intersections); Gendered Relations; Health, Sex, and Gender.

Suggested Readings
1. Chacko, P.M. (Ed.), Tribal Communities and Social Change
9. Elwin, V., The Philosophy of NEFA
14. Kimmel M., the Gendered Society. Introduction and Chapters 1, 2 and 4, 2000

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SWWE0062: DEVELOPMENT CONCERNS AND WOMEN EMPOWERMENT (3-0-0)  
(3 Credits - 45 hours)

Course Outcomes:

- Develop an understanding of the feminist perspective of women empowerment (Remembering and Understanding)
- Understand the status of women in the present social, political and economic context (Remembering and Understanding)
- Develop an understanding of the women’s problems and issues (Analyse)
- Know the national and international efforts for the welfare of women and gender parity (Evaluating and Creating)

Module I: Understanding Gender, Patriarchy, and Society (11 hours)
Gender, Sex and Patriarchy- Meaning; Social Construction of Femininity, Social Construction of Masculinity, Patriarchy, Intersectionality and Gender roles; Feminism – Meaning, Feminist Theories- Liberal, Radical, Marxist, Socialist and Eco-Feminism, Feminist Research Methodology; Feminist Economics and Introduction to Women’s Studies

Module II: Women’s Movement and Women’s Development (11 hours)
Women’s Movement in the USA, UK and India- Seneca Fall Declaration, the Suffragettes; Women in Indian Society - Women in early India, pre-colonial period and modern India, Women’s Movement in India and its impact, The history of women’s education; Theories of Development (Empowerment, Alternative Approaches: Women in Development, Women and Development and Gender and Development)

Module III: Concerns, Issues and Laws (11 hours)

Module IV: Social Work Practice with Women (12 hours)
Social Action- Saul Alinsky’s Theory, Advocacy, Examples of Social Action by women’s groups, Recent Trends; Good Practices by INGOs and NGOs- UN Women, SEWA, NEN, The Ant, ABWJF, MGSN, Meira Paibis, Assam Mahila Samitti, Naga Mothers Association, Mizo Hmichhe Insuihkham Pawl, Impulse, Achik Mothers Association.

Suggested Readings
1. Agnes, Flavia., Law and Gender Inequality: The Politics of Women’s Rights in India. Delhi: Oxford University Press, 2004
13. Kumar, Girish (Ed.), Health Sector Reforms in India. New Delhi: Manohar, 2009

Mapping of COs to Syllabus

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SWSN0063: FAMILIES WITH SPECIAL NEEDS (3-0-0)  
(3 credits - 45 hours)

Course Outcomes:
- Understand the context, responses and practice framework for special-care-needs families (Remembering and Understanding)
- Imbibe and become familiar with practice principles, values and ethics while dealing with families with special needs (Remembering and Understanding)
- Develop skills required for meaningful intervention (Applying and Analysing)
- Promote care-planning for families with special needs (Evaluating and Creating)

Module I: Understanding the Context (11 hours)
Understanding Early Childhood Development: Disabilities, Diseases, Gender; Issues Of Care Planning For Children, Youths, Women, Men With Special Care Needs; Special Needs of families in Northeast India: Families in Conflict, Disasters, Displacement, Superstition, Homelessness and Poverty; Emerging Concerns Of Seniors and Elderly: Global, National And Regional Contexts.

Module II: Understanding the Responses (11 hours)
Understanding the theoretical foundations for Social Work Support, Counseling, Resource Coordination and Advocacy Services for Families With Special Care Needs; Overview of service systems for special need groups; Issues, challenges and practice approaches with children and parents in Adoptions and Foster care; Clients and care-providers in Institutional Care; Adoption System: pregnant women, Adoptive Parents And Adopted Children; Disability, Pregnancy, LGTBs, geriatric care, Long-term care needs of terminally ill; Social Work Practice Principles and values in these settings.

Module III: Advanced Practice Skills (11 hours)
Case/Care Management of families with special needs: Terminally ill person, Mental Health Care, Addictions, Long-Term Care, Aging, HIV/AIDS, Disabilities, Occupational services, Child Welfare, and Immigrant/Refugee Families; Assessment; Care planning, and Resource linkages: programmes, schemes and services; Family Therapy: Communication-pattern Approach; Family subsystem Approach; Cognitive Behavioral Approach: cognitive restructuring, contingency contracting, skills.

Module IV: Working with Parents in families with Special Needs (12 hours)
Child Development Knowledge and Care; Positive Interactions with Child, Responsiveness, Sensitivity; Nurturing, Emotional Communication, Disciplinary Communication, Discipline and Behavior Management; Promoting Children's Social Skills or Pro-social Behavior; Promoting Children’s Cognitive or Academic Skills.

Suggested Readings

Mapping of COs to Syllabus
SWPW0064: PSYCHIATRIC SOCIAL WORK (3-0-0)  
(3 credits - 45 hours)

**Course Outcomes:**

- Introduce the field of psychiatric social work and comprehend the roles and responsibilities of psychiatric social workers (Remembering and Understanding)
- Introduce the concept of rehabilitation and the application of different therapeutic interventions (Understanding and Applying)
- Introduce different non-pharmacological therapeutic approaches used in psychiatry (Understanding, Analyzing and Applying).
- Introduce National Policies and Programs related to Mental Health and discuss (Understanding, Analyzing, Evaluating & Creating)

**Module I: Psychiatric Social Work and its Application in the Field (11 hours)**

Psychiatric Social Work - Definition and Historical development in UK, USA and India; Present status and challenges in the field; Multi-disciplinary team approach in the treatment of Psychiatric Illness; Role and Functions of Psychiatric Social Worker in the team; Psychiatric social worker in the Field Of Community Mental Health; Skills and Techniques used in Psychiatric Social Work Practice.

**Module II: Rehabilitation and Practice of Psychiatric Social Work in various Clinical settings (11 hours)**

Psychiatric rehabilitation - definition, psychosocial rehabilitation, principles and strategies; The concept of social diagnosis and social work interventions in psychiatric settings- psychiatric departments /hospitals/clinics, halfway homes, day care centers, child guidance clinics and de-addiction centers.

**Module III: Therapeutic Approach to Mental Illness (11 hours)**

Treatment and after care of mentally ill patients, application of social work methods in the treatment of mental disorders; Various therapeutic methods: Psychotherapy, Electroconvulsive Therapy, Occupational Therapy, Group Therapy, Client Centered Therapy, Gestalt Therapy, Reality Therapy, Behaviour Therapy, Play Therapy, Rational Emotive Therapy, Therapeutic Community, Motivational Enhancement Therapy, Psycho education and Family Therapy.

**Module IV: Policies and Programmes in the Field of Mental Health (12 hours)**

Mental health policies and legislation in India; National Mental Health Programmes; Designing and implementing programmes on mental health in communities, monitoring and evaluation of programmes; Research – qualitative and action research on mental health issues.

**Suggested Readings:**

3. Francis, C. M., Promotion of Mental Health with Community Participation. The Center for Health Care Research and Education. Kerala: 1991

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**SWCH0065: COMMUNITY HEALTH AND SERVICES (3-0-0)**  
(3 credits: 45 hours)

**Course Outcomes**
- Define the concept of health, community health and health care services. (Remembering)
- Explain the administration of basic health infrastructure and services in the country; and illustrate the important national health policy, health programmes, their implementation, advocacy and lobbying. (Understanding)
- Make use of the knowledge on health education and health promotion in the field of work. (Applying)
- Analyze the important strategies and approaches of social work in community health. (Analyzing)
- Assess the health problems and health services with specific focus on marginalized and vulnerable groups and determine the role and specific skills required for social work practice in community health. (Evaluating)
- Build the skills of communication, community mobilization, organization, counselling and referrals; and formulate approaches for prevention and promotion of health, curative and rehabilitative services in Indian context. (Creating)

**Module I: Understanding the concept of Health and Community Health (11 Hours)**

**Module II: Health education and health promotion (11 hours)**

**Module III: National Health Programmes (11 hours)**
Health Policies and Committees – National Health policy, National Health Mission, Health programs; their implementation, advocacy and lobbying. Health administration and Planning: Structure and Functions at National and State and District levels- Primary Health Centers - Corporation and Municipal health services. Hospital Administration and Management.

**Module IV: Strategies and approaches of social work in Community health (12 hours)**
Understanding health from the Human Rights perspective – Environment issues and health – Media and health. Health Movements and Campaigns. Role and Specific skills required for Social Work Practice. Health education and communication, counseling and referral, Community mobilization and organization, Health system restructuring and reform, Capacity building and training, Resource mobilization and application

**Suggested Readings**
3. Department of Health Ministry of Health and Family Welfare, National Health Policy, New Delhi, 2002
8. Abelin, T., Brzenski Z.I., and Carstairs, V.D., Measurement in Health promotion and protection, WHO, Copenhagen, 1887

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SWHR0066: HUMAN RESOURCE MANAGEMENT: SOCIAL WORK PERSPECTIVE (3-0-0)
(3 Credits- 45 hours)

Course Outcomes
- Understand HRM as a profession. (Remembering and Understanding)
- Understand the role of HRM in business. (Remembering and Understanding)
- Equip learners with knowledge, skills, attitude, professional competencies and social sensitivities essential for a successful career in HRM. (Applying and Analyzing)
- Integrate the knowledge obtained from theory with the practice. (Evaluating and Creating)

Module I: Introduction to Human Resource Management (11 hours)
Concept, scope and applicability of Human Resource Management- HR as a profession (Strategic Role – Basics); Structure, functions, mechanisms of HRM; Functional area of Human Resource Management; Role, characteristics and skill essentials of Human Resource Managers; International HRM; HRM in a dynamic environment – Basic concepts and trends.

Module II: Basics of Human Resource Management Practice (11 hours)

Module III: Contemporary Human Resource Management (11 hours)
Process, benefits and relevance of strategic HR; Human Resource - The Strategic Business Partner; Mergers and acquisitions – Concept, meaning, process and issues; Human Factors in mergers and acquisitions; Employee engagement and Climate /Engagement Surveys – Meaning, concept and best practices; Benchmarking – Meaning, concept and purpose.

Module IV: Career Development (12 hours)
Career development and succession planning - Concept and changing aspects; Mentoring and employee development – Concept and issues; Performance Management System – Meaning, Methods, Merits and limitations; Quality Management System and its significance – ISO Standards; Employee Counseling – Relevance and Practice.

Suggested Readings
27. SubrotoBagchi, The Professional. Penguin India, 2009

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SWCI0067: CORPORATE SOCIAL RESPONSIBILITIES - CONCEPTS & IDEOLOGIES (3-0-0)
(3 Credits - 45 hours)

Course Outcome
- Introduce students into CSR concepts (Understanding)
- Develop competencies for effective field interventions, research and management of CSR interventions (Applying)
- Develop an insight into present CSR strategies and model business organization (analysing)
- Enable students with conceptual clarity on need, purpose and relevance of research applicability in CSR practice (Creating)

Module I: Concepts (11 hours)
CSR: Definition, Concept and scope; Evolution of CSR; CSR and Social Legitimacy; The evolving role of stakeholders; Moral and Economic arguments for CSR; History of CSR in India; Dimensions & Importance of CSR; Understanding CSR: Responsibility, Accountability & Sustainability.

Module II: CSR Policy and Governance (11 hours)
Stakeholder engagement; Environmental assessments; Theories & Models of CSR; CSR in emerging market; Limitation of CSR; Strategic Context of CSR.

Module III: Community Investment and Evaluation (11 hours)
CSR and Human Resource Management; Reporting and communication; Implementing CSR programs; Monitoring and measuring the impact of CSR programs; Company Act: 2013; CSR: Global Perspective; Roles of institutions in CSR: Government, NGOs, Education institutions & role of Media.

Module IV: - Introducing a Systems-Based Approach to Developing CSR (12 hours)
Assessing the current state of a company’s CSR activities; Linking CSR to brands and reputation; Stakeholder engagement; Current and future Trends & Practices in CSR; Indian CSR: Selected Case Studies.

Suggested Readings
3. Prasenjit M., Corporate Social Responsibility - Vol. – I & II, Sharda Publishing House, Jodhpur (India), 2010

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SWSPO068: CHILDREN WITH SPECIAL NEEDS (3-0-0)
(3 Credits – 45 hours)

Course Outcomes
- Understand the children with special needs and develop skills in social work intervention (Remembering and Understanding)
- Understand the context, responses and practice framework for inclusive programs and special-care-needs families (Remembering and Understanding)
- Imbibe and become familiar with practice principles, values and ethics while dealing with families with special needs (Applying and Analyzing)
- Apply a number of assessment procedures that identify internal and external risk protective and promotive factors that may affect children and adolescents. (Applying and Creating)
Module I: Understanding Children with Special Needs (11 hours)
Developmental Disabilities: Causes, Classifications and Labeling of children with special needs; Sensory Impairments-Vision, Hearing, And Speech; Physical disabilities and health problems; Learning, Behaviour and Emotional disorders; Understanding the Environment- Bronfenbrenner’s ecosystem perspectives.

Module II: Best Practices in Inclusion (11 hours)
Definition and History of Inclusion; Benefits and challenges of Inclusion for Children with and without Disabilities; Elements of Good quality, inclusive programs for Infants, Toddlers, And Preschoolers; Six key aspects of best practices for Working with Children with Special Needs; Public Policy and Advocacy for inclusive practices; History and Impact of legislations affecting Children with Special Needs; Landmark court cases on Services for Children with Special Needs.

Module III: Documenting and Assessing to Support Families with Special Needs (11 hours)
Knowing about and using Observation, Documentation, and other appropriate Assessment Tools Understanding and practicing responsible Assessment, Knowing about Assessment Partnerships with Families and other Professionals; Documenting Case History; Family Assessment- Understanding the Goals, Benefits, and uses of Assessment; Problems-Strengths Identification.

Module IV: Partnerships with families and caregivers (11 hours)
Knowing about and understanding Family, Family in transition, and Community characteristics; Impact of Disabilities on Families- Understanding Families, Family Crises; Supporting and Empowering Families and Communities through Respectful, Reciprocal relationships; Involving Families and Communities in their Children’s Development and Learning-Trajects and Adapting Materials and use of Adapting Technologies; Individualized Education Programs (IEPs); Individualized Transition Plans (ITPs) and; Individualized Family Service Plans (IFSPs); Community Resources and Cultural Sensitivity; Services by Government and Non-government agencies in India.

Suggested Readings
15. WHO, The ICD – 10 Classification of Mental and Behavioural Disorders, Diagnostic Criteria for Research, AITBS Publishers and Distributors (Regd.). Delhi: 2004

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SWRP0070: CHILD RIGHTS AND CHILD PROTECTION (3-0-0)
(3 Credits – 45 hours)

Course Outcomes
- Understand different social work perspectives on working with children. (Remembering and Understanding)
- Recognize the role of families and other stakeholders in child protection and demonstrate methods of strengthening families for child protection. (Applying and Analysing)
- Develop advanced intervention skills in working with children, adolescents and their families. (Evaluating and
Creating)
- Help students practice effective communication, networking and collaboration skills with different stakeholders related to child protection. (Applying and Analyzing)

**Module I: Social Work Perspectives on Working with Children (11 hours)**
Ecological Model; Strengths based Perspectives; Child-centered Approach; Children's Perspective to Life; Family Centered Social Work, Problem Solving Approach; Developmental approach.

**Module II: Governance and Child Rights (11 hours)**
Understanding Governance, Child Rights Governance from Global Perspective; Governance in North East; Child Poverty and Good governance; Public finance and Child Budgeting, Child Rights Programming; Planning and Advocacy for Child Rights, Activism and Networking with Allied systems.

**Module III: Working with Families and other Stakeholders (11 hours)**
Working with Families- Families in the Indian Context (Diverse Functions, Structure and Size of Families), Family Dynamics, Family Work and Parenting Skills, Strengthening Family's ability to Protect Children (Assessment, Identifying Needs and Life Stage of Each Member, Impact of Family Conditions on the Child, Linkages with Schemes for Family Strengthening); Working with Other Stakeholders (Child Protection Committees, Panchayats, Police, Government Departments, Schools, Residential Care Institutions, Community Groups, Self-Help Groups, Youth Groups), NGOs, Statutory Committee

**Module IV: Skills in Working with Children (12 hours)**
Counseling and guidance - Counseling Techniques – Client-centered, Counselor Centered and Eclectic Counseling; Types of Counseling and Tools Required – Individual and Group counseling, Family Group Counseling, Individual Counseling Tools– Interview, Case study, Tests and Clinical; Assessment; Group Counseling–Informal Discussion; Group Reports, Lectures, Dramatics, Case conference; Communication Skills - Individual and Group, Use of Creative Activities like Storytelling, Play, Art, Music and Dance Movement; Skills in Behavior Modification techniques, Advocacy and Campaigning for Children, Relationship Building; Skills in working with different Vulnerable Groups; Facilitating Child Participation.

**Suggested Readings**

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VALUE ADDED COURSES

SWAW6015: ACADEMIC WRITING, RESEARCH PROPOSAL DEVELOPMENT AND DISSERTATION WRITING
COURSE (15-0-15)
(2 credits - 30 hours)

Course Outcomes:
- Remember the concepts and meaning related to academic and professional writing. (Remembering)
- Understand the different components, stages and steps of academic writing, research proposal development and dissertation writing. (Understanding)
- Able to apply the skill of professional and academic writing into practice. (Applying)
- Able to analyse different types of writing in professional life. (Analyzing)
- Able to review and evaluate writing styles in keeping with the framework of different professional and academic writing. (Evaluating)
- Able to write academic articles, develop research proposal, dissertations and professional reports. (Creating)

Module 1: Introduction to academic writing and publication (8 hours)
Academic writing – academic writing, citations, referencing – APA, MLA, Chicago etc., peer review process and types – single blind, double blind, open peer review; publishing in journals (Indexed and UGC CARE List), edited books and books; authorship and ethics of publication.

Module 2: Research Proposal Development, Presentation and Approval (14 hours)
Research proposal – Background of study, review or literature, statement of the problem/research concern, significance of the study, rationale of the study, research hypotheses, research questions, research objectives, definition of terms, research methodology – design, population, sampling, tools and techniques of data collection, sources of data, analysis, interpretation and representation of data, ethical concerns of research (Academic Integrity and Ethical Review Board), likely outcomes, limitation of the study and research timeline. Process of research proposal approval – presentation, feedback, revision, re-presentation and approval. The role of research guide in research process.

Module 3: Dissertation Writing, Presentation and Defense (8 hours)
Dissertation writing - scientific setting, sections of research dissertation, declarations and consent forms, chapterisation, annexures and reference. Drafts, mentoring by guide, printing, final submission, presentation, defense and viva voce examination.

Suggested Reading:

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SWRB6014: RESULTS BASED MANAGEMENT OF PROJECTS AND PROGRAMMES (15-0-15)
(2 Credits 30 hours)

Course Outcomes:
- Understand the importance and process of Result based management of projects and programmes and formulating projects using the Logical Framework Analysis
- Develop an understanding of the problems and issues faced by the poor and the marginalized
- Develop an insight into the different strategies and approaches commonly adopted by Development Organisations for Project Management
- Learn Skills to develop project proposals, implement, monitor and evaluate project, enhance process documentation and reporting skills
Module I: Overview (5 hours)
Overview of Results based Management and Project Cycle Management: Identification, Design, Implementation, Reviewing, Monitoring, Evaluation, Learning the lessons

Module 2: Project Identification (5 hours)
Project Identification : Situational Analysis and Problem Tree Analysis

Module 3: Project Design (10 Hours)
Capacity assessment: human, social, natural, physical, economic, cultural: Stakeholder analysis: user groups, interest groups, beneficiaries, decision makers; Primary and Secondary stakeholders: Identifying appropriate stakeholders for participation; levels of participation: Logical Framework Approach:

Module 4: Monitoring and Evaluation (4 Hours)
Methods and process of Monitoring and Evaluation

Module 5: Resource Mobilisation (6 Hours)
Internal and External Resources; Fundraising – principles, sources, ethics, methods and their implications. International sources for Funding – Concept note; application, procedure and FCRA, record keeping, documentation and legal compliance

Suggested Readings

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SWWD6016: WORKING WITH DIVERSITY (15-0-15)
(2 Credits 30 hours)

Course Learning Objectives:
• Reflect on your own diversity (reflection), how it impacts on others (reflexivity) and how it informs to the development of critical cultural competence
• Understand the key theories related to the concept of diversity
• Critique the theoretical approaches of Equality, Human Rights and Diversity as they are applied in practice
• Apply the Diversity approach to current global issues including Covid-19
• Raise awareness of diversity through an application of theory to a co-created project promoting social change and human rights (Diversity Project and seminars)

Module – I (7 hours)
Defining Diversity and Difference; Theoretical and Conceptual understanding of Diversity; Models and Approaches; Levels of intervention in Diversity; Intersectionality and Structures of Diversity; Equality, Human Rights and Diversity.

Module – II (7 hours)
Perspectives of Diversity; Diversity, Difference and Disadvantage; Cultural Competence in Social Work and its Critiques; Current Strategies in Managing Diversity and its implications in Social Work;

Module III (7 hours)
Global Examples: Pandemic & Inequality; Black Lives Matter (Anti-Racism); Migration and Inclusion; Climate change and environmental issue; Resistance and solidarity in the context of indigenous (tribal/avasi) development in India.

Module IV (9 hours)
Co-creation of Projects on Diversity and its management for social development in different global context.

Suggested Reading:


5. Online Journals:
   - Journal of Ethnic and Cultural Diversity in Social Work
   - Journal of Multicultural Social Work

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**SWLS6017: Life Skills for competency development (15-0-15)**
(2 Credits 30 hours)

** Objectives:**
The basic objective of the course is to introduce the students to the:
- Basic concepts and core life skills and its application
- Strategies for developing personality and competency
- Practice life skills for self-enrichment and well-being

**UNIT 1: INTRODUCTION TO LIFE SKILLS [6 hours]**
- Definition and importance of life skills
- Evolution and development of the concept of life skills:
  - UN Inter-Agency Report
  - Hamburg Declaration
  - Dakar Framework: Quality education and life skills

**UNIT 2: CORE LIFE SKILLS: SOCIAL SKILLS, THINKING AND COPING SKILLS [12 hours]**
- **Self-Awareness and Empathy**
  - Empathy: sympathy, empathy & altruism; practising empathy
- **Effective Communication and Interpersonal Relationship**
- **High order thinking skills: Critical & Creative thinking**
  - Critical thinking: Process; strategies to enhance critical thinking
  - Creative thinking: Stages of creative thinking; strategies to enhance creative thinking
- **Problem Solving & Decision Making**
  - Problem solving: concept, stages in problem solving; models in problem-solving
  - Decision Making: process; models of decision making; decision making in a group
- **Coping Skills: Coping with Emotions and Stress**
  - Coping with emotions: concept and types of emotions; coping with negative emotions and cultivating positive emotions
  - Coping with Stress: concept and meaning; types and sources of stress, strategies to manage stress

**UNIT 3: LIFE SKILLS FOR PERSONALITY DEVELOPMENT AND PRACTICUM [12 hours]**
- **Life Skills for Personal Effectiveness**
  - Values: Punctuality, honesty, loyalty, dependability, reliability, integrity, respect, Constitutional values
  - Building self-confidence and self-motivation
  - Goal setting: types, steps, personal vision and goal
  - Time management
- **Topics prescribed for workshop/Skill lab**
References:
5. Family Health International, NACO, USAID (2007), Life Skills Education tool kit for Orphans and vulnerable children in India
11. Singh Madhu (2003), Understanding Life Skills, Background paper prepared for Education for All: The Leap to Equality

Web Sites:
- UNESCO – http://www.unesco.org/
- UNFPA - http://www.unfpa.org/
- www.oecd.org

SWFT6018: FAMILY THERAPY (15-0-15)
(2 Credits 30 hours)

Module 1
Introduce the concept of Family and family therapy (7 Hours)
Family: Concept of family – Homeostasis, Family Rules, Content and Process of interaction, sequence of interaction, Specific dimensions – family context, Boundaries, Power, Decision making, Family affect, family goals, family myths and cognitive pattern, family roles, family strengths, Pathology of – boundaries, alliances, triangles, hierarchies, Characteristics of family, family life cycle, Family Therapy – Brief History of Family Therapy, definition of Family Therapy, Challenges faced by a family therapist.

Module 2
Theoretical Perspectives of Family Therapy (8 Hours)
Key Concepts, Goals and Techniques used in Structural Family Therapy and Systemic Family Therapy

Module 3
Basic Concepts of Family Therapy (7 Hours)
Assessment –Family Assessment Performa – family structure, leadership patterns, Role structure and function, Communication, Reinforcement, Cohesiveness, Adaptive patterns, Exploring the presenting problem, assessing for
Module 4

Techniques Used (8 Hours)

Genogram- different symbols, Asking Questions – Lineal questions, Circular Questions, Strategic Questions, Reflexive Questions, Placing, Blaming, Super-reasonable, Irrelevant Behaviour, Family Reconstruction, Reframing, Boundaries, Unbalancing, channeling, specifying, tracking and linking, filtering, Normalizing, Providing support, Confronting, Pacing, Complementarity, Realities, Constructions, Strengths, Paradoxes

Tools- Family Sculpting, Family Genograms, Ecomap

Suggested Readings
3. the learner is able to apply the knowledge and skill of communication for development for intervention projects aimed at social change. (applying)
4. the student is able to analyse and adopt appropriate media for carrying out communication for development applications in appropriate contexts. (analysing)
5. the learner is able to assess the appropriate use of communication for development to find participatory solutions to different social and cultural issues affecting communities. (evaluating)
6. the learner is able to design and execute a communication for development project for social and behaviour change communication. (creating)

### Mapping of cos to syllabus

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### Suggested readings

5. Wilkins, k.g.,tuft, t., & obregon, r. (2014).the handbook of development communication and social change. Delhi: wiley.
PRACTICUM

SWFR6008: CONCURRENT FIELDWORK I (6 credits): 200 hours of Fieldwork in 15 weeks (0-0-16)

Expected Outcomes:
- Students are exposed to the community and community issues
- The students understand the dynamics and issues in the community and become aware of the sensitivities of people while working with them.
- Students get a close feel of the community and community settings
- They also get a firsthand experience of the programmes and projects implemented in the communities by NGOs and government agencies and the impact that these have on the community.
- Understand the tension between tradition and change that the communities in the region are likely to experience, and how it is handled.

Process
The field work practice in the first semester consists of orientation visits, lab sessions for skills training and placement.
- In the first semester, the focus of field work is the community.
- The students are placed in communities and in NGOs, Service Organizations and Government Agencies working with communities, and in those settings where they can be.
- They also interact with the agency personnel and the community members.
- They, with the help of the agency and the field work supervisor, identify an issue and work on it following the principles of community organization. The students are expected to be creative and innovative in assisting the agency and community in whatever way possible.
- Normally a student spends fifteen hours over two days per week in field work. However, keeping in mind the peculiar situation of transport and communications in the region and the expenses involved, the field work practice may be arranged in other convenient ways as the department deems fit.
- After each session of field work the students write a report of their activities and submit to the concerned field work supervisor. The supervisor conducts individual and group field work conferences regularly.
- At the end of the semester the student submits a summary report for the semester and an external viva voce examination is conducted.

SWFW6009: CONCURRENT FIELD WORK II (0-0-16)
(6 credits - 200 hours of fieldwork in 15 weeks)

Expected Outcome:
Ensures that the student understands the way these institutions and agencies function and practice the skills of working with individuals and different groups.

Process
- The field work practice in the second semester will consist of lab sessions for skills training and placement. The focus will be on the practice of Social Case Work and Group works.
- The students shall be placed in NGOs, Government Departments, Service Organizations and Communities working with individuals and families, and in those settings where they can be exposed to issues related to individuals and groups. Normally a student spends fifteen hours over two days per week in field work.
- The student is expected to complete 5 cases in casework and follow up one group with at least 5 sessions.
- Besides this, the student shall be involved in the activities of the institution and fulfill the responsibilities that are asked of him/her by the agency/field supervisor.
- After each session of field work the students shall write a report of their activities and submit to the concerned field work supervisor. The supervisor shall conduct individual and group field work conferences regularly.
- At the end of the semester the student shall submit a summary report for the semester and an external viva voce examination is conducted.

SWCA0047/SWCA6010: COMPUTER APPLICATIONS FOR SOCIAL SCIENCES (Lab)(0-0-2)
(2 Credits - 30 hours)

Course Outcome:
- Learn the basic computer applications, those are useful for a social worker (Remembering)
- Learn and do data analysis for research using Statistical Analysis Package (Applying)

Module I (7 hours)
Word Processing: Meaning, Features, advantages; Structure of a Word Processor window; Creating document, saving opening and printing, find and replace. Creating table; Mail merge - main document, data source and merging

Module II (8 hours)
Spreadsheet Package: Cell, rows and columns; Range, structure of a spreadsheet window; Creating, saving opening and printing a spreadsheet, creating tables, charts; data analysis using formulae in a spreadsheet.

Module III (5 hours)
Presentation package: Creating presentations in a presentation package, text, tables, charts, Animation, running slide show, saving the slides, printing presentations; Internet and browsing, E-Mail, blogging, use of Internet in Research

Module IV (10 hours)
Data analysis using statistical software packages.

Suggested Reading:

Mapping of COs to Syllabus

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SWFW6010: CONTINUOUS FIELD WORK I (0-0-200)
(6 credits; 200 hours of Fieldwork in one month)

Expected Outcome:
- The students focus on their Area of Concentration / Specialization.
- Enable the students to become more proficient in the field and apply relevant skills and techniques in handling real situations.
- Opportunities to implement programmes

The process
1. The students shall be placed in the field for twenty five days of consecutive field work.
2. The field work settings shall be Communities, NGOs, Service Organizations, Hospitals, Clinics and Governmental Agencies.
3. The students will identify Organisations or Communities which will be approved by the Department.
4. The students are expected to apply all the methods of social work such as Social Casework, Group Work, Community Organization, Research and Administration, wherever applicable depending upon the organization and their services.
5. The students shall be involved in the activities of the Institution and fulfill the responsibilities as requested by the Agency Supervisor.
6. The students shall prepare a daily report of the field work activities implemented and share them through e-mail with the concerned Faculty Supervisor at the end of each day.
7. The Supervisor shall provide the necessary feedback and guidance to the students by also making personal visits if possible, to the field where they are placed.
8. At the end of the continuous field work placement, the students shall submit a consolidated or summary report highlighting the main activities implemented and the major learning from the field placement.
9. Every student shall also appear for an external viva voce examination at the end of the semester.

SWCF6012: CONTINUOUS FIELD WORK II (0-0-200)
(6 credits: 200 hours fieldwork in one month)

Expected Outcome:
- The students focus on their Area of Concentration / Specialization.
- Enable the students to become more proficient in the field and apply relevant skills and techniques in handling real situations.
- Opportunities to implement programmes

The process
- The students shall be placed in the field for twenty five days of consecutive field work.
- The field work settings shall be Communities, NGOs, Service Organizations, Hospitals, Clinics and Governmental Agencies.
- The students will identify Organisations or Communities which will be approved by the Department.
- The students are expected to apply all the methods of social work such as Social Casework, Group Work, Community Organization, Research and Administration, wherever applicable depending upon the organization and their services.
- The students shall be involved in the activities of the Institution and fulfill the responsibilities as requested by the Agency Supervisor.
- The students shall prepare a daily report of the field work activities implemented and share them through e-mail with
the concerned Faculty Supervisor at the end of each day.

- The Supervisor shall provide the necessary feedback and guidance to the students by also making personal visits if possible, to the field where they are placed.
- At the end of the continuous field work placement, the students shall submit a consolidated or summary report highlighting the main activities implemented and the major learning from the field placement.
- Every student shall also appear for an external viva voce examination at the end of the semester.

**SWIN6013: INTERNSHIP (0-0-200)**
*Pass/No Pass (200 hours fieldwork in one month)*

**Process**
- After the Examinations at the end of the 4th Semester or as per the prevailing socio-political situations, the students shall be placed with an NGO or Agency for a period of not less than one month for practical experience and application of their skills.
- While Internship is not credited, it is mandatory for the completion of the MSW programme.
- The students shall contact an agency of his/her choice and get the choice of agency approved by the department.
- Students shall endeavor to choose an agency that is primarily in tune with their AOC and which has credentials in the concerned field.
- At the end of every week the student shall send a brief report to the supervisor and at the end of the internship a summary report shall be submitted.
- The summary report shall contain the short description of the agency, the social service skills applied in his/her work and the student’s learning outcome.
- The report shall be submitted in the format prescribed by the department and shall be submitted together with the certificate from the agency confirming his/her internship in a prescribed format.

**SWRP6020: RESEARCH PROJECT PHASE I**
*(3 credits)*

Every student shall undertake a research project work which has bearing on his/her AoC under the supervision and guidance of a faculty member. The preliminary work may begin at the end of the second semester. The students are expected to complete the Literature Survey followed by a Synopsis presentation during the Phase I. The dates, the mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

**SWRP6021: RESEARCH PROJECT PHASE II**
*(3 credits)*

Every student shall undertake a research project work which has bearing on his/her AoC and present a written thesis on the research work under the supervision and guidance of a faculty member. The preliminary work may begin at the end of the second semester. The students are expected to complete the data collection before the fourth semester. The thesis is to be submitted to the department before the date notified. The mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester. There shall be a viva voce examination on the research project.

**SWSL0200: PARTICIPATORY SERVICE LEARNING-RURAL PRACTICUM(30-0-50)**
*Credits: 2 (30 Hours)*

**Course Outcomes**
- Understanding the meaning and objectives of service learning and participatory approach to social development (Remembering and Understanding)
- Learn and apply various methods, techniques and strategies for participatory rural/urban mapping, development and communication (Applying)
- Appraising the spatial, temporal and relational aspects of communities in the village/urban settings by application of participatory learning, action and reflection (Evaluating)
- Being familiar with culture, tradition, customs and social change and transformation processes of a rural/urban locality (Creating);
- Engage in inter-cultural teamwork to study, understand and promote development in rural areas (Applying)

**Module I: Introduction to Service Learning (5 Hours)**

Concept of Service Learning— definition, principles, models of different Higher Education Institution Service Learning; Service Learning as a medium of Social change.

**Module II: Introduction to participatory learning, action and reflection** *(5 Hours)*

What is participation? Participatory approach to social development; Principles of community participation; Participatory Appraisal Methods.
Module III: Participatory community mapping  (10 Hours)
Spatial maps- social map, transect, resource map, mobility map; Temporal maps- historical timeline, seasonal maps, daily activity maps, trends analysis; Relational maps- chapatti diagram, well-being ranking, pair-wise ranking, problem tree analysis. Community Dream Map.

Module IV: Participatory community development practice  (10 Hours)
Rapport building, project identification, definition and planning, participatory implementation and monitoring, evaluation and Exit.

Suggested Readings
10. https://ccel.umn.edu/

Mapping of COs to Syllabus

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DEPARTMENT OF EDUCATION

VISION:
To build a pool of intellectually competent educational leaders and teacher educators leading on the process of education in general and teacher education in particular which nurtures individual autonomy and social development by ensuring quality with peace across the globe

MISSION:
The Mission of the Department is to facilitate the expression of leaders hidden within the students, developing sound cognitive, affective and psychomotor abilities and making them a sound citizen of the country and world as a whole.

BA (Honours) IN EDUCATION
BA (Honours) Education programme at Assam Don Bosco University combines ideas and research from Education, Psychology, Sociology, Philosophy, and History. It introduces them to all important elements of Education including the foundations, theories and principles of Education, and an exposure to the latest developments in pedagogy and educational technology. Students will become familiar with scientific methodologies in curriculum development, measurement, and evaluation in Education. The course has been designed for students who have academic interests in Education or aspirations to work with children and young people in a variety of fields, helping them develop their critical thinking and character.

PROGRAM OUTCOMES – BA EDUCATION
PO 1: Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO 2: Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO 3: Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO 4: Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO 5: Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO 6: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO 7: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PO 8: All Round Development: A sound graduate in Education with high cognitive, affective and psychomotor abilities

PROGRAM SPECIFIC OUTCOMES – BA EDUCATION
Course wise by looking into the nature of each module of each course of studies, PSOs have been determined in view of Bloom’s Taxonomy of cognitive objectives:

PSO 1: Basics of Education: To enable the students to understand the different aspects of education.

PSO 2: Social Responsibility: To create a sense of social responsibility among the students by way of discussion, demonstration.

PSO 3: Cognitive and Affective Competencies: To make the students sound in their cognitive abilities and value system in relation to education.

PSO 4: Skill Based Competencies: Students are to possess basics of teaching and teaching skills, testing skills and some life skills along with the skill of educational management.

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**PROGRAM OUTCOMES - MA EDUCATION**

**PO 1: Critical Thinking:** To inculcate critical thinking among the students.

**PO 2: Effective Communications:** To generate an ability among the students to communicate their thoughts and ideas from one end to another clearly for making others comfortable in understanding.

**PO 3: Scientific Temper:** To inculcate scientific temper among the students to be judicious and logical in their thinking and presentation.

**PO 4: Effective Citizenship:** To enable the students to possess the qualities of a good citizen and prove to be a productive member of the society.

**PO 5: Ethics:** To create ethical values among the students to be a righteous individual.

**PO 6: Environment and Sustainability:** To create environmental awareness among the students lathing with the sense of sustainability.

**PO 7: Gender Sensitization and social commitment:** To sensitize the students about the gender variability and its utility in harmonious ways of life.

**PO 8: Self-directed and life-long learning:** To create a positive attitude among the learners to have the zeal for self-directed and life-long learning.

**PROGRAM SPECIFIC OUTCOMES - MA EDUCATION**

**PSO 1:** Educational Foundations and Educational Leadership: To equip the PG students with foundations of education and inculcating educational leadership among the students.

**PSO 2:** Skill Based Competence: To inculcate some skills relating to teaching, research, leadership, management computer etc.

**PSO 3:** Curriculum and Pedagogical Issues: To make the PG students well aware of the curriculum planning and designing and pedagogy to transact the curriculum effectively and testing the students.

**PSO 4:** Ethics and Social Responsibility in Education: To produce morally upright PG students who are to contribute in environmental sustainability and social development.

**MA List of Courses**

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1.3 Emerging Trends in Education
1.4 History and Development of Education in India
1.5 Educational Technology
1.6 Leadership and Social Responsibility
1.7 Journaling – a Technique for Personal and Academic Growth
2.1 Sociological Foundations of Education
2.2 Research Methodology in Education
2.3 Knowledge and Curriculum
2.4 Developing Educational Leadership
2.5 Human Development and Learning
2.6 Peace Education and Conflict Management
2.7 Educational Seminar I
2.8 Computer Applications for Social Sciences (Lab)
2.9 School Visits
3.1 Curriculum Development and Instruction

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DEPARTMENT OF EDUCATION
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DETAILED SYLLABUS

EDFE0124: FOUNDATIONS OF EDUCATION (5-1-0)

COURSE OUTCOMES
1. Describe the concept, process and functions of education. (Understanding) CO2 State individual, social and national aims. (Remembering)
2. Identify the forms and bases of education. (Application)
3. Analyze the curriculum and use the curriculum in practice. (Analysis)
4. Apply different methods for teaching and creating learning among the students. (Application)
5. Evaluate the practices of child-centrism in education. (Evaluation)

Module I: Meaning, Aims and Objective of Education (20 lectures)

Module II: Forms and Bases of Education (20 lectures)

Module III: Dimensions of Education (18 lectures)
The learner, the teacher-qualities and responsibilities; curriculum and co-curricular activities – meaning and modern concept, need and importance; Educational Institutions – school, family and social institutions, religious institutions, state, etc. – their roles in education.

Module IV: Child-Centrism in Education and Educational Methods (17 lectures)
Practices and significance of child centered education; Play and play-way in education - Kindergarten, Montessori, basic education and project method.

Suggested Readings
8. Isaacs, B. Understanding the Montessori approach: Early years’ education in practice.

Mapping of COs to Syllabus

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EDTE0125: THEORIES AND PRINCIPLES OF EDUCATION (5-1-0)

COURSE OUTCOMES
1. Explain the concept, process, functions of education and various factors influencing its functions. (Understanding)
2. Identify the individual differences among the students and teach accordingly. (Applying) CO3 State the various aspects and dimensions of education. (Remembering)
3. Explain the factors of conscious learning and the issues in formal discipline. (Understanding)
4. Evaluate the current trends in education. (Evaluation)
5. Apply the basics of environmental education, value education and human rights education. (Applying)

Module I: Understanding ‘Education’ (20 lectures)
Divergent description of Education; education as a process; functions of education (context of individual and social aim, factors influencing functions); education and schooling; education and indoctrination; heredity and educational attainment; individual differences in education.

Module II: Facets of Education (20 lectures)

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b. Ducasse’s dimensions of education - intellectual education, physical education, vocational education, education in social dexterity, education of the will, aesthetic education, moral and religious education, liberal education.

Module III: Conscious Learning and Formal Discipline (18 lectures)

a. Conscious Learning-factors in conscious learning, the evolution of judgment, the evolution of ideas.

b. Formal Discipline-rise of the concept of formal discipline, criticism by psychologists, positive discipline as formal discipline.

Module IV: Current trends in Education (17 lectures)

a. Indian constitution and education, globalization and education, privatization in education, modernization of Indian education.

b. Developing trends in environmental education, value education, human rights education etc.

Suggested Readings


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EDPF0126: PHILOSOPHICAL FOUNDATIONS OF EDUCATION (5-1-0)

COURSE OUTCOMES

1. Explain the theoretical bases of education and incorporate the application of different philosophies in education. (Understanding)

2. Describe the different philosophical ideologies of western and Indian thinkers. (Remembering)

3. Identify the link between educational philosophy and national values. (Applying)

4. Analyze the Indian and Western philosophy in terms of curriculum, method of teaching, discipline, role and place of students (Analyzing)

5. Explain the basics of philosophy of knowledge and value as a part of education. (Understanding)

6. Identify and classify the values and apply the different values in real life situations. (Applying)

Module I: Philosophy and Education (17 lectures)

Introduction to the historical and philosophical traditions in education - Socrates and philosophical ideals; relationship and influence of philosophy on education.

Module II: Western and Indian Philosophical ideologies (18 lectures)

Comparative analysis of Western and Indian Philosophical ideologies:


Module III: Schools of Philosophy and National Values (20 lectures)

- Indian schools of Philosophy: Vedic philosophies and Buddhism - in terms of knowledge, reality and value.
- Western Schools of Philosophy: Idealism, Naturalism, Pragmatism, Realism, Humanism: special reference to principles, aims of education, curriculum, teaching methods, teacher, discipline, role and place of student.

- Inculcation of core national values as enshrined in the Constitution of India.

Module IV: Education and Epistemology (10 lectures)

Knowledge - Nature, role of knowledge, scientific inquiry, senses and feelings, experience (empiricism), reasoning and logic - inductive and deductive.

Module V: Education and Axiology (10 lectures)

Values - conceptual basis, need and importance, role of education, morality and actions, aesthetics, ethics - Kantian ethics, responsibility and freedom.

Suggested Readings
**DEPARTMENT OF EDUCATION**

5. Froebel, F. The Education of Man. Fairfield, Kelley, New Jersey. (1903)

9. Hume, D. An Enquiry Concerning Human Understanding. La Salle. (1748)

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**EDES0127: EDUCATION AND SOCIETY (5-1-0)**

**COURSE OUTCOMES**

1. Discuss the concept of sociology of education and relationship between society and education. (Understanding)
2. Describe the existence of social groups, social institutions and agencies of education and the process of socialization. (Understanding)
3. State the role played by education in bringing about social change. (Remembering)
4. Identify the process of transmission and preservation of culture. (Applying)
5. Analyze the importance of social change, national integration, international understanding and democracy in a diverse social context. (Analyzing)
6. Evaluate the role of education in solving social problems. (Evaluation)

**Module I: Sociology and Education and Agencies of Education (20 lectures)**
Meaning of educational sociology and sociology of education; relationship between sociology and education; sociological determinants of education; agencies of education-family, school, community, religious institutions, state.

**Module II: Education, culture and social change (20 lectures)**
Meaning, concept, nature and components of culture, their role in transmission and preservation of culture; cultural lag and cultural change; social change—social mobility, stratification and the roles of education in bringing about change in society.

**Module III: Education and Society (20 lectures)**
Education and social groups—types of groups, social interaction and its educational implications, socialization concept, factors and implications; education for national integration, international understanding and democracy.

**Module IV: Current Social Problems in India (15 lectures)**
Equalization of educational opportunities; role of education in solving social problems such as illiteracy, nutrition, sanitation and unemployment; lifelong education.

**Suggested Readings**


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EDGC0128: GUIDANCE AND COUNSELLING (5-1-0)

COURSE OUTCOMES
1. Illustrate the concept, nature, and scope of guidance and counseling and its significance in the field of education. (Understanding)
2. State the qualities of a teacher as a guidance worker. (Remembering)
3. Apply the bases of guidance in guidance service. (Applying)
4. Identify the characteristics of diverse learners and perform the guidance activities accordingly. (Applying)
5. Apply the different skills and techniques of counselling. (Applying)
6. Discuss the different tools and techniques used in guidance and counselling. (Understanding)

Module I: Introduction to Guidance (18 lectures)
Meaning; Definition and Nature of Guidance; Historical background of the guidance in India; Need and Principles of Guidance; Bases of guidance; Teacher as a guide.

Module II: Types of Guidance (17 lectures)
Educational Guidance; Vocational Guidance; Personal Guidance.

Module III: Concept of Counselling (20 lectures)
Meaning; Definition and Nature of Counselling; Need for Counselling to educational institutions; Types of Counselling: Directive; Non-directive Counselling and Eclectic Counselling; Qualities of an effective counsellor.

Module IV: Tools and Techniques of Guidance and Counselling (20 lectures)
Testing Technique to measure the different constructs of an individual: Intelligence, Creativity, Interest, Aptitude and Personality traits; Non-testing Techniques: Observation, Interview, Scales, Cumulative records, Organisation of guidance and Counselling services.

Suggested Readings

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EDGE0129: GENDER EDUCATION (5-1-0)

COURSE OUTCOMES
1. Describe the concept, need and scope of gender education and understand gender studies as an academic discipline. (Understanding)
2. Identify the difference between sex and gender and to explain the social construction theories of identity. (Application)
3. Analyze the status of girl’s education in schools and how gender influences the issues in the education system. (Analysis)
4. Find out the status of gender disparities in India and the presence of gender biases in the school curriculum. (Application)
5. State the status of women's education. (Remembering)
6. Evaluate women’s movement in India and the policies and programmes adopted to improve the status of women education in India. (Evaluation)

Module I: Gender studies (13 lectures)
Concept, Need, Scope; Gender studies as an academic discipline; Gender and Economy and Work Participation; Gender and globalization; Gender and education.

Module II: Identification of structures of domination and control (15 lectures)
Society, Family and school in India; Issues in school education-Problems of access, enrolment, retention, stagnation, drop-out and push out; Higher Education and Professional Spaces.

Module III: Gender and Education (14 lectures)
Gender as the Basis of Inequality-Issue of patriarchy, hierarchy, power, dominance, subjugation; gender disparity in Education–gender bias in school curriculum.

Module IV: Issues of Indian women (15 lectures)
Family, caste, class, culture, religion related issues; Women’s education; Coeducation-its educational implications; Literacy and Non-formal education for women’s development; Education of Girl child in India: present status and challenges ahead.

Module V: Women’s Movements and routes towards change (18 lectures)
Pre-independent, post Independent and current women’s movements; National committees and commissions for women; governmental and non-governmental organizations for women and child development; Community participation for education of the girl child; Constitutional provisions, policies, programmes for women.

Suggested Readings
5. Geetha, V. Gender: Stree; Kolkata. (2002)
11. NCERT-National Curriculum Framework2005PositionPaperon. 3.1 by National Focus Group on

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EDP80130: PSYCHOLOGICAL BASES OF EDUCATION (5-1-0)

COURSE OUTCOMES
1. Describe the concept psychology as- Science of behaviour, Growth and Development.(Remembering)
2. Explain various theories related to human development and learning. (Understanding)
3. Elaborate the theories related to intelligence and personality. (Application)
4. Assess the intelligence and personality of individuals. (Analysis)

Module I: Psychology as a science of behaviour (15 Lectures)
Meaning of Psychology; Nature and fields of psychology; Educational Psychology-its meaning, nature and scope; Relationship between Education and psychology.

Module II: Psychology of growth and development (15 Lectures)
Introduction to growth and development; principles and factors of development; stages of development; Theories of development:

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Erickson’s theory of Psycho-social development.

Module III: Learning and theories of learning (15 Lectures)
Meaning, Nature of learning and maturation; types of learning; Laws of learning; Theories of learning: Trial and Error learning, Classical Conditioning, Operant Conditioning; Factors affecting Learning; Individual differences and its educational implications.

Module IV: Intelligence and its theories (15 Lectures)
Intelligence: Definition, Nature and Theories: Two Factor Theory of Intelligence, Guildford structure of Intellect; Intelligent Quotient (IQ); Emotional Intelligence; Assessment of Intelligence.

Module V: Personality and its theories (15 Lectures)
Meaning and Nature; Theories of personality: Type and Trait Theory, Determinants of personality, Assessment of personality: projective techniques.

Suggested Readings

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EDDE0131: DISTANCE EDUCATION (5-1-0)

COURSE OUTCOMES
1. Understand the Concept, Scope, objectives of Distance Education. (Remembering)
2. Review the Historical Development and its Growth in India. (Understanding)
3. Identify the types of Distance Education Institutions. (Application)
4. Illustrate the advantages and challenges in Distance Education and its Relevance to the Changing Society. (Evaluation)

Module I: Introduction to Distance Education (15 Lectures)
Concept of Distance Education: Meaning, Characteristics, Scope Types of Distance Education; Merits and Demerits of Distance Education; Objectives of Distance Education; Difference between Open Learning and Distance learning Relevance of Distance Education to the Changing society like India.

Module II: Historical Development of Distance Education (25 Lectures)
Historical development of Distance education; The University Grants Commission (UGC); Planning Commission; Central Advisory Board on Education; University of Delhi’s School of Correspondence Courses and Continuing Education; Education Commission (1964-66); Directorates of Distance Education/Centres of Distance Education; Open University system; Ministry of Human Resource Development; Indira Gandhi National Open University (IGNOU); Distance Education Council of India.

Module III: Types of Distance Education Institutions (20 Lectures)
National Open University; State Open Universities; Distance Education Institutions (DEIs) at: Institutions of National Importance, Central Universities, State Universities, Deemed to be Universities, State Private Universities; DEIs at Stand-alone Institutions: Professional Associations, Government Institutions, Private Institutions.

Module IV: Issues, Challenges of Distance Education (15 Lectures)
Issues and challenges of Distance Education: Network, Internet, Online courses, Webinars, Google meet, Google Classroom/Drive, SWAYAM Courses, NPTEL Courses; Adaptations of methods of Teaching-Learning: E-Seminars, Online-Workshops, Online Conferences, Video-Audio mode of presentations, Online Assessments.

Suggested Readings
5. Honeyman, M; Miller, G (December 1993). “Agriculture distance education: A validalternative for higher education?
Mapping of COs to syllabus

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EDDI0132: DEVELOPMENT OF EDUCATION IN INDIA (5-1-0)

**Course Outcomes**

1. Review the Ancient and Medieval system of Education in India. (Remembering)
2. Know about the different educational policies adopted by British Rule. (Understanding)
3. Understand the development of education during the British rule in India. (Application)
4. Analysis the development of Education in Independent India and Assam. (Analysis)
5. Understand various initiatives of the Government of India like SSA, Mid-Day Meal, etc. (Evaluation)
6. Evaluate the contemporary concerns and issues of Indian Education. (Creation)

**Module I: Education in Ancient India (20 Lectures)**

Vedic system of Education—Aims, Methods of Teaching, Curriculum, Teacher-pupil relationship, Discipline, Education of Women; Buddhist Period—Aims, Methods of Teaching, Curriculum, Teacher-Pupil Relationship, Discipline, Education of Women; Medieval Period—Aims, Methods of Teaching, Curriculum, Teacher- Pupil Relationship, Discipline, Education of Women.

**Module II: Education during the British Period in India (15 Lectures)**


**Module III: Education in Post-Independence (20 Lectures)**


**Module IV: Vocationalization of Education (10 Lectures)**

Concept, Scope and need of Vocational Education; Objectives of Vocational education in +2stage; Vocationalization and National Development, NPE-1986 and POA-1992 with reference to Vocational Education.

**Module V: Issues and Challenges in Indian Education at School Stage (10 Lectures)**

Concept of UEE and its problems: Physical, Social and Quality access in relation to UEE; Operation Blackboard (OBB); District Primary Education Programme (DPEP); Sarva Shiksha Abhiyan (SSA) and RTE-Act2009; Quality of Education at Secondary School Stage and Rashtriya Madhyamik Shiksha Abhiyan (RMSA); Use of ICT.

**Suggested Readings**


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EDPE0134: POPULATION EDUCATION (5-1-0)
COURSE OUTCOMES
1. Understand the trend of population in the world, India and North East India. (Remembering)
2. Understand the importance of quality life and population education. (Understanding)
3. Analyze the effects of over population and various plans. (Analyzing)
4. Evaluate various ways and means of controlling the growing population. (Evaluating)

Module I: Indian Population (20 Lectures)
Trend of Indian Population since 1901; Population scenario in North East of India; Population explosion, optimum population, under population and overpopulation, population scenario in the world; Quality of life.

Module II: Introduction to Population Education (20 Lectures)
Definition, nature, objectives and scope of population education; Curriculum of population education for school stages; Approaches for teaching population education and preparation of teachers.

Module III: Population Education Policies and Programme in India (20 Lectures)
Population Education and Five Year Plans of India; Population Education Policies and programmes in India with special reference to Family Planning; Mass media And Population Education; Nature and need of family life education.

Module IV: Evaluation in Population Education (15 Lectures)
Concepts of evaluation and measurement; Schemes of Evaluation: Formative and summative; Evaluation in Population education; Evaluation of students and population education programmes.

Suggested Readings

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EDET0135 EDUCATIONAL THINKERS (5-1-0)

COURSE OUTCOMES
1. Know the different educational thinkers of the world and India. (Remembering)
2. Analysis the contribution of educational thinkers of the world. (Understanding)
3. Analysis the contribution of educational thinkers in India. (Application)
4. Understand the different philosophies of some eminent educational philosophers. (Analyse)
5. Evaluate the role of teachers and various methods of teaching in the field of education. (Evaluate)

Module I: A-Indian Thinkers (20 Lectures)
Swami Dayanand (1825-1883): Philosophy, Aims of Education and values; Swami Vivekananda (1863-1902): Philosophy Principles, Character Building, Discipline and values; Rabindranath Tagore (1861-1914): Tagore’s Philosophy and its features, basic contributions in the field of Education.

Module II: B-Indian Thinkers (19 Lectures)

Module III: A-Western Thinkers (18 Lectures)

Module IV: B-Western Thinkers (18 Lectures)

Suggested Readings
DEPARTMENT OF EDUCATION


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EDTC0136 EDUCATIONAL TECHNOLOGY (5-1-0)

COURSE OUTCOMES
1. Understand the conceptual framework of educational technology. (Remembering)
2. Explain the concept of teaching, its nature, phases etc. (Understanding)
3. Describe the nature of instructional technology and process of communication. (Application)
4. Classify different approaches in educational technology. (Analysis)
5. Apply various innovations in the field of education for qualitative improvements using technology (Evaluation)

Module I: Introduction to Educational Technology (13 Lectures)
Emergence of educational technology, different views on educational technology, definition, meaning, nature and scope of educational technology, educational technology in formal and non-formal education, educational technology and quality education, problems of educational technology in the Indian context

Module II: Communication and Instruction (15 Lectures)
Concept and need of communication; Forms of communication; Model of communication process; Classroom communication: Verbal and Non-verbal; Instructional Technology: Programmed Instruction (PI), Personalized system of Instruction (PSI), Computer Assisted Instruction (CAI), Modular Instruction (MI)

Module III: Behavioural Technology (15 Lectures)
Need and Nature of behavioural technology; Features of teaching behaviour; Concept of teaching skills and their identification; Need, nature and steps of Micro-teaching; Interaction Analysis with special reference to Flanders; Simulated Social Skill Training (SSST)

Module IV: Emerging Trends of Educational Technology (15 Lectures)
Nature of Information Technology (IT); Mass Media in Education: Radio, TV, Internet and E-Learning; Multimedia Approach; EDUSAT, Blended Learning, MOOCs; Research in Educational Technology

Suggested Readings
3. Flanders, Ned A (1972) : Analyzing Teacher Behaviour, California, Addison Wesley

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EDFC0137 FOUNDATIONS OF CURRICULUM DEVELOPMENT (5-1-0)

COURSE OUTCOMES
1. Recall the conceptual framework of curriculum. (Remembering)
2. Explain/ classify the different bases and approaches of curriculum designing. (Understanding)
3. Evaluate the role of the teacher in the construction of the curriculum. (Application)
4. Analyze the developmental process and evaluation of the curriculum. (Analysis)
5. Use the different strategies for curriculum implementation. (Evaluation)

Module I: Nature of Curriculum (18 Lectures)
Defining curriculum; Components of curriculum; Principles of curriculum; Goals and objectives for curriculum development;
Characteristics of a good curriculum.

**Module II: Bases of curriculum construction (20 Lectures)**
Philosophical bases: Naturalism, Idealism, Pragmatism; Sociological bases: Society, education and schooling, social change and curriculum; Psychological bases: Learning theories and curriculum; humanistic psychology.

**Module III: Approaches to curriculum development (20 Lectures)**

**Module IV: Process of curriculum development and the role of teachers in curriculum development (17 Lectures)**
Process of curriculum development: Assessment of educational needs, Formulation of objectives Selection and organization of learning experiences, Evaluation; Role of teachers in curriculum development and some issues in curriculum development; Irrelevant curriculum; Emerging curriculum.

**Suggested Readings**

**Mapping of COs to syllabus**

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**EDCC0139: EARLY CHILDHOOD CARE AND EDUCATION (5-1-0)**

**Course Outcomes**
1. State the concept, need and significance, philosophies, policies and interventions of ECCE. (Remembering)
2. Explain and elaborate the underlying philosophies on ECCE in India. (Understanding)
3. Utilize the information to create a safe and secure environment for children. (Application)
4. Compare and contrast between the different philosophical ideas, policies and interventions (Analysis)
5. Evaluate the accuracy and relevance of the ECCE policies and interventions. (Evaluating)
6. Predict ways and means of implementing the ECCE policies and interventions. (Creating)

**Module I: Nature of ECCE (20 Lectures)**
Meaning, Definitions and Significance of ECCE in the context of Universalization of Elementary Education Objectives and scope of ECCE; ECCE and Human Resource Development.

**Module II: Philosophies on ECCE (15 Lectures)**
John Dewey; Maria Montessori; Friedrich Froebel; Rabindranath Tagore and Tarabai Modak.

**Module III: Policies and Programmes on ECCE (20 Lectures)**

**Module IV: Initiatives and Interventions (20 Lectures)**
Government, Private and NGO’s; ICDS and SSA; Preschool Education and training programmes; ECCE and National Curriculum Framework.

**Suggested Readings**
3. Koul, V.(et.al)[1993]: Early Childhood Care and Education: An Assessment, New Delhi, NCERT.

Mapping of COs to syllabus

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EDME0140: MEASUREMENT AND EVALUATION IN EDUCATION (5-1-0)

COURSE OUTCOMES
1. To recall the basics of educational measurement and evaluation. (Remembering)
2. To explain/illustrate the different types of techniques of measurement and evaluation. (Understanding)
3. To prepare a good test/scale (Creation).
4. To administer the tools and interpret the scores. (Application)

Module I: Nature of Measurement and Evaluation (15 Lectures)
Concept of Measurement; Types of Measurement: Psychological and physical; Concept of educational measurement; Functions of educational measurement; Concept of assessment and evaluation; Principles and steps of Evaluation; Relationship between educational measurement and evaluation.

Module II: Testing and Non-Testing Techniques in Educational Measurement and Evaluation (15 Lectures)
Testing Technique: Achievement Test aptitude Test, Intelligence Test; Non-Testing technique: Interview, Observation, Questionnaire, Rating Scales, Check list attitude scale, cumulative record.

Module III: Concept of Reliability and Validity (30 Lectures)
Meaning and Nature of reliability of the test scores; Methods of Computing Co efficient of reliability: test-retest, parallel form, split half, KR-20, 21; Factors influencing reliability of test scores; Meaning and nature of Validity of the test scores; Types of Validity: face, content, construct, concurrent, predictive; Relationship between validity and reliability; Factors affecting validity.

Module IV: Test Items (15 Lectures)
Concept and types of test items; Guidelines for writing objective types test items; Guidelines for writing essay type test items; Guidelines for interpretive exercises; Construction and standardization of test and attitude scale; Concept and types of norms.

Suggested Readings

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EDHR0142: HUMAN RIGHTS EDUCATION (5-1-0)

COURSE OUTCOMES
1. Recognize the origin, meaning, concept, objectives provisions of human rights, human rights education, and value. (Remembering)
2. Understand various constitutional provisions and conventions of rights of child and women along with others human rights. (Understanding)
3. Apply the Knowledge of Human Rights in life. (Application)
4. Analyze the functions of various national and international human rights bodies. (Analysis)
5. Evaluate the human rights curriculum and approaches to teach human rights at differentladders of school education. (Evaluation)
6. Prepare the Curriculum of Human Rights Education. (Creation)

Module I: Introduction to Human Rights Education (20 Lectures)
Origin and historical account of Human Rights; Description of UN Charter and UDHR; Meaning of Human Rights and Human Right Education; Constitutional Provisions for Human Rights.
Module II: International Covenants, Convention and Gender Equity (17 Lectures)

Module III: Human Rights and Duties (20 Lectures)
Human Right Protection Act and role of NHRC, SHRCs, UN, UNESCO; Curriculum framework of Human Rights Education; Approaches of Teaching for Human Rights Education.

Module IV: Value Education (18 Lectures)
Concept of Value; Sources of Value: Biological, Psychological, Sociological and Spiritual; Meaning, nature and objectives of Value Education; Value clarification approach.

Suggested Readings

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EDES0143 ELEMENTARY STATISTICS IN EDUCATION (5-1-0)

COURSE OUTCOMES
1. State the concept of, nature, and utility of statistics. (Remembering)
2. Understand the nature and organization of data. (Understanding)
3. Developing the skill of presenting data graphically. (Application)
4. Analyze the data by using measures of central tendency and variability. (Analyzing)
5. Synthesizing the data. (Synthesis)
6. Evaluating the computed results indicating the relationship in two sets of data. (Evaluation)

Module I: Introduction to Statistics (20 Lectures)
Meaning, definition and functions of Statistics Need of Statistics in Education; Concept of data, methods of organizing data; Graphical representation of data: Frequency Polygon, Histogram, Cumulative Frequency curve, Cumulative Frequency Percentage curve or ogives.

Module II: Measures of Central Tendency (18 Lectures)
Meaning and significance of Measures of Central Tendency; Computation of Mean from Ungrouped and Grouped data; Computation of Median from Grouped and Ungrouped data; Computation of Mode from Grouped and Ungrouped data.

Module III: Measures of Variability (17 Lectures)
Meaning and significance of Measures of Variability Concepts; Uses and Computation of Range, AD, SD and QD Percentile and Percentile Ranks.

Module IV: Linear Correlation (20 Lectures)
Meaning of Correlation; Degrees of Correlationship; Computation of Correlation by using –Product Moment Method and rank Difference Method; Interpretations of Computed Co-efficient of Correlation.

Suggested Readings

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Concepts, Module II: Types and Educational needs of children with special needs.

CO5

CO6

EDAE0144: ADULT EDUCATION (5-1-0)

COURSE OUTCOMES
1. Understanding the nature, scope, and relevance of adult education among the students. (Understanding)
2. Identify different methods and skills for effective transaction of the adult education curriculum. (Application)
3. Understand different forms of adult education. (Understanding)
4. Dealing with different adult education agencies and making use of those agencies for the growth and development of adult education in India. (Application)
5. Creating some critical thinking and values among the adults. (Analyzing)
6. Establishing effective and productive adult education centres and ensuring desired functioning of the centres. (Application)

Module I: Concepts of Adult Education (20 Lectures)
Concept of adult education, objectives of adult education, importance of adult education, difference between formal and non-formal education, non-formal education, difference between informal, non-formal and formal education

Module II: Methods of Adult Education (20 Lectures)
Methods of Adult Education: Campaign method, centre method, individual method, residential method and mass communication method. Meaning, scope and importance of adult literacy. Difference between literacy and functional literacy, methods of imparting literacy; Follow up programmes: Types, need and importance.

Module III: Forms of Adult Education (18 Lectures)
Forms of Adult Education: Remedial, continuing, workers and mass media; Methods of adult education: Teacher dominated method, co-operative method and mass media methods; Administrative structure of adult education, organization of adult education programmes at the field level training of adult education functionaries.

Module IV: Agencies of Adult Education (17 Lectures)

Suggested Readings

Mapping of COs to Syllabus

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EDSP0145: SPECIAL EDUCATION (5-1-0)

COURSE OUTCOMES
1. Understand the meaning of Special education. (Remembering)
2. Explain the characteristics, trends and issues in special education. (Understanding)
3. Discuss the nature, types, characteristics and educational implications of children with disabilities. (Understanding)
4. Examine the nature, scope and issues in career education and rehabilitation of persons with disabilities. (Evaluation)
5. Recognize and describe role of family, school and community in children's performance. (Remembering)
6. Analyse the various policies and acts of government. (Analysis)

Module I: Introduction to Special Education (18 Lectures)
Special Education: Definition and History, Scope and nature of Special Education, Need and importance of Special education, Changing Trends and Issues in Special Education.

Module II: Types and Educational needs of children with special abilities (20 Lectures)
Concept, Definitions and Characteristics of special ability; Definition and types: Hearing Impairment, Visual Impairment, Mental...
Retardation, Neuro–muscular, Autism; Dyslexia; ADHD; Down Syndrome; Epilepsy; Cerebral Palsy; Slow Learners and ASD; Approaches in teaching children with special educational needs.

Module III: School, Community and Children with special abilities (20 Lectures)
Family and their impact on the child with special needs; Parental reaction and attitudes to the child with disabilities; Need and importance: School and Community; Role of special teachers; Types of programmes for community awareness and participation; Role of community in prevention, identification, and intervention of disabilities, Role of NGOs, Role of Mass media for community awareness.

Module IV: Career Education and Rehabilitation (17 Lectures)
Rehabilitation: Concept, Objective and Function; International Legislation for Special Education; Role of UN; Persons with Disabilities Act, 1995; Rights of Persons with Disabilities Act, 2016; Vocational training and job opportunities.

Practicum:
Visit at least two institutes for disabilities and observe children with disabilities learning, and submit a report of observation. Making learning materials for students with disabilities.

Suggested Readings
5. Status of Disability (2012). Rehabilitation Council of India, New Delhi

Mapping of COs to Syllabus

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EDEE0146: ECONOMICS OF EDUCATION (5-1-0)

COURSE OUTCOMES
1. Understand the conceptual framework of economics and its relationship with education (Understanding)
2. Understand education as an industry in terms of investment (inputs), process, and output (Understanding)
3. Finding out the cost effectiveness of education system (Application)
4. Analyzing the cost of education system and making it low-cost effectiveness (Analysis)
5. Explain the financing system at different stages (Understanding)
6. Evaluate the financing system of educational institution (Evaluation)

Module I: Education in Economic Context (20 Lectures)
Meaning of economics and its relation with education: Concept, Need and Scope of Economics of Education; Education as Public good and Private Good; Education as investment and consumption at individual and societal levels; Education as an industry.

Module II: Cost, Pricing and Financing of Education (18 Lectures)
Concept of Cost of Education at different stages; Types of costing-direct and indirect, private and social cost; Pricing of Education at different stages: micro and macro perspectives; Financing of education at different stages Sources of financing: private and public, endowments, grants and grants in aid.

Module III: Economics and Development (17 Lectures)
Contribution of education towards Economic Development; Education as a process of Human Capital formation; Education equity and income distribution; Economic conceptualisation of Innovation, Knowledge and Technology; Effect of Migration of knowledge workers and Brain drain.

Module IV: Economics of Educational Institutions (20 Lectures)
Schools and financing- government and private schools: aided and non-aided - How these different modes of financing get reflected in the admission policy, fee-structure, teaching-learning process and teacher recruitment, New economic policy and school education, Understanding the demand for and supply of higher education, Education quality and job-market: developments in Information and Communication Technology (ICT) and Artificial, Intelligence (AI)- implications for job market and education policy.

Suggested Readings
1. Education and Development in India- Critical Issues in Public Policy and Development, Jandhyala B G Tilak
3. Investment in Education and Social Choice, Tapas Majumdar
4. The Economics of Inequality in Education, J.B.G. Tilak
5. Education and Economics: Disciplinary Evolution and Policy Discourse, Saumen Chattopadhyay
6. Handbook of the Economics of Education ;Eric A Hanushek Stephen Machin LudgerWoessmann

| ADBU| Regulations and Syllabus|2022-23|573
7. The Economics of Education, Samuel Akinyemi
8. Resources, Values and Development; Amartya Sen
9. An introduction to the Economics of Education, Mark Blaug
10. Economic value of education, Theodore W. Schultz
11. Economics of Education selected readings Vol1 and Vol.2, Mark Blaug (Ed)

**Journal Articles**

**E-resources**

**Mapping of COs to Syllabus**

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**EDHG0147 HUMAN GROWTH AND DEVELOPMENT (5-1-0)**

**COURSE OUTCOMES**
1. Recall the concept of Growth and Development and its associated variables and issues (Remembering)
2. Explain the concepts of maturation and individual differences, their effect on humangrowth and development (Understanding)
3. Use the knowledge of the various theories of growth and development and its associated variables in addressing the diversity of the classroom (Application)
4. Critically analyze the theories of development and their Educational Implications (Analysis)
5. Explain childhood and adolescence as stages of development along with their developmental characteristics and role of the teacher in addressing their needs (Understanding)

**Module I: Introduction to Growth and Development (20 Lectures)**
Concept and characteristics of Growth and Development; Difference between growth and development; Principles of growth and development and its implications for education; Dimensions of Development; Factors that influence growth and development: Heredity and Environment; Havighurst’s Developmental Tasks throughout one’s lifespan: Concept of Developmental tasks, Characteristics of Developmental tasks, Sources of Developmental tasks, Developmental tasks from babyhood to old age, Educational Implications of Developmental tasks; Stages of Human growth and development (characteristic features): Prenatal Development, Postnatal Development.

**Module II: Maturation and Individual Differences (18 Lectures)**
Maturation: Concept, Effect of Maturation on Human growth and development, Educational implications of maturation; Individual Differences: Concept, Dimensions/Types of individual differences, Causes of individual differences, Educational implications of Individual differences, Strategies to accommodate individual differences in the classroom.

**Module III: Theories of Development and their Educational Implications (20 Lectures)**

**Module IV: Childhood and Adolescence (17 Lectures)**
Childhood: Concept, Developmental Characteristics and role of teacher in addressing their needs; Adolescence: Concept, Developmental characteristics, problems encountered by adolescents, role of the teacher in addressing adolescent problems.

**Suggested Readings**
2. Rex Book Store: Manila Philippines

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COURSE OUTCOMES

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EDTL0148 TEACHING LEARNING METHODS AND PEDAGOGY (5-1-0)

Course Outcomes

Module I: Concepts of teaching and learning (18 Lectures)
Meaning and definitions of the term teaching; Teaching from a descriptive point of view; Teaching from a success point of view. Variables and functions of teaching, levels and phases of teaching

Module II: Theories and Principles of Teaching (19 Lectures)
Nature of theory of teaching; Significance of theory of teaching; Formal, descriptive and normative theories of learning; Teaching skills and Microteaching; Techno-Pedagogy

Module III: Instructional Objectives and Approaches of Teaching (20 Lectures)
Concept of instructional objectives and learning outcomes; Taxonomy of instructional objectives with special reference to cognitive objectives; Methods of teaching: Lecture method, Discussion method, Demonstrative method; Approaches of teaching: Inquiry approach.

Module IV: Lesson Plan and Process of Evaluation (18 Lectures)
Meaning and significance of lesson plan; Approaches of lesson plan; Preparation of lesson plan; Concepts of measurement and evaluation in education; Principles of evaluation in education; Preparing a balanced question paper with its blue print

Suggested Readings


Mapping of COs to syllabus

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3. Understand the concept of school and school management and types of administration. (Understanding)
4. Analyze the qualities and role of school personnel and their professional ethics. (Analysis)
5. Identify the different steps and approaches of institutional planning. (Application)
6. Apply the principles of supervision in educational management and administration. (Application)

Module I: Introduction to Educational Administration (20 Lectures)
Meaning, Definition, Nature of EA, Scope of EA; Objectives of EA; Types of EA, Elements of EA, Characteristics of Administration; Functions of EA, Factors influencing EA.

Module II: School Management (18 Lectures)
Concept of School, Need of School, Meaning and Definitions of School management; Process of School Management, Qualities of a Headmaster/Principal; Role of teachers in school management; Essential Qualities of Teachers, Professional ethics and attitude of the teachers, Autocratic and Democratic administration.

Module III: Institutional planning (17 Lectures)
Meaning of Planning; Concept of Institutional Planning; Importance of Institutional Planning; Aims of Institutional Planning; Steps and Preparation of Institutional planning; Approaches of Educational Planning – Man Power and Rate of return approach.

Module IV: Supervision (20 Lectures)
Meaning and Nature of Supervision; Concept of Inspection; Difference between Inspection and Supervision; Aims, Types, Scope of Supervision; Supervision Procedures; Principles of Supervision; Problems in Supervision; Suggestions for developing supervision; Effective supervision; Functional basis of supervision; Difference between supervision and administration.

Suggested Readings

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EDTE0150: TEACHER EDUCATION (5-1-0)

COURSE OUTCOMES
1. Know the concept of Teacher Education programmes. (Remembering)
2. Understand the structure and curriculum of the Teacher education Programme. (Understanding)
3. Understand the concepts of Pre-service & In-service Teacher Education Programmes. (Understanding)
4. Analyze the current trends in the field of Teacher Education. (Application)
5. Apply process of research in the field of Teacher Education. (Application)

Module I: Introduction to Teacher Education (20 Lectures)
Meaning, nature and scope of Teacher Education; Historical background of Teacher Education in India; Objectives of Teacher Education; Paradigm shifts in education and preparation of teachers.

Module II: Structure and Curriculum of Teacher Education (17 Lectures)
Salient Features of the Teacher Education Curriculum; Structure of Teacher Education curriculum at Pre-primary and Primary level; Structure of Teacher Education curriculum at Secondary stage; Curriculum for Teacher Educators.

Module III: Pre-service and In-service Teacher Education (18 Lectures)
Concept of Pre-service & In-service Teacher Education; Features of Pre-service & In-service Teacher Education; Terms and conditions for Pre-service & In-service Teacher Education Programmes per NCTE; Modes of Transaction; Micro Teaching and SSST; Team Teaching.

Module IV: Current Trends and Research in Teacher Education (20 Lectures)
Practice Teaching and Internship; Flander’s Interaction Analysis Category System (FIACS); Integrated Teacher Education Programme; Research in Teacher Education; Process of Action Research; Technology in Teacher Education.

Suggested Readings
Course Outcomes Mapping of COs to syllabus

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EDEE0151: ENVIRONMENTAL EDUCATION (5-1-0)

COURSE OUTCOMES
1. Learning about the concepts of environmental education. (Remembering)
2. Understanding the relationship between man and environment. (Understanding)
3. Identification and classifying the natural resources and measures for conserving these resources. (Application)
4. Developing a sound curriculum of environmental education and creating critical thinking through its transaction. (Analysis)
5. Assessing the environment and its impact on the quality of life. (Evaluation)
6. Providing approaches and skills to transact the curriculum efficiently and productively. (Creation)

Module I: Introduction to Environment and Environmental Education (20 Lectures)
Meaning, components and nature of environment; Relationship between man and his environment; Determinism and Possibilism; Nature, objectives and scope of environmental education.

Module II: Natural Resources (18 Lectures)
Land, Water, and Air resources; Mineral resources; Plant life and animal life as resources; Depletion of resources and conservation of resources; Use of resources and sustainable development; Climate change.

Module III: Environmental Pollution (20 Lectures)
Meaning of environmental pollution; Causes, effects, and control of pollution of air, water, land, soil, noise etc.; Global warming; Solid waste management; Radioactive waste management; Concept of 3R’s (Reduce, Reuse, Recycle); Environmental hazards- Floods, earthquakes, cyclones etc.; Environmental Disaster and Disaster Management.

Module IV: Curriculum of Environmental Education and some Issues (17 lectures)
Process of curriculum development of environmental education; Transaction of the curriculum of environmental education; Evaluation of students in environmental education; Growth of population and its effects on environment; Values and ethics of life.

Suggested Readings

Mapping of COs to syllabus

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EDPN0152: PHYSICAL EDUCATION (5-1-0)

COURSE OUTCOME
1. Describe physical and health education and develop the skills in organizing the physical education programmes in schools. (Application)
2. Explain the health and safety education and understand the nature of injuries and top provide first aid. (Understanding)
3. Illustrate knowledge about yoga and physical exercises, about recreation, health and safety education. (Application)
4. Identify common communicable diseases with the nature of injuries and to provide firstaid. (Analysis)
5. Display knowledge about yoga and physical exercises. (Application)
6. Discuss diet modification in the treatment of under-weight and obesity. (Application)

Module I: Introduction to Physical Education (18 Lectures)
Meaning, Definition, Aims, Scope and Importance of Physical Education; Physical Fitness - Meaning, Definition, Components and Benefits; Origin and Development of Ancient and Modern Olympics-Olympic torch, Olympic Flag, Marathon Race, Difference between Ancient and Modern Olympic Games - Recreational activities; First Aid: on Road, Water, Fire accidents and Snake bite; Common sports injuries: Strain, Sprain, Contusion, Laceration, Fractures and Dislocation; Safety Education: Importance with reference to Schools, Play fields, Road, School and Home.

Module II: Causes and Prevention of Diseases (18 Lectures)
Lifestyle disorders: Heart diseases, Cancer, HIV/AIDS, Reproductive Helpless Health, Osteoporosis, Depression, Intentional & Unintentional Injuries, Diabetes and Obesity; Back Pain: Causes, Symptoms and Prevention; Addiction: Alcoholism, Smoking and Drugs; Impact of Pollution on Human health; Communicable diseases: Malaria, Swine flu, Chikungunya, Typhoid, Cholera, Smallpox, Tuberculosis and Dengue: Causes, Symptoms and Prevention.

Module III: Yoga and Physical Exercises (19 Lectures)
Meaning, Definition and Uses of Yoga - Essentials of Yogic Practices, Methods and Benefits of selected Asanas and Pranayama - Physical Exercises, Types: Aerobic, Anaerobic; Effects of Physical Exercises on various systems - Circulatory, Muscular, Digestive and Respiratory systems; Difference between Physical Exercises and Yoga - Fitness components and its importance - Effect of Physical Exercises on human body systems.

Module IV: Concept of Health Education (20 Lectures)
Meaning, Definition, Objectives and Importance of Health Education; Nutrition - Malnutrition - Personal Hygiene - Health Education in Schools - Health Instruction, Health Services; Food and Nutrition: Meaning of Food, Classification, Constituents of Food, Vitamins and Deficiency Diseases, Meaning of Nutrition, Malnutrition – Causes of Malnutrition - Balanced Diet and Diet for Obesity and Underweight.

Suggested Readings

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EDPE0153 PEACE EDUCATION (5-1-0)

578 | ADBU| Regulations and Syllabus|2022-23
COURSE OUTCOMES
1. Recall the different elements related to peace education. (Remembering)
2. Explain the development and importance of peace education both at the national and international level. (Understanding)
3. Critically analyze the stage wise curriculum of education for peace. (Analysis)
4. Put into classroom practice the pedagogy of education for peace. (Application)
5. Assess the present relevance of the ideology of eminent thinkers on peace education. (Evaluation)

Module I: Peace Education (18 Lectures)
Meaning - Definition - Aims of Peace Education; Different Levels of Education; Gandhian concept of peace; Different approaches to peace; Historical Development of Education; Peace Education in India and its development; Gandhiji’s contributions to peace movement; Creation of United Nations; Creation of UNESCO, UNICEF, UNO-UNDP, UNEP, UNHRC; Amnesty International, International Committee of Red Cross and NGOs.

Module II: Education for Peace and Peace Culture (20 Lectures)
Concept and meaning of Education for peace; Curriculum Development of Education for peace; Stage specific approach: Early childhood, Elementary stage, Secondary stage, Higher Education stage, Adult Education stage; Fostering Culture of Peace, Role of home in Peace cultivation, Participatory Communication, Democratic Participation and Gender equality, Sustainable Economic and social development, Non-violence, International Peace and Security.

Module III: Pedagogy of Education of Peace (17 Lectures)
Introduction- Enquiry method; Value clarification; Jurisprudential Model of Teaching; Role playing; Dramatics; Literacy Activities; Yoga and Meditation; Sports and Games; Teacher Education for Peace.

Module IV: Peace Thinkers (20 Lectures)
(Study of relevant extracts from the writings of) John Dewey; Paulo of Freire; Montessori (‘Peace and Education’); Dalai Lama (‘Universal Responsibility’); Krishnamurti, J. (‘Education and World Peace’); Gandhi (‘Brute Force’ and ‘Passive Resistance’ in Hind Swaraj); Sri Aurobindo (‘The Ideal of Human Unity’).

Suggested Readings

Mapping of COs to syllabus

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EDIT0154 INSTRUCTIONAL TECHNOLOGY (5-1-0)

COURSE OUTCOMES
1. Describe the nature of Educational Technology. (Application)
2. Distinguish about the meaning and nature of Instructional Technology. (Analysis)
3. Explain the Structure of Teaching-learning Process. (Application)
4. Create and generate skills for designing Instructional materials. (Application)
5. Illustrate the modern approaches of imparting instruction in the classroom. (Application)

Module I: Nature of Educational Technology (18 Lectures)
Contributions of Science and Technology in Human Life; Concept and nature of Educational Technology; Technology in Education and Technology of Education; Types/Forms of Educational Technology: ET- I, ET- II, ET- III; Objectives of Educational Technology; Scope of Educational Technology.

Module II: Concept of Instructional Technology (18 Lectures)
Meaning and Nature of Instructional Technology; Need of Instructional Technology; Difference between Teaching and Instruction; Assumptions of Instructional Technology; Basic features of Instructional Technology; Instructional Designs.

Module III: Instructional Objectives (19 Lectures)
Meaning of Instructional Objectives; Relationship of Instructional Objectives with General aims and objectives of Education; Taxonomy of Instructional Objectives: Cognitive, Affective and Psychomotor Instructional Objectives; Writing Instructional Objectives in behavioural Forms.

Module IV: Modern Approaches to Instructions (20 Lectures)
Programmed Instructions: Meaning, Principles, Features; Styles of Programming: Linear Programming, Branching Programming and Mathetics Programming; Development of Programmed Instructional Material; Personalized Systems of Instruction, Computer Assisted Instruction; Bloom’s Mastery Learning Approach to instruction.

Suggested Reading:

Mapping of COs to syllabus

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EDER0155 ELEMENTS OF RESEARCH (S-1-0)

COURSE OUTCOMES
1. Understand the conceptual framework of research. (Remembering)
2. Apply the process of research. (Application)
3. Create different tools of research. (Creation)
4. Use of tools and collecting desired data. (Application)
5. Understand statistical techniques to analyze the collected research data. (Understanding)

Module I: Introduction to Research in Education (17 Lectures)
Meaning and Nature of research, Relationship between research and philosophy, Types of Research: Fundamental, Applied and Action Research, Principles of research, Qualities of a good researcher, Scope of research in education.

Module II: Methods of Research (18 Lectures)
Meaning and nature of research designs, Historical method of research, Descriptive cum normative survey method of research, Experimental method of research, Case study method.

Module III: Process and tools of research (20 Lectures)
Process of research, General steps of research, Review of related literature, Variable and their types, Meaning, significance, and types of hypotheses, Sample and sampling, Tools of research: Tests, scales, questionnaire, interview, observation, features of a good tool of research, Preparation of research proposal.

Module IV: Statistics in Research (20 Lectures)
Meaning, significance, and limitations of statistics, Concept of data and its graphical representation: Frequency polygon, Histogram,

Mapping of COs to Syllabus

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Suggested Reading:

EDSE6101: LIFE SKILLS EDUCATION (1-0-1)

COURSE OUTCOMES
1. Understand the concept of life skill and life skill education and its importance. (Understanding)
2. Understand the meaning of emotion, empathy, etc. (Understanding)
3. Employ various skills in life such as social skills, cognitive skills, communication skills, coping skills, creative thinking skills, decision making skills, etc. (Application)
4. Construct the meaning of self. (Application)

Module I: Understanding of Life Skills and Social Skills (9 Lectures)
Skills and life skills; Origin and development of Life skills; Understanding life skills; Significance of life skills; Introduction to 10 core skills, Communication types, styles, barriers, skills of effective communication; Interpersonal relationships- healthy relationship

Module II: Cognitive skills and Coping Skills (11 Lectures)
Cognitive skills-nature, elements, types; Critical thinking- nature, Stages; Creative thinking-nature, stages; Problem solving: factors, steps; Decision making - process, need, consequences, coping with emotion: characteristics, types, classification-wheel model, coping strategies; coping with stress: sources of stress; General adaptive syndrome model of stress coping strategies.

PRACTICUM:
Topics prescribed for workshop (10 hours)
- Leadership & Team building
- Facing interviews
- Creativity
- Exercising Life skills in day-to-day life /through case study analysis/discussions/ debates/ experience sharing

Suggested Readings:

Mapping of COs to syllabus

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EDPT6102: PSYCHOLOGICAL TESTING (1-0-2)
2 Credits- 0-2-0

COURSE OUTCOMES
1. Recall the steps of various psychological tests. (Remembering)
2. Understand the importance of psychological tests and explain the procedures of conducting the same. (Understanding)
3. Applying the steps and procedures for administering a psychological tests correlate it to real life situations. (Application)
4. Analyze the procedures of psychological testing. (Analysis)
5. Evaluate the psychological experiments with the help of apparatuses. (Evaluate)
6. Develop the ability to create self-prepared tests. (Creation)

**Psychological Experiment with apparatus**

Any two from the following:
1. Maze Learning
2. Bilateral Transfer - Mirror learning
3. Division of Attention (Tachistoscope)
4. Reaction Time

**Test Administration**

Any two from the following:
1. Adjustment Inventory by V. K. Mittal
2. Rorschach Ink blot test
3. Thematic Apperception Test (TAT)
4. Differential Aptitude Test (DAT)

**Scheme of Evaluation:**
- Psychological Experiment with apparatus: 10 Marks
- Psychological Experiment without apparatus: 10 Marks
- Practical book: 10 Marks
- Viva Voce: 20 Marks

**Total:** 50 Marks

**Mapping of COs to syllabus**

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**EDPW6103: PROJECT WORK (EDUCATIONAL TOUR) (0-0-3)**

**COURSE OUTCOMES**
1. Identify the goals of institutions. (Remembering)
2. Analyze the overall functions of institutions. (Analysis)
3. Evaluate the academic performance of final year class/classes and assess the physical infrastructure. (Evaluation)
4. Explain the plans and policies of the institutions. (Understanding)
5. Create project report. (Creation)

Educational Tour as a project for UG 6th semester students aims at providing some practical experience about eminent educational institution/institutions. This educational tour will be of two/three day’s duration.

On the basis of all the observations, the students need to prepare the complete report of the project stepwise. Each student needs to make the presentation of this project report indicating their experiences. The constituted group of members will assess the project report presented by the students.

**Evaluation:**
- Internal Assessment = 40 % (Presentation)
- External Assessment = 60 % (Report + Viva)

**Mapping of COs to syllabus**

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MA EDUCATION DETAILED SYLLABUS

EDLR0007: LEADERSHIP AND SOCIAL RESPONSIBILITY (3-0-0)

COURSE OUTCOMES
1. State the meaning of leadership and the qualities of a true leader. (Remembering)
2. Discuss the concept of leadership and management and the different theories and styles of leadership. (Understanding)
3. Analyze the role of individual social responsibility and the social responsibility of educators. (Analysis)
4. Identify the role of leadership in the decision-making process and find out the techniques that improve decision-making processes. (Application)
5. Discuss the role of leadership in policy formulation and find out the effect of leadership in social entrepreneurship. (Application)

Module I: Leadership and Management (13 Lectures)
Understanding Leadership; Its need and function; Styles and Theories of Leadership; Styles of leadership (Autocratic, Democratic, Laissez Faire) and Theories of Leadership (Great Man Theory, Trait Theory, Fiedler's Contingency Theory, Hersey and Blanchard's Situational Theory, Tannenbaum and Schmidt Leadership Continuum); Changing roles of Leadership; Concept of Management, functions of Management, Leadership and Management issues; Discipline in Leadership, Leadership-A bridge to improved practice, Ways to improve Staff Achievement; Staff motivation, Performance and Personal Organization.

Module II: Social Responsibility (10 Lectures)
Concept of Social Responsibility, Types of Social Responsibility, Its need, Changing role; Social Engagement; Individual Social Responsibility and Corporate Social Responsibility, Social Responsibility of the Educators.

Module III: Leadership and Decision Making (12 Lectures)
Decision Making process; Types of Decision Making, Key steps in Decision Making, techniques of effective Decision Making; Barriers towards Decision Making, Ways of mitigating Barriers in Decision Making; Importance of Decision Making in Educational Institution, Organisational Behaviour, Leadership and Decision Making.

Module IV: Leadership Implementation and Implantation (10 Lectures)
Leadership and implantation; Leadership roles in Policy Formulation; Complexity of joint actions; Economic theory and program implementation; Implantation as exploration; Volunteerism; social entrepreneurship.

Suggested Readings

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EDFE0011: PHILOSOPHICAL FOUNDATIONS OF EDUCATION (4-0-0)

COURSE OUTCOMES
1. Recall/identify/state the philosophical foundation of education. (Remembering)
2. Explain/compare and contrast the contributions of different schools of philosophy and philosophers to the field of education. (Understanding)
3. Apply philosophical implications in designing and developing the curriculum. (Application)
4. Using Indian and Western philosophical thoughts in practice. (Application)
5. Analyze the aims, function and agencies of education. (Analysis)
6. Create one’s own philosophy to address the different educational problems one may come across. (Creativity)

Module I: Nature and Scope of Education (10 Lectures)
Education as a science and Education as a social process; Nature of Knowledge; Role of Philosophy in Education; Aims of education – individual, social, vocational and democratic; Formal, informal, and non-formal agencies of education; Relation between school and society. Functions of education: Individual development, Transmission of cultural heritage, Acquisition of skills, Acquisition and...
generation of human values, Social cohesion; A practical approach to philosophy of education.
Module II: Indian Schools of Thought (17 Lectures)
Astika and Nastika; Sankhya, yoga, Nyaya, Vaisheshika, Mimamsa, and Vedanta; Buddhism, Jainism, Carvaka.

Module III: Western Philosophical Thought (20 Lectures)
Some major schools: Naturalism, Idealism, Rationalism, Pragmatism, Realism, Logical positivism, Empiricism, Existentialism, Marxism and Postmodernism - Their educational implications with special reference to epistemology, axiology and the process of education.

Module IV: Modern Indian Thinkers (13 Lectures)
Vivekananda, Tagore, Gandhi, Aurobindo, J. Krishnamurti, Radhakrishnan; Nature of Knowledge and theories of knowledge; Social Philosophy of Education – Freedom, Equality, Democracy and Responsibility; Indigenous philosophy with special reference to northeast India.

Suggested Readings

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EDEP0012: FUNDAMENTALS OF EDUCATIONAL PSYCHOLOGY (4-0-0)

COURSE OUTCOMES
1. Recall the contribution of psychology to the varied aspects of education. (Remembering)
2. Extrapolate the educational implications of psychological concepts. (Understanding)
3. Apply the different strategies of the theories of learning, memory, motivation, thinking and problem-solving age appropriately for the development of students. (Application)
4. Apply the psychological testing to improve the teaching-learning situations. (Application)
5. Critically analyze the psychological theories to identify their gaps and relevance. (Analysis)
6. Justify the implications of the different theories of development, learning, memory, motivation, thinking and problem solving. (Evaluation)
7. Predict human behaviour. (Creation)
8. Design classroom environment that promotes student learning. (Creation)
Module I: Foundations of Psychology (12 Lectures)
Definitions of psychology; Historical antecedents of psychology and trends in 21st Century; Psychology: Its meaning, nature, methods and scope; Educational Psychology: concept concerns and scope, and functions of educational psychology.

Module II: Human growth and Development (14 Lectures)
Human Development and growth: Concept, principle; Factors influencing development and their relative role; Stages of human development: General characteristics and problems of each stage; Stage specific developmental tasks; Adolescence in Indian context – Characteristics and problems of adolescents, their needs; Theories of growth and development; Piaget, Bruner, Erickson and Kohlberg –and their educational implications. Individual Difference: Concept of intra and inter differences.

Module III: Learning and Memory (12 Lectures)
Learning: Concept, kinds, levels of learning, laws of learning and various viewpoints on learning; Theories of Learning: trial and error, classical conditioning, operant conditioning, Gagne’s theory of learning, Carl Rogers theory of learning and field theory of learning; cognitive view point and information processing; Educational implications of the viewpoints on learning; Memory: Encoding and remembering, different forms of memory, theories of forgetting.

Module IV: Motivation, Thinking and Problem Solving (22 Lectures)
Motivation: Meaning; Motives: Types; Theories: McDougall’s, Freud’s and Maslow’s Self Actualization Theory; Thinking: Definition and concept, nature, Theories, Tools, Types, Training, Development of thinking; Problem Solving: Meaning and Definition, Steps in Problem Solving, Factors affecting Problem Solving, and Strategies for Problem Solving.

Suggested Readings

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EDTE0013: EMERGING TRENDS IN EDUCATION (3-0-0)
COURSE OUTCOMES
1. Recall contemporary issues, techniques in education. (Remembering)
2. Explain/identify/classify the contemporary issues and techniques in education. (Understanding)
3. Use the new techniques of teaching in practice. (Application)
4. Appraise the present educational institutions regarding the challenges and hurdles faced. (Evaluation)
5. Formulate actionable strategies to prevailing problems in the educational system. (Creation)

Module I: Recent Pedagogical and Delivery Techniques (10 Lectures)
Distance Education – Purposes, functions, organization and management of Distance Education Programme; e-learning – Nature, Characteristics, Styles, Arrangement for e-learning in an educational institution; Virtual Classrooms – Modus operandi, Advantages and Limitations. Teleconferencing and; Video conferencing – Meaning, types, Educational Advantages.

Module II: Recent Techniques in Education (10 Lectures)
Language laboratory - Need, Types, Functioning, Uses and Applications; Team Teaching-Meaning, Definition, Objectives, Principles, Types, Organization, Procedure and steps, Advantages and Limitations; Co-operative learning and collaborative learning-Key elements-implementing the elements.

Module III: Autonomy, Accountability and Accreditation (8 Lectures)

Module IV: Challenges in School Education (10 Lectures)
Current student related Challenges: Parental Involvement, Drugs and Violence, School safety. Current Teacher related challenges: Diverse learning needs, Quality and expectations, Pupil- Teacher ratio. Teacher mentee /mentor programs. Current School related challenges- Technology issues, Bullying, harassment and ragging.

Module V: Learning Environment in Educational Institutions (7 Lectures)

Suggested Readings

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EDDE0014: HISTORY AND DEVELOPMENT OF EDUCATION IN INDIA (3-0-0)

COURSE OUTCOMES
1. Recall the characteristic features of education in ancient India, Pre- Independent India and post- Independent India. (Remembering)
2. Explain, compare and draw generalizations about the various educational commissions and policies. (Understanding)
3. Justify the relevance of different educational features from ancient to post-independent India in present day educational system. (Application)
4. Critically analyze the various policies and commissions in terms of their relevance and implementation. (Analysis)
5. Trace the contribution of each period to the shaping of the present education system. (Evaluation)
6. Construct ways and means of improving the quality and quantity of Indian education system. (Creation)

Module I: Ancient Indian Education (8 Lectures)
Fundamentals of Ancient Indian Education, Salient features, purpose of studying Vedas, Relevance of Ancient Indian education in the 21st Century. Chief Characteristics of Vedic Educational System; Education in post Vedic (Buddhist) period – features; Female education; Swadhyaya (Self-Education, State patronage and Growth of education, Primary Education (Maktabs), Higher Education (Madrassas), Female Education, Student and Teacher relationship

Module II: Education during Pre Independent India (13 Lectures)

Module III: Education during Post Independent India (14 Lectures)

Module IV: Current Government Policies (10 Lectures)

Suggested Readings
4. Govt. of India, report of the University Education Commission, Vol -I, Simla,(1949)

Mapping of COs to syllabus

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EDET0015: EDUCATIONAL TECHNOLOGY (3-0-0)

COURSE OUTCOMES
1. State the nature, scope and approaches of Educational Technology. (Remembering)
2. Describe the teaching models and explain the concept of instructional design. (Understanding)
3. Analyze the different instructional approaches in the process of teaching and learning. (Analysis)
4. Discuss the nature of the process of communication and the application of ICT in the teaching-learning process. (Application)
5. Identify the various software and hardware and state its use both in face-to-face and virtual classroom platforms. (Application)

Module I: Educational and Behavioural Technology (13 Lectures)
Meaning, nature and scope; Historical perspective of Educational Technology; Approaches- Software, hardware and system; Utility and problems of Educational Technology in Formal and non-formal education; Behavioural Technology: teacher behaviour and teaching behaviour, teaching skills, Micro Teaching; SSST and FIACS.

Module II: Designing Instructional System (12 Lectures)
Teaching learning process, variables, levels, functions, taxonomies of instructional objective, instructional strategies, PI, PSI, MI, CAI, BMLS.

Module III: Process of Communication and ICT (10 Lectures)
Concept and process of communication, Barriers to communication, Principles of communication, Mass Media and multimedia; Concept and need of ICT.

Module IV: Emerging trends in Educational Technology (10 Lectures)
Distance Education; Open learning system; New technologies- Videotapes, Radio, Teleconferencing, CCTV, INSAT, EDUSAT, Internet, Broadband; Resource centres for Educational Technology: CIET, UGC, IGNOU, NIOS; 3D printing, mobile learning, Gamification, Flipped, blended learning/classrooms, Cloud computing, Massive open online course (MOOCs), Flash notes, Virtual Reality, Wearables, etc.

Suggested Readings

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EDPC0016: PEACE EDUCATION AND CONFLICT MANAGEMENT (3-0-0)

COURSE OUTCOMES
1. Describe the importance and relevance of peace education (Application)
2. Explain the concept of peace as held by different thinkers and other religious beliefs.(Analysis)
3. Discuss the awareness of the modes and methods for conflict management.(Application)
4. Compare the global issues and peace movements. (Evaluation)
5. Narrate the various methods of conflict Management. (Application)
6. Describe the theories of Peace. (Analysis)

Module I: Understanding peace as a dynamic social reality (10 lectures)
Peace – meaning, nature; theories of peace – democratic peace and active peace; religious beliefs and peace – Buddhism, Islam, Hinduism and Christianity.
Module II: Philosophy of peace and peace education (15 lectures)
Montessori, Freire, the Dalai Lama, Gandhi, Krishna murthy, Aurobindo and Tagore; Concept and scope of peace education; peace teacher, peace method and other enabling practices for a culture of peace in an educational setting.

Module III: Conflict management and its methods and modes (10 lectures)
Meaning, types, levels and reasons for conflict; approaches to the study of conflict; methods and modes of conflict resolution - mediation, negotiation, diplomacy, coercive methods; creativepeacebuilding, cross cultural methods.

Module IV: Global issues and peace movements (10 lectures)
Human rights, preservation of ecology, population control, economic exploitation, deprivation, non-alignment movement, campaign for nuclear disarmament and role of world organizations in promoting peace.

Suggested Readings

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EDSF0017: SOCIOLOGICAL FOUNDATIONS OF EDUCATION (4.0-0-0)

COURSE OUTCOMES
1. Explain the meaning and scope of sociology and the relationship between sociology and education. (Remembering)
2. Summarize the contributions of different theoretical perspectives on better understanding of the society. (Understanding)
3. Assess the influence and impact of classroom climate on student’s learning. (Evaluation)
4. Propose methods for securing healthy cooperation between home and school in the teaching-learning process. (Application)
5. Identify and suggest ways and means to make the community an effective agency of education. (Application)
6. Discuss sociology of education in National perspectives and identify the merits and demerits of state control on education. (Analysis)
7. Describe schooling in the context of Globalization and National policies. (Understanding)

Module I: Concept and Approaches (10 Lectures)
Education from a sociological point of view – functionalism, structuralism, system approaches to education and a critical evaluation of these approaches; transition from pre-capitalist to capitalist social formations and its impact on educational structure and function; education and social groups, education in a multi-cultural context.

Module II: Theoretical Perspective of Educational Sociology (15 Lectures)
Theoretical approaches to educational sociology and their relevance in present day scenario - standpoint theory, theory of social learning by Bandura, social realism, critical theory, rational choice theory, human capital theory, conflict theory.

Module III: School as a Social Institution (15 Lectures)
School as a social institution, school as an organization; hierarchy of authority and their functions in school, unpacking schools’ social
contexts - contexts and factors shaping differences in schooling and schooling outcomes, schools as sites for social development, school choice, social mobility by means of education; organisational climate types, classroom climate and its impact.

Module IV: Cross-National Perspectives on the Sociology of Education (10 Lectures)

4. Conceptualizing modernization from educational point of view,
   - a. Culture - conceptual understanding of culture, developing intercultural competency through education, culture and personality, education for cross-national understanding;
   - b. Education beyond geographical barriers - distance education, online certification courses, student and faculty exchange programmes, curriculum goals for creating globally competent students.

Module V: Schooling in the Context of Globalization and National Policies (10 Lectures)

Central policies of education, privatization of education, sanskritisation and westernization of society and role of education, conceptualizing modernization from educational point of view, present education system and sociological issues - primary level, secondary level, higher educational level

Suggested Readings

1. Aims of education; Education as a system; School inclusion.

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SPECIALISATION: EDUCATIONAL LEADERSHIP

EDEE0019: DEVELOPING EDUCATIONAL LEADERSHIP (3-0-0)

COURSE OUTCOMES

1. Explain the importance of education and describe the educational system and institutions (Understanding)
2. Appraise the nature of collaboration and role played by stakeholders in the field of education. (Evaluation)
3. Critically analyze the curriculum content and pedagogy existing in schools. (Analysis)
4. Illustrate the role of leadership in the process of inclusion. (Application)
5. Describe the various features of good leadership in the field of education. (Remembering)

Module I: Education system and Institutions (15 Lectures)

a. Education as an ideal (What is education?; Aims of education); Education as a system; School as a social institution.
   - b. Decentralisation of Education: Education - a concurrent subject in the Constitution; Structure of the educational system in India; Study of the structure at the state level; Linkages within the system.
   - c. Roles and responsibilities of the personnel involved: Teacher as an academic leader, Head teacher as a school leader, CRC, BEO, DEO, DIET Principal, SCERT Director, NCERT Director, Panchayati Raj Institutions.
   - d. Reflecting on one's own experiences of schooling to understand school as a social institution, nature of relationships among the students.
Module II: Stakeholder Collaboration (10 Lectures)

a. Parent, learners, community, teachers as stakeholders: their expectations and roles. Ensuring their participation.
b. Analysis of research on impact of stakeholder participation, challenges and principles for successful collaboration.

Module III: Leadership for Inclusion (10 Lectures)

a. School Culture: Meaning and components; Hidden curriculum.
b. Zones of exclusion. Analysing curriculum-content and pedagogy to critically examine school processes; Identifying school processes that cause exclusion.
c. Synthesizing principles of inclusive institutional culture.

Module IV: Constructing ‘Educational Leadership’ (15 Lectures)

a. Leadership for quality education, equity and inclusion, continuous professional development of teachers, creation of learning communities, ensuring autonomy of learners, teachers and other staff, contextualisation of the curriculum.
b. Crafting vision and mission for an educational institution. Critical review of the vision based on the parameters of educational aims, ideals of administration and values of democratic society. Assess an educational issue to arrive at strategic principles, action plans, resource management to address the issue.

Suggested Readings

8. School as a social institution, Andre Baiteile.

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SPECIALISATION: EDUCATIONAL PSYCHOLOGY

EDDDL0020: HUMAN DEVELOPMENT AND LEARNING (3-0-0)

COURSE OUTCOMES

1. Explain the nature of child and childhood education. (Understanding)
2. Characterize the nature of human growth, maturation and development. (Application)
3. Appraise the nature and theories of development. (Evaluation)
4. Describe an understanding about adjustment mechanism in social context. (Remembering)
5. Classify the differently abled persons and discuss their educational implications. (Analysis)

Module I: Understanding Child and Childhood (10 Lectures)

Importance of understanding child and childhood; capabilities of children belonging to different socio-economic and cultural backgrounds; idea of multiple childhood; nature-nurture debate; language development; learning and acquisition; promoting autonomy in children.

Development of case studies of children belonging to different backgrounds

Module II: Development and Learning (10 Lectures)

Stages of development; growth and maturation; Adolescence: why it is a sensitive period, the importance of recognizing issues related to adolescence; Erikson’s stages of psycho-social development; Vygotsky’s theory on social constructivism; concept of tools;
zone of proximal development, Piaget and Vygotsky debate.

Developing a personal narrative of experiences of adolescence

Module III: Enabling learning (10 Lectures)
Bronfenbrenner’s ecological systems; theory of development; social context of learning; enabling school environment; promoting independence of thought and action; parenting at different stages of development.

Students analyze views of parents on parenting and child care practices. Quality frameworks.

Module IV: Psychology of Adjustment and Adjustment Mechanisms (6 Lectures)
Adjustment as a process; a theory of cognitive adaptation. Frustration and conflict; causes of maladjustment; contribution of Freud, Adler, Jung and Neo-Freudians to understand maladjustment, adjustment mechanisms. Conflicts and defence mechanisms, mental hygiene.

Module V: Differently-abled persons and learning (9 Lectures)
Understanding differently abled persons; educational implications: ADHD, autism, dyslexia. Juvenile delinquency.

Develop a detailed discussion paper on various kinds of learning difficulties

Suggested Readings

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EDC10021: CURRICULUM DEVELOPMENT AND INSTRUCTION (3-0-0)

COURSE OUTCOMES
1. Explain the nature of curriculum. (Application)
2. Describe the basis of curriculum development. (Analysis)
3. Distinguish the approaches of curriculum development. (Evaluation)
4. Mention the process of curriculum development. (Application)
5. Frame about the assessment of curriculum. (Remembering)
6. Distinguish the factors influencing curriculum implementation. (Understanding)

Module I: Understanding curriculum (6 Lectures)
Contemporary definition of curriculum; curriculum criteria, curriculum goals and values, basic principles of curriculum and instruction Brainstorming session on the issues and trends of school/college curriculum.
Module II: Philosophical underpinnings of curriculum (15 Lectures)
Curriculum types and Models of teaching: Social, Information Processing, Personalist, and Behavioral, Child-Centered, Society-Centered, Knowledge-Centered, or Eclectic; Goals and Philosophies of Education across changing education paradigms - Idealism, Realism, Perennialism, Essentialism, Experimentalism, Existentialism, Constructivism and Reconstructivism.

Module III: Approaches to curriculum development (10 Lectures)
Tagore, Gandhi, Krishnamurthy, Plato, Dewey, Montessori, Don Bosco, Freire. Detailed discussion on the pedagogical approach of one of the above thinkers

Module IV: Curriculum development frameworks in 21st Century (6 Lectures)

Module V: Curriculum development and assessment (8 lectures)
Developing a curriculum document: Approach and organization, stages of curriculum development, guidelines of statutory bodies with regard to curriculum development – UGC, NCTE, NCF; Curriculum integration: disciplines, media and technology; evaluating and assessing a curriculum; Models of curriculum; Curriculum implementation - Factors influencing curriculum implementation.

Suggested Readings
3. (Chicago: The University of Chicago Press).
5. Tyler Ralph, W. Basic Principles of Curriculum and Instruction. (University of Chicago Press).

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EDTP0022: PRINCIPLES & TECHNIQUES OF TEACHING AND PEDAGOGY (3-0-0)

COURSE OUTCOMES
1. Explain the nature of teaching. (Understanding)
2. Mention the theories of teaching and different models of teaching. (Analysis)
3. Distinguish the different methods of teaching. (Application)
4. Narrate the concept of pedagogy in the process of teaching and learning. (Evaluation)
5. Communicate the various Recent Developments in Pedagogy. (Application)
6. Describe the aspects of teaching in connection to various skills. (Analysis)

Module I: Concept and aspects of teaching (10 Lectures)
Teaching: Concept, nature and scope; Teaching competency: Understanding the child, understanding the subject, contextualization,
punctuality, regularity, integrity, humility, accountability, humanism, empathy, enthusiasm; Skills of teaching: Explaining, questioning, stimulus variation, reinforcement, achieving closure, etc.; Integration of different teaching skills and Strategies of teaching: Autocratic, Permissive, Democratic. Study the biographies of famous teachers and develop teacher profiles within historical and contemporary perspectives.

**Module II: Theories and models of teaching (10 Lectures)**
Principles and maxims of teaching; Theories of teaching: behaviourism, cognitivism, constructivism, co-operative approach; Models of teaching: information processing models, social models, behavioural models and personal models Demonstration on models of teaching by students.

**Module III: Teaching Methods (15 Lectures)**
Teacher-centred methods: lecture, demonstration, team-teaching, mastery learning strategy; Learner-centred methods: programmed learning, personalized system of instruction, problemsolving method; Activity-centred methods: seminar, workshops, peer-tutoring, group discussion, projects, heuristic method, panel discussion, brainstorming, symposium and role-play; Teaching aids: significance, types and uses Classroom teaching practice.

**Module IV: Recent developments in Pedagogy (10 Lectures)**
Pedagogy: concept and significance; History of pedagogy: Indian, Greek and Roman history of pedagogy; Innovative pedagogy: crossover learning, learning through argumentation, incidental learning, learning by doing, embodied learning; Pedagogical approaches for diversity in society and its interface with the classroom.

*Analysis of teaching in a real classroom situation*

**Suggested Readings**

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**EDTE0023: TEACHER EDUCATION (3-0-0)**

**COURSE OUTCOMES**
1. Describe the concept of teacher education. (Understanding)
2. Explain teaching as a profession. (Application)
3. Identify the structure of teacher education programmes. (Application)
4. Illustrate the recent trends of teacher education. (Remembering)
5. Prepare the course structure of Teacher Education with integrated Teacher Education Programmes. (Analysis)
6. Distinguish the various aspects of teaching as a profession. (Evaluation)

**Module I: Concept and Fundamentals of Teacher Education (13 Lectures)**

**Module II: Teaching as a Profession (12 Lectures)**
Approaches to teacher education: Behaviouristic and constructivist approaches; Modification of teaching behaviour: Simulated teaching, Flanders’ Interaction Analysis; Performance appraisal of teacher; Teacher effectiveness; Code of conduct and ethics in teacher education.

**Module III: Structure of Teacher Education Programmes (10 Lectures)**
Role of professional organizations and bodies of Teacher Education; Pre-service and In-service teacher education; Teacher education by open and distance learning; Role of different agencies in quality assurance - MHRD, UGC, NCERT, NCTE, SCERT, NAAC, RIE, SIE, IASE, UGC-HRDC.

**Module IV: Recent trends in Teacher Education (10 Lectures)**
Internship, Practice teaching for developing an effective teacher, Integrated Teacher education programme; Action research; ICT in teacher education; preparing teachers for inclusive classrooms; Issues and challenges in teacher education. Analyse the course structure of an integrated teacher education programme.

Suggested Readings
5. Buch. M.B. First survey of research in Education. Baroda: SERD.
6. Buch.M.B. Second survey of research in Education. Baroda: SERD.

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EDME0024: MEASUREMENT AND EVALUATION IN EDUCATION (3-0-0)

COURSE OUTCOMES
1. Describe the conceptual framework of educational measurement and evaluation.(Applying)
2. Mention different dimensions of educational measurement and evaluation.(Remembering)
3. Explain the concepts of reliability and validity of test scores. (Remembering)
4. Identify the tools and techniques to be used in the process of educational measurement and evaluation (Analyzing)
5. Apply the process of construction and standardization of tools. (Applying)
6. Find out reliability and validity of a tool. (Applying)

Module I: Educational Measurement (7 Lectures)
Overview of measurement and assessment; Types of measurement - psychological and physical; Functions of measurement - Prognosis, Diagnosis, Research; Scales of measurement, Properties and Types - Nominal, Ordinal, Equal interval, Ratio; General problems of measurement; High stakes’ testing, Performance and portfolio assessment.
Critical evaluation of the current trends in educational measurement

Module II: Dimensions of Educational measurement and Evaluation (10 Lectures)
Diagnostic, Aptitude, Achievement, Intelligence; Mode of assessment - formal, informal, formative, summative, continuous, terminal, process, product, internal and external; Process of assessment - Teacher-made test, standardized test, Norm reference test and criterion reference test.
Review of Stanford-Binet Test and General Aptitude Test Battery (GATB)

Module III: Reliability and Validity of a Test (8 Lectures)
a. Overview of reliability - Methods of estimating reliability with computation - test retests method, Equivalent forms method, Split half method, Kuder-Richardson method; Inter-rater consistency; Interpreting reliability coefficient; factors influencing reliability measures.
b. Nature of validity, major considerations in validation – content consideration, construct consideration, test-criterion relationship, consideration of consequences; Methods of estimating validity; factors influencing validity; Relationship between reliability and validity.
Practice session on estimating reliability and validity.

Module IV: Tools and techniques for educational measurement (10 Lectures)
Overview of constructing various types of objective tests; Guidelines for writing objective test items; Essay questions: forms, uses, guidelines for constructing, scoring criteria. Interpretive exercises: nature, forms, and uses of the interpretive exercises, Advantages and limitations.
Administration of a group test of intelligence using a standardized tool.

Module V: Standardization of a test (10 Lectures)
Planning the test: Determining the objective and test specification, preparing the preliminary format- writing, arrangement, review and editing of test items; tryout of the test - administration, scoring and item analysis; preparing the final form of the test - selection of items, fixing the time limit, direction to the examinee, preparation of scoring key; administration of the final form of the test-determining validity, reliability, norms, standard scores; manual of the test, interpretation of test results, characteristics and uses of standardized test.

Students will prepare, administer and standardize a test, following the set procedures of standardization of a test.

Suggested Readings

Mapping of COs to Syllabus

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SPECIALISATION: EDUCATIONAL LEADERSHIP

EDFM0026: FINANCIAL MANAGEMENT AND ACCOUNTING (3-0-0)

COURSE OUTCOMES
1. Describe accounts and finance in relation to education. (Application)
2. Illustrate the various processes of taxation regulations related to education. (Evaluation)CO3Work out the double entry accounting. (Analysis)
3. Illustrate the process of budgetary control and Auditing. (Application)
4. Identify the Process of Deduction of Tax and computation of Tax at source. (Remembering)
5. Explain the importance and working of Balance Sheet in accounting. (Evaluation)

Module I: Introduction (8 Lectures)
Evaluation of Financial Accounting; Difference between Accounting and Bookkeeping; Accounting Concepts; Principles, Bases and Policies.

Module II: Journal (8 Lectures)
Double Entry Accounting; Journal; Posting; Ledger.

Module III: Balance Sheet (8 Lectures)
Trial Balance; Final Account – Trading Account, Profit And Loss Account, Receipt And Payment Account; Income Expenditure Accounts; Balance Sheets.

Module IV: Financial Management (10 Lectures)
Decision Making; Meaning and Scope; Cost Analysis; Budgetary Control; Standard Costing; Financial Analysis; Relevant Cost; Management Accounting Framework; Function of Management Accounting; Internal Audit; School Accounting and Auditing; Investment.

Module V: Taxation Management (11 Lectures)
Basic Concepts; Deduction from Gross Total Salaries; Income From House, Property; Profits and Gains of Business and Profession; Capital Gains; Income from other Sources; Set off and Carry Forward of Losses; Assessment of Individuals and Computation of Tax at Source, Assessment of Companies and Fringe Benefit and Service Tax. VAT/ GST.

Suggested Readings

Mapping of COs to Syllabus
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**EDLE0027: LIFE SPAN DEVELOPMENT AND EDUCATION (3-0-0)**

**Course Outcomes**
1. Recognize the meaning, concept, process, nature, and scope of life, development, life span development, and emotions of an individual. (Remembering)
2. Understand the biological bases and anatomical structures controlling human development along with understanding emotional development and its associated components. (Understanding)
3. Analyze theories of development M1 and issues of human development at various stages. (Analysis)
4. Apply the principles and knowledge of the theories of development and human anatomy in educating children as well as mitigating bio-psycho-socio-emotional issues. (Application)
5. Evaluate the influence of socialization on the development process of an individual. (Evaluation)
6. Creating models to bring about a balanced emotional development of students. (Creation)

**Module I: Introduction to LifeSpan Development (8 Lectures)**

Analyze the role of education in socialization and development of the child.

**Module II: Biological Bases of Human Development and Anatomy of the Nervous system (14 Lectures)**
The Evolutionary perspective and Heredity-Environment Correlations, genetic foundation, Conception, effect of Teratogens on Prenatal Development, Neonatal health - Low birth weight, Neonatal Assessment; Neuron: Structure, types and functions. Structure of the nervous system, physiological basis of the action potential (neural response); Structure and function of the brain: fore brain, midbrain, hindbrain, cerebral cortex, temporal, parietal and occipital lobes; prefrontal cortex; The effect of hormones on the nervous system

Debate on heredity and environment: essential factors affecting human development.

**Module III: Physical development across lifespan (11 Lectures)**
Physical growth during childhood, adolescence and old-age brain development across lifespan, Bio-Psycho-Social health model, aging, biological theories of aging and death.

Discussion on educational implications of stages of physical development.

**Module IV: Emotional and Moral Development (12 Lectures)**


**Suggested Readings**

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EDLI0028: LEARNING AND INDIVIDUAL DIFFERENCES (3-0-0)

COURSE OUTCOMES
1. Recognize the concept, nature, process, laws, types, and methods of learning. (Remembering)
2. Understand the relationship of learning with interest, motivation, maturation, and individual difference. (Understanding)
3. Analyse various factors influencing learning. (Analysis)
4. Apply the laws and theories of learning, use components of learning to solve problems, and utilize the knowledge of individual differences to facilitate adequate provisions. (Application)
5. Evaluate the educational implications of learning and effectiveness of learning styles. (Evaluation)
6. Create a conducive environment of learning. (Creation)

Module I: Understanding Learning (10 Lectures)
Learning: Concept and Scope; Nature of learning: learning as a process and learning as an outcome; Laws of learning: Types of learning: factual, associations, conceptual, procedural, generalizations, principles and rules; Methods of effective learning; Learning curves - Types, features and its educational implications; Plateaus in Learning; Learning styles. Students analyze their own learning styles.

Module II: Factors Influencing Learning (12 Lectures)
Factors influencing learning - Intellectual, Emotional, Physical and Social; Concept and nature of attention, determinants of attention, relationship with interest; Concept, nature and types of motivation – intrinsic, extrinsic and achievement; Learning and maturation; Learning to think, reason and solve problems Discuss the role of a teacher in addressing various factors influencing learning.

Module III: Transfer of learning (10 Lectures)
Transfer of learning - Concept, Importance, Nature; Types of transfer of learning; Theories of transfer of learning - Theory of mental discipline, Theory of identical elements, Theory of generalization and theory of ideals; Methods of enhancing transfer of learning. Developing a narrative of personal experiences on the basis of transfer of learning in various situations.

Module IV: Individual Difference (13 Lectures)
Concept of individual difference; Dimensions of individual difference; Determinants: Role of heredity and environment, their inter-relationship; Types/varieties of individual differences - Physical, mental, motor, emotional, interest and aptitude, attitudes, social and moral development. Individual difference and education; Influence of individual differences on learning outcomes; Provisions for individual differences in educational institutions; Implications of individual differences for organizing educational programmes Sharing session on the problems and issues related to individual differences as faced by the students.

Suggested Readings

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EDOC0029: ORGANISATIONAL COMMUNICATION (4-0-0)

COURSE OUTCOMES
1. Understand the concept, scope, importance, process, types, advantages, and barriers of communication in an organization. (Understanding)
2. Apply skills of presentation utilizing visual aids, implement decision making techniques for effective communication. (Application)
3. Analyse the communicative dimensions of team work and violation of professional boundaries. (Analysis)
4. Create and draft business letters and design and develop conflict management strategies. (Creation)
5. Understand the concept, need, significance, and execution of administrative feedback in organizational communication. (Understanding)
6. Evaluate the modes of effective communication and feedback models in an organization. (Evaluation)

Module I: Conceptual Framework of Communication (10 lectures)
Concept and functions of Communication; Communication and four senses; Communication process; models of feedback, administrative feedback, and communication model and its elements; scope of communication

Module II: Organisational Communication (12 lectures)
Relationship between organisation and communication; common modes of communication in an organisation: writing, conversation, reading, media, charts, proceedings, T.V. telephone, e-mail and other modes of communication; formal and informal communication; practical approaches in understanding administrative communication: cross communication, downward communication, upward communication

Module III: Communication Techniques (13 lectures)
Presentation skills, effective use of voice in presentation: articulation, tone, pitch; making effective presentations; use of visual aids in presentation; communication in teams: project teams, quality improvement teams, virtual teams; communicative dimension of team work: roles, norms, decision-making processes and management of conflict.

Module IV: Feedback and professional boundaries (10 lectures)
Feedback, Administrative feedback, models of feedback, assessing the listening skills; maintaining Professional Communication-professional boundaries, violation and maintaining of boundaries

Suggested Readings
3. Hardman, E. Active Listening 101: How to turn down your volume to turn up your communication skills.

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SPECIALIZATION: EDUCATIONAL LEADERSHIP

EDEA0030: EDUCATIONAL ADMINISTRATION (3-0-0)

COURSE OUTCOMES
1. Recognize the nature, scope, objectives, significance, and elements of educational administration. (Remembering)
2. Understand the characteristics of successful and democratic administration along with understanding the concept of school, school management, supervision and its features, evaluation and its principles, and role of headmaster and teachers in school management. (Understanding)
3. Apply democratic educational administration in practical situations and the principles of evaluation in supervisory works. (Application)
4. Analyse the duties of educational administrators/school managers including headmaster and teachers. (Analysis)
5. Evaluate democratic administration, functional basis of supervision, and roles of educational administrators. (Evaluation)
6. Utilize creative ways towards infrastructural resource management and supervisory programmes. (Creation)

Module I: Conceptual Framework of Educational Administration (12 Lectures)
Nature and scope of educational administration; Objectives of educational administration; Elements of educational administration; Characteristics of successful administration; Democratic administration.

Module II: School Management (10 Lectures)
Concept of School; Need of school; School management; Headmaster/Principal as the school manager and her/his qualities; Role of teachers and community in school management; Infrastructural resource management.

Module III: Concept of Supervision (12 Lectures)
Meaning of supervision; Difference between supervision and administration; Effective supervision; Functional basis of supervision; Supervision as leadership. Module IV: Evaluation and Supervision (12 Lectures)
Concept of evaluation; Principles of evaluation; Evaluation of supervisory programme; Evaluation of Educational administrative programme; Evaluation as a continuous programme for quality improvement.

Suggested Readings

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EDSR0031: ETHICS AND SOCIAL RESPONSIBILITY IN EDUCATION (3-0-0)

COURSE OUTCOMES
1. Recognize the meaning, need, and components of ethics and value, identify the significance of values and morals along with types of ego, and meaning, need, role, and types of social responsibility. (Remembering)
2. Understand the theoretical perspectives of ethics and social responsibility, relationship of educational ethics with gender and leadership, and significance of teaching profession. (Understanding)
3. Evaluate the strategies of social responsibility and role of ethics in a workplace. (Evaluation)
4. Apply the criteria of profession and UGC’s code of conduct for teachers. (Application)
5. Analyze the influence of globalization on ethics and developmental activities and importance of code of conduct. (Analysis)
6. Mitigate the problems encountered in the process of delivering social responsibility. (Creation)

Module I: Educational Ethics (9 Lectures)
Concept of Ethics and educational ethics; Need of ethics in educational settings; Components of ethics; types of values, morals.

Module II: Theoretical Perspectives of ethics (12 Lectures)
Ethical theories: Utilitarianism, Kantian ethics, Natural rights theories; religious ethics; virtue ethics; Kantian vs utilitarian; gender and ethics; ethics and leadership. Concept of ego: psychological, ethical, rational. Moral philosophy.

Module III: Ethics and Social Responsibilities (12 Lectures)
Concept of social responsibility; Need of social responsibility; Types of social responsibility; Social responsibility of educators; Strategies of social responsibility.

Module IV: Professional Development (12 Lectures)
Concept of profession; Criteria for a profession; Teaching as a profession; Workplace and code of conduct, Technology and globalization in relation to professional ethics and developmental activities.

Suggested Readings

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**SPECIALIZATION: EDUCATIONAL PSYCHOLOGY**

**EDSP0032: COUNSELLING SKILLS FOR EDUCATIONAL PSYCHOLOGISTS (3-0-0)**

**COURSE OUTCOMES**
1. State the meaning, nature, objectives, scope, process, types, and approaches of counselling. (Remembering)
2. Explain various theories of counseling and understand the concept, need, and skills of educational psychologists. (Understanding)
3. Apply the theories and tools and techniques of counseling. (Application)
4. Assess the skills of counseling and role of teacher as a counselor. (Evaluation)
5. Analyze the theories of counseling and various types of guidance. (Analysis)
6. Create the tools and techniques to be used for student counseling and improvise teachers' role in counseling process. (Creation)

**Module I: Introduction to Counselling (12 Lectures)**
Meaning, nature, objectives and scope of counselling; counselling as a process: factors affecting counselling process, stages of counselling process; types: individual and group; approaches of counselling: Directive, Non-directive and Eclectic Counselling.

**Module II: Theories of Counselling (12 Lectures)**
Gestalt Counselling; Psychoanalytic Counselling; Cognitive Psychologists; Personality - Cattle's Truth Theory; Behavioral Counselling.

**Module III: Introduction to Educational Psychologists (11 Lectures)**
Concept of Educational psychologists; need of educational psychologists; educational psychology as a career; key skills for educational psychologists; concept of guidance, need and types of guidance; guidance and counselling services; tools and techniques to be used for student counselling process.

**Module IV: Teacher as a Guide and Counsellor (10 Lectures)**
Role of teacher as an educational psychologist; guidance worker and counsellor; Counselling skills: Building trust, Listening, Attending, Building rapport, Demonstrating Empathy, Observing; Difference between counsellors, educational psychologists, clinical psychologists.

**Suggested Readings**

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**EDCA0033: CHILD AND ADOLESCENT MENTAL HEALTH (3-0-0)**

**COURSE OUTCOMES**
1. Recognize the historical background of mental health, objectives, scope, and need of mental health, factors affecting mental health of children and adolescents, and the characteristics of a mentally healthy person. (Remembering)
2. Explain the factors affecting mental health in childhood, the features of adolescents, and the role of parents and teachers in these regards. (Understanding)
3. Apply solutions to various problems pertaining to mental health of child and adolescents. (Application)
4. Evaluate problem behaviours among children and adolescents. (Evaluation)
5. Analyze the status of mental health of school going children and adolescents and the best practices in mental health care. (Analysis)
6. Create awareness among the students about mental health of children and adolescents and develop preventive measures for mental health by designing a mental health system. (Creation)

Module I: Introduction to Mental Health (11 Lectures)
Concept of mental health: Historical background of mental health, objectives, scope, and need of mental health, factors affecting mental health; characteristics of a mentally healthy person; Mental health promotion, preventive intervention & treatment.

Module II: Mental Health as a Primary Health Concern among children (12 Lectures)
Childhood as critical stage of development: Child mental health as a primary health concern, factors affecting child mental health; Children with problem behaviours and developmental difficulties- language difficulties, Autism, Need for a comprehensive mental health system; Integrated approaches to early childhood mental health; Government policies and programs addressing childhood well-being.

Module III: Mental Health as a Concern among Adolescents (12 Lectures)
Concept of adolescents and adolescence, Adolescence as a period and its characteristics, Adolescence as period of stress and storm; Indicators of mental health development among adolescents, Introduction to problem behaviours among adolescents - delinquency, anxiety, conflict, stress, depression, drug abuse, substance abuse, alcoholism, adjustment mechanisms.

Module IV: Education and Mental Health (10 Lectures)
Mental health services in schools; child guidance clinic; Role of parents and teachers in fostering mental health among children and adolescents; promoting psychological well-being among children and adolescents; guidance and counseling.

Suggested Readings

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EDRM0034: RESEARCH METHODOLOGY IN EDUCATION (4-0-0)

COURSE OUTCOMES
1. Describe the conceptual framework of Research process. (Understanding)
2. Explain the methods and designs in Educational Research. (Analysis)
3. Apply and interpret the tools and techniques of research. (Application)
4. Examine the organization and analysis of data. (Remembering)
5. Analyze the application of statistics in Educational research. (Application)
6. Design and develop the synopsis and thesis writing. (Creation)

Module I: Introduction to Research in Education (13 Lectures)
Meaning and nature of research; Methods of Acquiring knowledge; Types of Research: Fundamental, applied, action research; Quantitative, Qualitative research; Principles and scope of Research in education; Scientific method and process of research; Preparation of synopsis for any research work in education; Ethics of Research.

Module II: Methods and Designs in Educational Research (14 Lectures)
General steps of research; review of related literature; Concept of Research Design and Types of designs; Methods of Educational Research: Historical, Survey, experimental, case study; Concept of hypotheses, Types and Testing hypotheses, Levels of significance, Fiduciary limits, Type I and Type II Errors.

Module III: Sampling and Tools of Research in Education (16 Lectures)
Concepts of Population and sample; Probability and Non-Probability sampling; Sample size and features of a good sample, Sampling Error; Tools of Research: Achievement Test, Intelligence Test, Observation, Interviews, Questionnaires, Attitude scale; Process of Development of tools; Nature of data and sources of data.

Module IV: Statistics in Educational Research (17 Lectures)
Concept, significance and functions of statistics; Measures of Central Tendency and measures of Variability; Coefficient of correlation:
Product moment and rank difference method, Applications of z-test, t-test and f-test, Chi-square, median test, sign test, Report writing.

Suggested Readings
5. Garrett, H. E. Statistics in Psychology and Education, Vikils, Feiffer and Semen’s Ltd,

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EDJ6602: JOURNALING - A TECHNIQUE FOR PERSONAL AND ACADEMIC GROWTH (1-0-2) – Practicum

COURSE OUTCOMES
1. Recall one’s life experiences. (Remembering)
2. Explain clearly and specifically one’s life experiences. (Understanding)
3. Develop the skill of writing. (Application)
4. Analyze life experiences at a conscious level and enhance reflective thinking. (Analysis)
5. Synthesize one’s thoughts in an organized manner and create a new piece of writing. (Creation)

Journaling is a strategy for making sense of experiences. The objective of journaling is to develop in students a reflection that can be described as an inner dialogue with oneself whereby a person calls forth his or her own experiences, beliefs, and perceptions about an idea; informing and transforming functions of knowledge; and a conscious and systematic mode of thought. This is to nurture in future educational leaders a sense of reflective practice.

Each student is required to maintain a reflective journal, using the Visible Thinking Routine (Harvard), as a critical structure for guiding their journal writing. The students are to submit the journal every Friday. Journaling has to be done six days of the week. At the end of the semester, the student will be awarded a grade/marks after assessing the learning.

Suggested Readings

Mapping of COs to Syllabus

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EDES6603: EDUCATIONAL SEMINAR I (0-0-2) – Practicum

COURSE OUTCOMES
1. Develop higher cognitive abilities to respond to new knowledge, critical thinking, and keen observation of research conducted.
(Understanding & Evaluation)
2. Develop the abilities to seek clarification, defend the ideas of others, and present effectively. (Application & Creation)
3. Develop the feeling of tolerance, co-operation, and respect of the ideas and feelings of others. (Understanding)
4. Acquire good manners of putting questions and answering the questions of others effectively and develop emotional abilities. (Analysis & Application)

During the course of the programme, students are expected to present a series of seminars which will address fundamental intellectual, conceptual and practical issues in current educational philosophy and application. They may also deal with other relevant topics such as use of ICT in education, design of new and innovative curricula, methodological issues in education, etc. Students will be assisted through guest lectures, discussions, field work in education related institutions and active engagement with faculty members. During these interactions students will be provided with an opportunity to explore how best to bring new interdisciplinary scholarship, technology and critical thinking into the development of the chosen seminar area. They will also consider alternative pedagogic strategies, teaching techniques and technologies. Students will prepare and present a final paper based on these seminars. The course will be evaluated on the basis of the seminars and the final paper.

Mapping of COs to Syllabus

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EDSV6004-SCHOOL VISITS (0-0-2) - PRACTICUM

COURSE OUTCOMES
1. Aware of the school environment and its functioning. (Remembering)
2. Understand the dimensions of use of lands, different amenities and different equipment available in the schools. (Understanding)
3. Analyze the role of teachers and their code of ethics. (Analysis)
4. Apply measures to improve the outputs of the school. (Application)
5. Assist the principal/teachers in the smooth functioning of schools. (Application)

Report to be Prepared:
Report on Inputs:
• Human Resources
• Non-Human Resource
• Report on Processing:
• Teaching-Learning Process
• Analysis of Curriculum
• Analysis of Time table
• Use of Hardwares
• Use of Softwares
• Modes of Transactions
• Identifying the problems faced by teachers
• Classroom Management etc

Report on Outputs:
• Subject wise Performance
• Causes of poor and high Performance

Attitude of Teachers and Students towards School

Mapping of COs to Syllabus

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EDDI6005: DISSERTATION PHASE-I (0-0-2)

COURSE OUTCOMES
1. Develop the skill to prepare the Research Proposal. (Application)
2. Apply the skill in collection of data in the field. (Application)
3. Develop the ability to analyze the data. (Analysis)
4. Ability to write the report in standard academic formats. (Creation)

Every student shall undertake a research project work under the supervision and guidance of a faculty member. The students are expected to complete the literature review and present a research proposal during the first phase. The dates, mode and components of evaluation and the weightages attached to them shall be published by the department at the beginning of the semester.

Mapping of COs to Syllabus

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EDDI6007: DISSERTATION PHASE-II (0-0-4)

COURSE OUTCOMES
1. Develop the skill to prepare the Research Proposal. (Application)
2. Apply the skill in collection of data in the field. (Application)
3. Develop the ability to analyze the data. (Analyzing)
4. Ability to write the report in standard academic formats. (Application)

The students of the final semester will have to compile their research study in the form of a dissertation. Each dissertation has to be systematically structured following proper methodology of educational research. To set the dissertations in a standardized pattern the supervisor should ensure that it follows proper sequence containing following aspects:

Preliminary section
1. Title page
2. Approval sheet
3. Acknowledgments
4. Table of contents
5. List of tables (if any)
6. List of figures (if any)

Main body
1. Introduction
   • Conceptual framework of the theme
   • Some relevant studies
   • Rationale/Justification of the study
   • Statement of the problems
   • Operational terms
   • Statement of the study
   • Objectives of the study
   • Hypotheses
   • Delimitation of the study
2. Review of related literature
3. Method and Procedure of the study
   • Procedures used
   • Methods of gathering data
   • Description of data gathering tools
4. Presentation and Analysis of Data
   • Texts
   • Tables
   • Figures
   • Statistical treatment
   • Analysis of data gathered and interpretations
5. Conclusion
   • Brief restatement of problems and procedures
   • Major findings and conclusion
   • Educational implications
   • Recommendations for further research

Reference section
1. References (APA sixth edition)
2. Appendix

The supervisor will help students to understand the detailed steps of writing a dissertation. He/she will ensure that the dissertation is prepared keeping in view Of Intellectual Property Rights, maintenance of research ethics and avoidance of plagiarism. Phase I of the course is carried out in the 3rd semester where the students will work on research proposal, literature review and the first part of the data collection. In the 4th semester they will complete data collection, analysis, and preparation of a research report (Phase II). Students are required to make a presentation of the dissertation submitted to the department on the date set in the academic calendar for the same.

Mapping of COs to Syllabus

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EDIN6008: INTERNSHIP (0-0-3)

COURSE OUTCOMES
1. To acquaint the students with the total environment of the school. (Remembering)
2. To learn about the functioning of the school. (Understanding)
3. To observe the administrative and managerial activities. (Remembering)
4. To observe the morning assembly and teaching work in the classroom for having an idea of teaching work. (Analysis)
5. To prepare lesson plans and teaching aids for conducting classes. (Application)
6. To observe and participate in the co-curricular activities and extracurricular activities. (Application)
7. To organize the co-curricular and extracurricular activities. (Creation)
8. To understand the behaviour of teachers, students, principal, headmaster and others supporting staff. (Understanding)

Activities to be performed:
I. Organization/ observation of morning assembly.
II. Classes to be taught during the day by preparing lesson plans.
III. Unplanned classes to be taken during the day if some teachers are on leave. Observing the class of an effective/ good teacher.
IV. Participating/ organizing co-curricular activities. Participating/ organizing extracurricular activities. Any other specific events of the day.
V. Undertaking action research or case study.
VI. On the basis of daily reports the students are to prepare the final report on the school Internship Programme.

EVALUATION:

| Stock of daily reports and Action research | 30 |
| Preparation of final report | 10 |
| Lesson plans | 20 |
| Teaching aids developed | 10 |
| Presentation of final report and viva voce | 30 |

Mapping of COs to Syllabus

| CO 1 | H |
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| CO 3 | H |
| CO 4 | H |
| CO 5 | H |
| CO 6 | H |
| CO 7 | H |
| CO 8 | H |

EDES6009: EDUCATIONAL SEMINAR II (1-0-1) – Practicum

COURSE OUTCOMES
1. Develop higher cognitive abilities to respond to new knowledge, critical thinking, and keen observation of research conducted. (Understanding & Evaluation)
2. Develop the abilities to seek clarification, defend the ideas of others, and present effectively. (Application & Creation)
3. Develop the feeling of tolerance, co-operation, and respect of the ideas and feelings of others. (Understanding)
4. Acquire good manners of putting questions and answering the questions of others effectively and develop emotional abilities. (Analysis & Application)

Following the previous course of Educational Seminar-I, in the present course of the programme the students are expected to present a series of seminars which will address fundamental intellectual, conceptual and practical issues in current educational philosophy and application. They may also deal with other relevant topics such as use of ICT in education, design of new and innovative curricula, methodological issues in education, etc. Students will be assisted through guest lectures, discussions, field work in education related institutions and active engagement with faculty members. During these interactions, students will be provided with an opportunity to explore how best to bring new interdisciplinary scholarship, technology and critical thinking into the development of the chosen seminar area. They will also consider alternative pedagogic strategies, teaching techniques and technologies. Students will prepare and present a final paper based on these seminars. The course will be evaluated on the basis of the seminars and the final paper.

Mapping of COs to Syllabus

| CO 1 | H |
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EDTP6010: TEACHING PRACTICE (1-0-1) - Practicum
COURSE OUTCOMES
1. Understand the concept and purpose of teaching practice (Understanding)
2. Develop skill of preparing lesson plan (Creating)
3. Practice various teaching skills in classroom situations (Application)

Module I: Concept of Teaching Practice (10 Lectures)
Introduction to Teaching Practice, Concept of teaching practice Objectives of teaching practice, Concept of Lesson Plan, significance of lesson plan, Approaches for preparing lesson plan, Format of lesson plan, Teaching skills and Micro Teaching

Module II: Preparation of Lesson Plan (20 Lectures)
Preparation of Lesson Plan and Presenting lesson plans, Preparing 10 lesson plans for Secondary / Senior Secondary / UG students Delivering four (4) Lesson Plans in Secondary / Senior Secondary /UG Classes One lesson plan for final practice teaching

Evaluation Scheme:
- Internal Assessment: 20 Marks
- External Assessment: 20 Marks
- Record: 20 Marks
- Final Teaching Practice: 20 Marks
- Viva: 20 Marks

Suggested Readings

Mapping of COs to Syllabus

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SWCA6010: COMPUTER APPLICATION FOR SOCIAL SCIENCES (1-0-1) - Practicum

COURSE OUTCOMES
1. Describe the application of the basics of Word Processing. (Applying)
2. Illustrate the basics of Excel Worksheet. (Applying)
3. Explain the basics of PowerPoint Presentation tools. (Analyzing)
4. Work out data analysis in research using Statistical Analysis Packages. (Applying)
5. Identify and describe the practical aspects of Computer Applications. (Evaluating)

Module I: Basics of Microsoft Office Word Processing (7 lectures)

Module II: Basics of Microsoft Office Excel Worksheet (8 lectures)
Worksheet Package: Cells, rows, columns, Range, Structure of a worksheet window, creating, opening and saving, Printing a worksheet document, creating tables, charts, data analysis using formulae in worksheet.

Module II: Basics of Microsoft Office PowerPoint Presentation (5 lectures)
Presentation Package; creating presentations in a presentation package, text tables, charts, Animation, running slide show, saving the slides, Printing the presentations.

Module IV: (Practicum) Using Statistical Packages for Data Analysis (10 lectures)
Qualitative Data Analysis, Quantitative Data Analysis. Statistical Packages for Data Analysis: Statistical Package for Social Sciences (SPSS), Analysis of moment structures (AMOS)

Suggested Readings

Full Marks: 50
Internal: 20 Practicum & Viva: 30
Mapping of COs to Syllabus

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EDSL0200: SERVICE LEARNING (A COMMUNITY-UNIVERSITY ENGAGEMENT PROGRAMME) (1-0-1)

**COURSE OUTCOMES**

1. Learn the concept of service learning and community engagement. (Remembering)
2. Understand the importance of service learning and community engagement for developing the skills of addressing real life issues in one’s own community. (Understanding)
3. Develop the ethics of civic participation. (Applying)
4. Develop an understanding of the importance of communication skills in interacting with community members. (Understanding)
5. Be exposed to and empathize with people who are less fortunate than they are, economically, socially, academically, medically etc. (Applying)
6. Organize awareness programmes, rallies, campaigns, social service etc. (Analysing)
7. Develop the skills of problem solving and reflective thinking. (Analysing)
8. Realize one's potentiality to make a difference in the life of their community members. (Evaluating)
9. Understand and experience the system of inequality that exists in the Educational system. (Evaluating)
10. Applying the pedagogical concepts learned in class in the educational institutions of the community. (Creating)

**Module I: Service Learning and Community- University Engagement**

Concept of service learning and community-university engagement; History of service learning in the context of Indian Universities; Principles for an effective service learning; Principles of a good service learning pedagogy; Models of Service Learning: Project Model, Charity Model, Social Justice Model.

1. Programs of Service learning: Community Engagement, Field Education, Volunteerism, Internship.
2. Benefits of Service learning: For Students, Academic enhancement, Personal/ Professional Growth, Understanding Diversity, Civic learning, Critical reflection, For the University, For the community.

**Module II: Practices for Service Learning and Community- University Engagement**

By collaborating with the Community Members, Village Panchayats, Parents, Educational Institutions (Heads, Teachers and Students), Anganwadis, Balwadis etc. and following the mentioned Models and Programs of Service Learning students can be engaged with the community welfare in the following ways: (Any...)

1. Creating awareness among community members regarding Early childhood care and nutrition.
2. Creating awareness among community members about parenting.
3. Self-participatory internship in a school of one’s own choice.
4. Creating awareness among school children and community members and providing training in developing one’s life skills.
5. Providing teachers training in pedagogy.
6. Providing training to school teachers in the use of ICT for enhancing students’ learning.
7. Providing training to teachers in the preparation of teaching aids by using available community resources.
8. Creating awareness on Mental Health and strategies for its sustenance.
9. Creating awareness on the importance of Physical health and ways of maintaining one’s health.
10. Creating awareness on the importance of education and ways of creating a conducive environment for proper learning.
11. Creating awareness on AIDS.
13. Creating awareness on life skills and ways to develop one’s life skills.

**EVALUATION:**

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<td>Project presentation and Viva</td>
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<td>Organization of activities and project report</td>
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**Suggested Readings**

2. Centre for Community Engagement. (n.d.). Faculty Toolkit for Service Learning. Middlesex Community College. [Downloaded from https://www.uml.edu/docs/Faculty_Toolkit_MCC_tcm18-52567.pdf.]
Across Disciplines. Sterling Virginia.


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VALUE ADDED COURSES

EDES6011: EDUCATION FOR SUSTAINABLE DEVELOPMENT (1-0-1)

COURSE OUTCOMES
1. To create awareness about the concept of Sustainable Development. (Remembering)
2. To make the students aware of the concept of education for sustainable development. (Understanding)
3. To create awareness about the role of education in sustainable development. (Applying)
4. To create an understanding among the students about the concept of Education for Sustainable Development. (Analyzing)

Module I: Introduction to Sustainable Development (5 Lectures)
Concept of Development; Concept of Sustainability; Sustainable Development: Its 5 Ps (People, planet, prosperity, peace, and partnership); Sustainable Development Goals - 17

Module II: Curricular Framework for Education for Sustainable Development (10 Lectures)
Definition and meaning of education for sustainable development; Principles; Key themes: Climate change, Biodiversity, Sustainable production and consumption, Reduction of poverty; Key Sustainable Competencies to be developed through ESD: Systems thinking, Competencies, Anticipatory Competency, normative competency, Strategic competency, Collaboration Competency, Critical thinking competency, Self-awareness Competency and integrated problem solving competency; Pedagogical approaches in ESD: Whole-institution approach, Learner centered approach, Action oriented learning, Transformative approach; Teaching techniques for ESD: Simulations, Class discussions, Issue Analysis Techniques, Storytelling.

Module III: Practical Implications of ESD (15 Lectures) (Any two)
Sharing their own stories of struggle/success with the class
Visiting neighboring areas to collect community related stories/activities towards the realization of sustainable development goals.
Surveying industries and submitting reports on its sustainability norms. Surveying schools and submitting reports on its sustainability norms.

EVALUATION:

| Written test | 10 |
| Attendance | 5 |
| Non-formal Reports (2) | 15+15=30 |
| 30 |

Suggested Readings

Mapping of COs to Syllabus

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EDTT6012: TEACHER AND TEACHING SKILLS (1-0-1)

COURSE OUTCOMES
1. To create awareness among the students about conceptual framework of teaching skills. (Remembering)
2. To make the students aware of the sources of teaching skills. (Understanding)
3. To create awareness about the approaches concerning teaching skills. (Applying)

Module I: Introduction to Teaching and Teacher
Concept of teaching; Structure of teaching; Levels and phases of teaching.

Module II: Concept of Teaching Skills
Meaning of teaching skill; Significance of teaching skills for a teacher; Sources and identification of teaching skills; Social skills for a teacher.
Module III: Micro teaching as an approach
Concept of Micro teaching; Need of micro teaching; Steps of micro teaching; Preparation of micro teaching lesson plan; Teaching practice for teaching skills through micro teaching lesson plans.

Suggested Readings

Mapping of COURSE OUTCOMES

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EDHW6013: EDUCATION FOR HEALTH AND WELLNESS
Credits: 2
Total Marks: 50 - Internal: 40 % (20 Marks) Total Hours: 30 External: 60% (30 Marks)

Course objectives
After completing the course, students will be able;
1. To acquire the knowledge, about health and physical education
2. To acquire the knowledge about health and safety education
3. To understand the nature of injuries and providing first aid
4. To develop the skills for organizing games and sports in educational institution.
5. To acquire the knowledge about yoga

Module-I: Concept of Health Education
a. Meaning, Definition, objectives of health education
c. Food and Nutrition: Meaning, classification, constituents of food, vitamins and their deficiency, Balanced Diets, Diets for obesity and under Weight

Module-II Introduction to Physical & Yoga Education & Wellness Studies
a. Meaning, Definition, Objectives and scope of Physical education
b. Physical fitness: Meaning, definition, components, and benefits
c. Games and sports
d. First Aid: Road Accident, water accident, fire accident
e. Yoga Education: Meaning, Definition and uses of yoga for focussed mind.
f. Selected Asanas and Pranayama: Physical exercises
g. Dimensions of Wellness & Mindfulness.

Practicum:
a. Preparation of first aid kit
b. Health awareness programme
c. Demonstration of Asanas and Pranayama
d. Organizing games
e. Writing about the eminent performers in games and sports

Suggested Readings:
SCHOOL OF HUMANITIES AND SOCIAL SCIENCES
DEPARTMENT OF ENGLISH

VISION
To be a centre of excellence in learning, teaching and research in the areas of language and literature by imparting personalized education, inculcating human values and thereby contributing to nation building.

MISSION
● To develop critical thinking, creative writing and interpretive ability
● To foster professionalism to face the competitive world by developing language and communicative skills and by maintaining creative literary activity
● To generate sensitivity to culture and ethical issues
● To develop human potential to its fullest by mentoring and upholding human and spiritual values
● To prepare individual to become responsible citizens of tomorrow

PROGRAMME OUTCOMES –BA ENGLISH
PO1 Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organisational and personal) from different perspectives.
PO2 Effective communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language and make meaning of the world by connecting people, ideas, books, media and technology.
PO3 Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in a group setting.
PO4 Effective Citizenship: Demonstrate empathetic social concerns and equity centre, national development and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO5 Ethics: Recognize different value systems including your own, understand the moral dimensions of your actions and accept responsibility for them.
PO6 Environment and Sustainability: Understand the issues of environmental context and sustainable development.
PO7 Self-directed and life-long learning: Acquire the ability to engage in independent and life lessons to find proper channels for utilizing their potential in terms of their future academic work, and also to further their aspirations in their respective careers.

PROGRAMME SPECIFIC OUTCOMES
PSO1: To familiarize the students with the different genres of English literature and understand the various literary techniques employed in the prescribed texts.
PSO2: To develop a critical aptitude in the analysis of the literary texts and apply relevant literary theories and approaches in the study of the texts.
PSO3: To understand the means of effective communication and enhance the creative use of language.
PSO4: To develop the technical skills and ethical decisions appropriate for the holistic professional development in terms of new entrepreneurial ideas in related fields.
PSO5: To create avenues for sharing the results of academic and disciplinary learning through the preparation and publication of research materials.

LIST OF COURSES
1.5 British Poetry and Drama: 14th to 17th Centuries
1.6 British Poetry and Drama 17th and 18th Centuries
1.7 English Communication/MIL
1.8 Academic Writing and Composition
2.1 British Literature: 18th Centuries
2.2 British Romantic Literature
2.3 Environmental Studies
2.4 Contemporary India: Women and Empowerment
3.1 British Literature- 19th Century
3.2 British Literature: The Early 20th century
3.3 European Classical Literature
3.4 Creative Writing
3.5 Soft Skills
3.6 Language and Linguistics
4.1 Indian Classical Literature
4.2 American Literature
4.3 Modern European Drama  
4.4 English Language Teaching  
4.5 Translation Studies  
4.6 Language, Literature and Culture  
5.1 Post-Colonial Literature  
5.2 Indian Writing in English  
5.3 Literary Criticism  
5.4 British Literature: Post World War II  
5.5 Literature of Indian Diaspora  
5.6 Science Fiction and Detective Literature  
6.1 Popular Literature  
6.2 Women's writings  
6.3 Literary Theory  
6.4 Travel Writing  
6.5 Partition Literature  
6.6 Autobiography  

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**PROGRAMME OUTCOMES- MA ENGLISH**

**PO1:** Critical Thinking: Apply theoretical knowledge to make a critical analysis, intervene using innovative frameworks and evaluate and follow up.

**PO2:** Effective Communication: Engage in inter and intra personal communications, behavioural change communication and proficiency in information Communication Technology.

**PO3:** Scientific Temper: To build essential skills of life including questioning, observing, testing, hypothesizing, analysing and communicating.
PO4: **Effective Citizenship:** Demonstrate empathetic social concern and engage in service learning and community engagement programmes for contributing towards achieving local, regional and national goals.

PO5: **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions and accept responsibility for them.

PO6: **Environment and Sustainability:** Participate and promote sustainable development goals.

PO7: **Gender Sensitization and Social Commitment:** To imbibe Gender sensitivity and the sense of social responsibility for self and community for the benefit of the society at large.

PO8: **Self-directed and Life-long learning:** Engage in continuous learning for professional growth and development.

**PROGRAMME SPECIFIC OUTCOMES**

PSO1: To familiarize with the writers of English literature across different ages and continents, their theories, perspectives, models and methods.

PSO2: To be able to demonstrate competence in analysis and critically analyse scholarly work in the areas of English language teaching, literary research and translation.

PSO3: To enhance literary and critical thinking.

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DETAILED SYLLABUS – BA ENGLISH

EGBP0101: BRITISH POETRY AND DRAMA: 14 TO 17 CENTURY (5-1-0) (CREDITS: THEORY- 5, TUTORIAL-1)

Course Outcomes
1. Define and identify the role of various genres, themes and style pertaining to the prescribed periods of English literature. (Remembering)
2. Critically read and describe the various genres from the concerned periods. (Understanding)
3. Apply historical events and changes in reading of the texts. (Applying)
4. Analyse the socio-political and literary shift in the literature of the age. (Analysing)
5. Evaluate and justify the plot, theme, characters and context of the selected texts. (Evaluating)
6. Design an innovative understanding of the texts based on its social and cultural set up. (Creating)

Module I: Selected Poetry (35 lectures)
Geoffrey Chaucer - "The Wife of Bath’s Prologue" Edmund Spenser - Selections from Amoretti Sonnet LXXV ‘Like as a huntsman…’ / Sonnet LVII ‘Sweet warrior…’
Sonnet LXXV ‘One day I wrote her name…’ John Donne - “The Sunne Rising” “Batter MyHeart” “Valediction: forbidding mourning”

Module II: Selected Drama (40 lectures)
Christopher Marlowe - Doctor Faustus William Shakespeare - Macbeth
William Shakespeare - Twelfth Night

Suggested Readings

Mapping of COs to Syllabus

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EGBL0102: BRITISH LITERATURE: 18TH CENTURY (5-1-0) (CREDITS: THEORY- 5, TUTORIAL-1)

Course Outcomes
1. Describe the historical and literary contexts of the eighteenth century along with the writers. (Remembering)
2. Differentiate the eighteenth century from the rest of literary periods of England. (Understanding)
3. Apply the understanding of the historical contexts in reading the literary texts. (Applying) Illustrate the literary texts as representative of the historical events. (Analysing)
4. Summarize the thematic concerns of the given literary texts. (Evaluating)
5. Develop a pertinent interpretation of the given literary texts. (Creating)

Module I: Selected Drama (15 lectures)
William Congreve - The Way of the World

Module II: Selected Fiction (35 lectures)
Jonathan Swift- Gulliver’s Travels (Books III and IV)
Laurence Sterne - The Life and Opinions of Tristram Shandy, Gentleman

Module III: Selected Poetry (25 lectures)

Suggested Readings

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   ---. “Chapter 10.”, Rassela, OUP, 1819, pp. 38-42.

Mapping of COs to Syllabus

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EGPD0103: BRITISH POETRY AND DRAMA: 17 AND 18 CENTURIES (5-1-0) (CREDITS: THEORY-5, TUTROIAL-1)

Course Outcomes
1. Identify the representative literary trends of the ages. (Remembering)
2. Critically read and interpret the literary genres of the period. (Understanding)
3. Apply the technique of mock heroism in reading a few texts. (Applying)
4. Analyze the social and political scenario pertaining to the Puritan to Neoclassical period. (Analysing)
5. Assess and evaluate the plot, theme, characters and context of the selected drama. (Evaluating)
6. Formulate an innovative theoretical reading of the text. (Creating)

Module I: Selected Poetry (35 lectures)
John Milton- “Paradise Lost”: Book1
Alexander Pope- “The Rape of the Lock” (Canto 1 & 2)

Module II: Selected Plays (40 lectures)
John Webster- The Duchess of Malfi Aphra Behn- The Rover

Suggested Readings
4. The Gospel according to St. Luke. chaps. 1–7and 22–4 The Holy Bible, Genesis, chaps.1–4

Mapping of COs to Syllabus

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EGLE0104: BRITISH LITERATURE: 19TH CENTURY (5-1-0) (CREDITS: THEORY-5, TUTORIAL-1)

Course Outcomes
1. Describe the historical context and literary figures of the nineteenth century. (Remembering)
2. Understand the difference of the nineteenth century from the rest of the literary periods. (Understanding)
3. Examine the historical matters of the nineteenth century in the literary texts. (Applying)
4. Critically analyse the representation of the historical events in the given literary texts. (Analysing)
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5. Evaluate the plot, themes, characterisation, narrative techniques and rhetoric of the given literary texts. (Evaluating)
6. Build relevant arguments regarding the thematic concerns and literary techniques of the literary texts. (Creating)

Module I: Selected Fiction (40 lectures)
Jane Austen - *Pride and Prejudice*
Charlotte Bronte - *Jane Eyre*
Charles Dickens – *Hard Times*

Module II: Selected Poetry (35 lectures)
Christina Rossetti: “The Goblin Market”
Alfred Tennyson: “The Lady of Shalott”, “Ulysses”, “The Defence of Lucknow”

Suggested Readings

Mapping of COs to Syllabus

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EGWC0105: ACADEMIC WRITING AND COMPOSITION (5-1-0) (CREDITS: THEORY 5, TUTORIAL-1)

Course Outcomes
1. Define and identify the role of academic writing and its component (Remembering)
2. Discuss the significance of critical thinking.(Understanding)
3. Examine the ways of summarizing and paraphrasing a text. (Applying)
4. Categorize the components of the argument and writing process. (Analysing)
5. Summarize a piece of writing with literary significance. (Evaluating)
6. Formulate literary piece with the help of the skills acquired. (Creating)

Module I: Introduction to writing (15 lectures)
Introduction to the Writing Process
Introduction to the Conventions of Academic Writing

Module II: General Principles of Summarizing (15 lectures)
Writing in one’s own words: Summarizing and Paraphrasing

Module III: Development of Critical Thinking (20 lectures)
Critical Thinking: Synthesis, Analyses, and Evaluation

Module IV: Development of Argument, Citation and Reviewing (25 lectures)
Structuring an Argument: Introduction, Interjection, and Conclusion Citing Resources; Editing, Book and Media Review

Suggested Readings

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Mapping of COs to Syllabus

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EGEC0107: ENGLISH COMMUNICATION (2-0-0) (CREDITS: THEORY- 02)

Course Outcomes
1. Define the theories of Communication, its types and modes. (Remembering)
2. Explain various dimensions of communication skills. (Understanding)
3. Use the correct and suitable art of communication in today’s world of complexities, multiplicities and competition. (Applying)
4. Analyse the difference in personal and professional interactions. (Analysis)
5. Evaluate different documents and reports, prepared or presented. (Evaluating)
6. Summarize various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments. (Creating)

Module I: Introduction (6 lectures)
Theory of Communication, Types and modes of Communication

Module II: Language of Communication (6 lectures)
Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies, Intra-personal, Inter-personal and Group communication

Module III: Speaking Skills (6 lectures)
Monologue, Dialogue, Group Discussion Effective Communication/ Mis- Communication, Interview, Public Speech

Module IV: Reading and Understanding (6 lectures)
Close Reading, Comprehension, Summary, Paraphrasing, Analysis and Interpretation Translation (from Indian language to English and vice-versa) Literary/ Knowledge Texts

Module V: Writing Skills
Documenting, Report Writing, Making notes, Letter writing

Suggested Readings

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EGWE0113: CONTEMPORARY INDIA: WOMEN AND EMPOWERMENT (5-1-0) (CREDITS: THEORY-5, TUTORIAL- 1)

Course Outcomes:
1. Trace the developmental history of Women Empowerment in India vis-à-vis significant socio-political events (Remembering)
2. Develop an understanding of the space accorded to women in India through history (Understanding)
3. Apply relevant literary theories and approaches to the study of texts under scrutiny (Application)
4. Analyse the manner in which the social construction of gender comes about (Analysing)
5. Critique the given and stereotypical notions of gender constructions (Evaluation)
6. Summarize and offer a critique of the evolution of Women's Empowerment both in terms of policy and discourse. (Creating)

Module I: Social Construction of Gender (15 lectures)
Masculinity and Femininity, Patriarchy, Women in Community

Module II: History of Women's Movements in India (Pre & Post Independence) (15 lectures)
Women and Nation Women and the Partition
Women and Political Participation Women in the Public and Private Spaces

Module III: Women and Law (15 lectures)
Women and the Indian Constitution, Personal Laws (Customary practices on inheritance and Marriage) Workshop on legal awareness

Module IV: Women's Body and the Environment (15 lectures)
State interventions, Khap Panchayats, Female foeticide, Domestic violence, Sexual harassment Eco-feminism and the Chipko Movement

Module V: Female Voices (15 lectures)
Kamala Das, “The Old Playhouse” Mahashweta Devi, Mother of 1084 Krishna Sobti, Zindaginama

Suggested Reading:

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EGBR0114: BRITISH ROMANTIC LITERATURE (5-1-0) (CREDITS: THEORY-5, TUTORIAL- 1)

Course Outcomes
1. Identify the essence of Romanticism in the selected texts. (Remembering)
2. Describe the recurrent themes pertaining to Romantic age as reflected in the texts prescribed. (Understanding)
3. Examine the Romantic concepts like Imagination, Fancy and Nature with reference to the prescribed texts. (Applying)
4. Analyze the plot, theme and characters as explored in the prescribed novel. (Analyzing)
5. Evaluate the text from a socio-political context of the Romantic Period. (Evaluating)
6. Build a critical reading of the selected texts from a Romantic perspective. (Creating)

Module I: Selected Poetry (50 lectures)
Robert Burns ‘A Bard’s Epitaph’, ‘Scots Wha Hae’
Lord George Gordon: Noel Byron ‘Child Harold’: canto III, verses 36–45 (lines 316–405); canto IV, verses 178–86 (lines 1594–674)
Percy Bysshe Shelley ‘Ode to the West Wind’ ‘Ozymandias’ ‘Hymn to Intellectual Beauty’ John Keats ‘Ode to a Nightingale’ ‘To Autumn’, ‘On First Looking into Chapman’s Homer’

Module II: Selected Novel (25 lectures)
Mary Shelley’s Frankenstein
Suggested Readings

Mapping of COs to Syllabus

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EGEC0115: BRITISH LITERATURE: THE EARLY 20TH CENTURY (5-1-0) (CREDITS: THEORY-5, TUTORIAL-1)

Course Outcomes
1. Recognize the impact of urbanization, industrialization, late capitalism and competitive imperialism through their representation in British literature. (Remembering)
2. Understand the concepts like Colonialism, Modernism and Psychoanalysis from their reading of the prescribed texts. (Understanding)
3. Apply a philosophical outlook to engage creatively and conscientiously with social issues arising in a multicultural context. (Applying)
4. Analyze the various genres of literature, such as poetry and novel vis-à-vis the context of modernism (Analyzing)
5. Assess and compare the thematic concerns in the works of the modern writers (Evaluate)
6. Summarize and critically appreciate the poems prescribed in the course (Creating)

Module I: Novels (39 lectures)
Heart of Darkness: Joseph Conrad
Sons and Lovers: D.H. Lawrence
Mrs. Dalloway: Virginia Woolf

Module II: Poetry (36 lectures)

Suggested Readings

Mapping of COs to Syllabus

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EGCL0116: EUROPEAN CLASSICAL LITERATURE (5-1-0) (CREDITS: THEORY-5, TUTORIAL-1)

Course Outcomes
1. Define the concepts of epic, tragedy, comedy, satire, catharsis etc. (Remembering)
2. Understand the significance and importance of Western Classical Literature (Understanding)
3. Apply the knowledge and understanding of Western mythology in the study of literary texts (Application)
4. Illustrate the recurrent themes and motifs of the texts under study (Analyzing)
5. Examine the plot, theme and characters of the prescribed texts (Evaluation)
6. Create a comparative study of the selected texts focusing on the commonalities and dissimilarities (Creating)

**Module I: Selected Greek texts (35 lectures)**

**Module II: Selected Roman texts (40 lectures)**

**Suggested Readings:**

**Mapping of COs to Syllabus**

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**EGCW0117: CREATIVE WRITING (2-0-0) (CREDITS: THEORY-02)**

**Course Outcomes**
1. Define the different creative techniques adopted by different writers in their work. (Remembering)
2. Interpret the emerging techniques of creativity inherent in different branches of literature- poetry, fiction, essays and Drama. (Understanding)
3. Apply different tropes and figures of speech to enhance creativity in literary and non-literary texts. (Applying)
4. Examine the most significant topics like creativity in Drama, novels, poems, speeches, writing for radio, television as well as psychological testing of creativity. (Analyzing)
5. Evaluate different literary and non-literary texts with reference to different seminal texts as well as existing paradigms of creativity tests. (Evaluating)
6. Elaborate and develop literary and non-literary texts as well as performances by adopting different skills and techniques of creative writing. (Creating)

**Module I: Introduction to Creative Writing (6 lectures)**
Introduction; Objectives of Creative writing; History of Creative Writing as an academic pursuit, Different types of Creative Writing; Scope and Area of Creative Writing

**Module II: The Art and craft of writing (6 lectures)**
Origin of Thought and Birth of an Idea: Inspiration, Imagination and Creativity, Incubation, Implementation and Interpretation; Strategies of a Writer

**Module III: Modes of Creative Writing (6 lectures)**
Mechanics of Writing: Cohesion, Coherence, Style, Context, Register, Content; Aesthetic function of Writing; Rules for good writing; Things that must be avoided by a Writer; Literal and Figurative Use of Language; Active and Passive style of writing; Direct and Indirect Speech Styles; Personal and impersonal styles of writing; Formal and informal use of language

**Module IV: Writing for Media (6 lectures)**
Writing a film / book review; Narrative or discursive essay / article; Personal and business letters; Writing a Business proposal; Report writing; Poetry writing; Short story writing; Dramatic dialogue writing; Designing a Website; Writing for the New Media; Poster writing; Advertisement; CV writing; Newspaper article and editorial; Emails and Blogs; Writing for Radio and Television

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Module V: Preparing for publication (6 lectures)
Cover Letter Writing, Understanding Editorial Preferences and Submission Guidelines

Suggested Reading:

Mapping of COs to Syllabus

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EGSS0118: SOFT SKILLS (2-0-0) (CREDITS: THEORY- 02)

Course Outcomes
1. Define soft-skills. (Remembering)
2. Explain the importance of soft-skills in personal and professional life. (Understanding)
3. Apply soft-skills at a work-place. (Applying)
4. Analyze the different aspects of soft-skills. (Analyzing)
5. Assess the do’s and don’ts of grooming and etiquette. (Evaluating)
6. Integrate the ideas pertaining to teamwork, leadership and adaptability to help in personality building. (Creating)

Module I: Soft Skills Part I (15 lectures)
Teamwork; Emotional Intelligence

Module II: Soft Skills Part II (15 lectures)
Adaptability; Leadership; Problem solving

Note: Hands on training session to be conducted on “Leadership and Problem Solving” (from Module 2) through Workshop.

Suggested Readings

Mapping of COs to Syllabus

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EGLLL0119: LANGUAGE AND LINGUISTICS (5-1-0) (CREDITS: THEORY-5, TUTORIAL- 1)

Course Outcomes
1. Define the historical development of languages, language varieties and language change. (Remembering)
2. Explain the theoretical foundations of language. (Understanding)
3. Determine the morpho-phonemic properties of human speech sounds. (Applying)
4. Classify the phonemic inventory of the English Language and categorize the human speech sounds. (Analyzing)
5. Assess the word relations pertaining to different languages. (Evaluating)
6. Create language models to identify linguistic structures by integrating the morpho-syntactic properties of different
Module I: Language (18 lectures)
Language and communication; language varieties: standard and non-standard language; language change.

Module II: Theoretical Foundations (18 lectures)
Swiss Structuralism, American Structuralism- Its course and development.

Module III: Phonology and Morphology (19 lectures)
Basic concepts: phoneme, allophone, morpheme, allophone, inflectional and derivational morphology, compounding and word formation patterns.

Module IV: Syntax and semantics (20 lectures)
Categories and constituents of phrase structure, IC Analysis; Word relations: synonyms, antonyms, homonyms, metonymy; Interpretations of meanings: denotation, connotation, entailment and presupposition; Maxims of conversation and Speech acts.

Suggested Readings

Mapping of COs to Syllabus

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EGIC0120: INDIAN CLASSICAL LITERATURE (5-1-0) (CREDITS: THEORY-5, TUTORIAL- 1)

Course Outcomes
1. Define the significance of Indian Classical Literature. (Remembering)
2. Summarize the plot of the prescribed texts. (Understanding)
3. Examine the dramatic techniques employed in the prescribed plays. (Applying)
4. Analyze the recurrent themes adopted by classical Indian writers. (Analyzing)
5. Evaluate the role of characters, plots and themes as portrayed in the prescribed texts. (Evaluate)
6. Formulate a critical understanding based on the reading of the prescribed texts. (Creating)

Module I: Selected text of Kalidasa and Vyasa (40 lectures)

Module II: Selected text of Sudraka and Ilango Adigal (35 lectures)

Suggested Readings

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Mapping of COs to Syllabus

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**EGAM0121: AMERICAN LITERATURE (5-1-0) (CREDITS: THEORY-5, TUTORIAL- 1)**

**Course Outcomes**
1. Identify the American context in the prescribed texts. (Remembering)
2. Discuss the pertinent themes pertaining to the American socio-political conditions. (Understanding)
3. Illustrate concepts like American Dream, Social Realism and Transcendentalism in relation to the prescribed texts. (Applying)
4. Analyze the role of characters, plots and settings as depicted in the texts prescribed. (Analyzing)
5. Evaluate the role of various genres like novel, poem and drama with reference to the American context. (Evaluate)
6. Generate critical interpretations of the various texts included in the course. (Creating)

**Module I: Selected Texts (50 lectures)**
Tennessee Williams: *The Glass Menagerie* Toni Morrison: *Beloved*
Edgar Allan Poe ‘The Purloined Letter’
F. Scott Fitzgerald ‘The Crack-up’ William Faulkner ‘Dry September’

**Module II: Selected poetry (25 lectures)**
Anne Bradstreet ‘The Prologue’
Walt Whitman Selections from *Leaves of Grass*: ‘O Captain, My Captain’, ‘Passage to India’ (lines 1–68) Alexie Sherman Alexie ‘Crow Testament’ ‘Evolution’

**Suggested Readings**

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**EGME0122: MODERN EUROPEAN DRAMA (5-1-0) (Credits: Theory-5, Tutorial- 1)**

**Course Outcomes**
1. Define the various dramatic movements emerging during the modern era in Europe. (Remembering)
2. Interpret the texts in relation to the dramatic techniques adopted. (Understanding)
3. Examine the role of the stage, performance and setting used in the play. (Applying)
4. Analyze the socio-political contexts surrounding the text. (Analyzing)
5. Assess the development of drama from Realism and Epic Theatre till the Theatre of the Absurd. (Evaluating)
6. Build a critical perspective of the various texts prescribed in the syllabus. (Creating)

**Module I: Selected plays on Realism and Epic theatre (40 lectures)**
Henrik Ibsen: *Ghosts*
Bertolt Brecht: *The Good Woman of Szechuan*

**Module II: Selected play on Theatre of Absurd (35 lectures)**
Samuel Beckett: *Waiting for Godot*
Eugene Ionesco: *Rhinoceros*

**Suggested Readings**

**Mapping of COs to Syllabus**

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**EGLT0123: ENGLISH LANGUAGE TEACHING (2-0-0) (CREDITS: THEORY 02)**

**Course Outcomes**
1. Define the fundamental concepts of English Language Teaching. (Remembering)
2. Describe the theoretical aspects of English Language Teaching. (Understanding)
3. Apply different language assessment skills to test the competence and performance of ELT learners. (Applying)
4. Analyze the issues related to language acquisition. (Analyzing)
5. Compare and evaluate the feasibility of the methodologies applied for the language teaching. (Evaluating)
6. Design syllabi for English language teaching and formulate lesson plans to execute the course objectives of the syllabi prepared. (Creating)

**Module I: Fundamental concepts ELT and Structures of English language: (7 lectures)**

**Module II: Methods of Teaching English Language and Literature: (8 lectures)**

**Module III: Assessing Language Skills: (7 lectures)**
Reading assessments, pedagogical competence, testing and evaluation.

**Module IV: Materials and methods for Language Teaching: (8 lectures)**
Design Syllabi for ELT, Formulate lesson plan, Teaching English for academic and business purpose, Use of Technology in Language Teaching, Developing study materials.

**Suggested Readings**
### Mapping of COs to Syllabus

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### EGTS0124: TRANSLATION STUDIES (2-0-0) (CREDIT: THEORY-02)

#### Course Outcomes
1. Define history, theories and methodologies of Translation Studies (Remembering)
2. Understand the significance and importance of translation in a multilingual and multicultural society like India (Understanding)
3. Apply different modes and types of translation such as literal, literary, communicative, audio-visual translation (Applying)
4. Examine critically the basic concepts and terms used in translation studies vis-à-vis their use in the practice of translation (Analyzing)
5. Evaluate the process of translation through the examination of standard translated literary and non-literary texts (Evaluating)
6. Create and offer a Critique of works in translation (Creating)

#### Module I: Introduction to Translation (6 lectures)
Introducing Translation: a brief history and significance of translation in a multi-linguistic and multicultural society like India.

#### Module II: Types/modes in Translation (6 lectures)

#### Module III: Basic Concepts and Terms used in Translation Studies (8 lectures)
a. Introducing basic concepts and terms used in Translation Studies through relevant tasks, for example: Equivalence, Language variety, Dialect, Idiolect, Register, Style, Mode, Codemixing/ Switching.

#### Module IV: The Process of Translation (10 lectures)
Defining the process of translation (analysis, transference, restructuring) through critical examination of standard translated literary/non-literary texts and critiquing subtitles of English and Hindi films.
Practice: Translation in Mass Communication/Advertising, subtitling, dubbing, Exercises to comprehend ‘Equivalence in translation’: Structures (equivalence between the source language and target language at the lexical (word) and syntactical (sentence) levels. This will be done through tasks of retranslation and recreation, and making comparative study of cultures and languages.
Practice: Tasks of Translation in Business: Advertising Discussions on issues of ‘Translation and Gender’ by attempting translation for media, films and advertisements from different languages.
Developing skills for Interpreting: understanding its dynamics and challenges. Interpreting: Simultaneous and Consecutive (practical application)

#### Suggested Readings:

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EGLA0125: LANGUAGE, LITERATURE AND CULTURE (5-1-0) (CREDITS: THEORY-5, TUTORIAL- 1)

Course Outcomes
1. Define basic concepts of language, literature and culture (Remembering)
2. Understand the intrinsic relationship between language, literature and culture (Understanding)
3. Illustrate the structure and function of language and its literary and cultural significance (Application)
4. Analyze the recurrent themes and forms of Indian literature through ages (Analyzing)
5. Compare the cultural cross-currents through ages in Indian literature in particular and society in general (Evaluation)
6. Develop a holistic approach towards literature and its critical interpretation through the lenses of language and culture (Creating)

Module I: Language (30 lectures)
- Language and Communication, What is Language, the Definition of Language, the Characteristics of Human language, Why Does Language Matter?
- How Language Function: Speaker – Listener –Message; Phonology Morphology Syntax and Semantics (only terms and definitions will be asked) Phonemes, phonetic transcription and phonology; Morphemes: free and bound morphemes Simple complex compound words Inflectional/derivational morphology; the process of word formation; Basic notions of syntactic constituents and phrase structure Clauses and sentences
- Language and Society; Language and Class; Language and Gender; Language and Ethnicity; Language and Identity; Language Variation; Dialect Idiolect Slang Pidgin Creole Jargon Standard and Non-Standard Language Bilingualism; Multilingualism; Code-mixing, Code-switching

Module II: Indian Literature (30 lectures)
This section of the course will involve a study of significant themes and forms of Indian literature through the ages, with the help of prescribed texts.
Prescribed text: Indian Literature: An Introduction (Delhi: University of Delhi, 2005). Different Phases of Indian literatures: Ancient, Medieval, and Modern
Chapter 1: Veda Vyasa, The Mahabharata: The Ekalavya Episode
Chapter 2: Sudraka, Mrichchhakatika: The Making of a Breach
Chapter 3: Ilanko Atikal, Cilappatikaram: The Book of Mathurai
Chapter 4: Mirabai, ‘I Know Only Krisna’
Chapter 5: Amir Abul Hasan Khusrav, ‘Separation’
Chapter 6: Asadullah Khan Ghalib, ‘Desires Come by the Thousands’
Chapter 7: Faiz Ahmad Faiz, ‘Do Not Ask’
Chapter 8: Subramania Bharati, ‘The Palla Song’
Chapter 9: Rabindranath Tagore, ‘The Cabiuliwallah’
Chapter 10: Shiril Shukla, ‘Raag Darbari’
Chapter 11: Ismat Chughtai, ‘Touch-Me-Not’
Chapter 12: Amrita Pritam, ‘To Waris Shah’
Chapter 13: Masti Venkateshalyengar, ‘Venkatashami’s Love Affair’
Chapter 14: Indira Goswami, ‘The Journey’
Chapter 15: Omprakash Valmiki, ‘Joothan’
Chapter 16: Shrikanth Mahapatra, Folk Songs

Module III: Culture and Society in Contemporary India (15 lectures)

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Suggested Readings

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EGPL0126: POST-COLONIAL LITERATURES (5-1-0) (CREDITS: THEORY-06)

Course Outcomes
1. Relate the various critical elements in adherence to the Post-colonial literature. (Remembering)
2. Distinguish the Historical context of the Post-colonial literature and the use of racist and colonial undertones in the texts under study. (Understanding)
3. Classify the texts on the basis of the Historical background, socio-political conditions of the respective time period and establish a connectedness across the commonalities of the theme and structure of the texts under study. (Application)
4. Analyse the various postcolonial theories and literary concepts from texts written in corresponding time frames and by authors coming from varied socio-linguistic milieu. (Analysing)
5. Examine and evaluate the significance of the Post-colonial literature from the historical, socio-political and literary perspective and its evolution within a relevant theoretical framework along with the writer’s psyche and contribution towards it. (Evaluating)
6. Discuss, summarise and critically appreciate the literary and the thematic aspects of the texts under study. (Creating)

Module I: Selected Novels (35 lectures)
Chinua Achebe Things Fall Apart
Gabriel Garcia Marquez Chronicle of a Death Foretold

Module II: Selected Short Fiction/ Short Stories (20 lectures)
Bessie Head ‘The Collector of Treasures’
Ama Ata Aidoo ‘The Girl who can’
Grace Ogot ‘The Green Leaves’

Module III: Selected Poetry (20 lectures)
Pablo Neruda ‘Tonight I can Write’, ‘The Way Spain Was’
Derek Walcott ‘A Far Cry from Africa’, ‘Names’
David Malouf ‘Revolving Days’, ‘Wild Lemons’
Mamang Dai ‘Small Towns and the River’, ‘The Voice of the Mountain’

Suggested Readings
EGIE0127: INDIAN WRITING IN ENGLISH (5-1-0) (CREDITS: THEORY-06)

Course Outcomes
1. Define the literature produced in India in English (Remembering)
2. Explain and comment on the poems and fictional works produced in India in their various socio-cultural context (Understanding)
3. Classify and apply different critical theories involved in the production of the selected indigenous texts (Applying)
4. Analyse the style and writing techniques of the Indian writers writing in English through critical reading of their works (Analysing)
5. Evaluate the contribution of the Indian writers in English to the development of Indian English literature and their treatment and representation of the Indian ethos in a global forum (Evaluating)
6. Summarise and critically appreciate the literary works and find out the commonalities in terms of themes and issues (Creating)

Module I: Selected novels (25 lectures)
R. K. Narayan Swami and Friends
Anita Desai In Custody

Module II: Selected Poetry (25 lectures)
Robin S. Ngangom The Strange Affair of Robin S. Ngangom’, ‘APoem for Mother’

Module III: Selected Short Fiction (25 lectures)
Urvashi Butalia ‘The Other Side of Silence’

Suggested Readings

Mapping of COs to Syllabus

EGLM0128: LITERARY CRITICISM (5-1-0) (CREDITS: THEORY-06)

Course Outcomes
1. Define key critical terms and concepts. (Remembering)
2. Distinguish between the various ideas of western literary criticism from the time of Aristotle to the Modern Period. (Understanding)
3. Find out the implications of the key ideas on the prose, poetry, drama and fiction in literature (Applying)
4. Analyse a representative critical text in literature. (Analysing)
5. Assess the works of the significant literary thinkers in the history of English literature. (Evaluating)
6. Discuss and summarise the key concepts of the various critical text. (Creating)

Module I: Literary Criticism: Romantic Period (25 lectures)
William Wordsworth: Preface to the Lyrical Ballads (1802)
S. T. Coleridge: Biographia Literaria. Chapters IV, XIII and XIV

Module II: Literary Criticism: Early Twentieth Century (25 lectures)

Module III: Literary Criticism: Late Twentieth Century (25 lectures)

Suggested Readings

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EGLD0129: LITERATURE OF THE INDIAN DIASPORA (5-1-0) (CREDITS: THEORY-06)

Course Outcomes
1. Define the various attributes of the Indian diaspora and the ‘ambivalence’ of their attitudes towards their own motherland as well as their adopted homeland. (Remembering)
2. Demonstrate the quest for cultural identity on the part of the citizens of Indian diaspora and would be able to understand the psychological, social and political problems associated with diaspora culture. (Understanding)
3. Apply the themes of these texts to further explore the conscientiousness of the relationship between the ‘homeland’ and the ‘diaspora’. (Applying)
4. Discover our own country from a different prism through the eyes of writers who have lived in a composite culture. (Analysing)
5. Assess and evaluate the selected texts vis-a-vis their context and socio political and cultural background. (Evaluating)
6. Discuss, summarise and critically appreciate the selected poems and other literary texts. (Creating)

Module I: Selected Fiction Part I (35 lectures)
M. G. Vassanji- The Book of Secrets
Rohinton Mistry- A Fine Balance

Module II: Selected Fiction Part II (40 lectures)
Meera Syal- “Anita and Me” Jhumpa Lahiri- The Lowland
Meena Alexander- Manhattan Music

Suggested Reading

### Mapping of COs to Syllabus

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### EGPW130: BRITISH LITERATURE: POST WORLD WAR II (5-1-0) (CREDITS: THEORY-06)

#### Course Outcomes
1. Locate significant historical events during and after World War II (Remembering)
2. Understand the socio-political and economic context of post World War II British literature (Understanding)
3. Identify socio-historical, political changes in England after World War II (Application)
4. Critically analyze the link changes in social norms to new literary forms (Analysis)
5. Examine the post World War II literary trends in English and the rise of the postmodernist aesthetics (Evaluating)
6. Formulate an understanding of the rise of multiculturalism in England, migration, importance of location vis-à-vis the self and the other (Creating)

#### Module I: Selected Novels (45 lectures)
John Fowles - *The French Lieutenant’s Woman*
Jeanette Winterson - *Sexing the Cherry Hanif Kureishi - My Beautiful Launderette*

#### Module II: Selected Poetry (30 lectures)
Phillip Larkin 'Whitsun Weddings', 'Church Going'Ted Hughes 'Hawk Roosting', 'Crow’s Fall' SeamusHeaney 'Digging', ‘Casualty’ Carol Anne Duffy ‘Text’, ‘Stealing’

#### Suggested Readings

### Mapping of COs to Syllabus

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### EGS0131: SCIENCE FICTION AND DETECTIVE LITERATURE (5-1-0) (Credits: Theory-06)

#### Course Outcomes
1. Define the conventions of the genre (Remembering)
2. Interpret works of science fiction and detective fiction from a variety of contexts (Understanding)
3. Apply critical insight in interpretations of science and detective fiction (Application)
4. Illustrate the relationship between science fiction, detective or crime fiction and mainstream literature (Analysis)
5. Examine the origin and historical development of science fiction (Evaluating)
6. Formulate the connection between science fiction and detective fiction and the impact of changing technology and social systems on people (Creating)

#### Module I: Selected Fiction Part I (35 lectures)
Wilkie Collins - *The Woman in White*
Course Outcomes:

EGPL0132: POPULAR LITERATURE (5-1-0) (CREDITS: THEORY-06)

Course Outcomes:
1. Define popular literature and its distinct characters (Remembering)
2. Critically interpret and understand the elements of popular literature (Understanding)
3. Apply various interpretative frameworks to their reading of selected works of popular literature (Application)
4. Analyse the themes and motifs in the works under study (Analysis)
5. Examine the style and techniques of the writers in creating popular literature (Evaluation)
6. Summarise and offer a comprehensive understanding of the selected works of popular literature (Creating)

Module I: Selected Fiction (60 lectures)
Lewis Carroll - Through the Looking Glass Agatha Christie - The Murder of Roger Ackroyd Shyam Selvadurai - Funny Boy

Module II: Selected Biography (15 lectures)
Durgabai Vyam Subhash Vyam - Bhimayana: Experiences of Untouchability / Autobiographical Notes on Ambedkar (For the Visually Challenged students)

Suggested Readings

Mapping of COs to Syllabus

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GWW0133: WOMEN’S WRITING (5-1-0) (CREDITS: THEORY-06)

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Course Outcomes
1. Define the various thoughts and theories pertaining to feminist writings and feminism. (Remembering)
2. Explain the themes and topics and relate it to real life situations. (Understanding)
3. Develop new ideas by connecting the various topics taught. (Applying)
4. Analyse the various movements related to gender and the progress in gender and literature. (Analysing)
5. Evaluate the interdisciplinary aspect in the various texts. (Evaluating)
6. Discuss and summarise the meanings, ideas and thoughts regarding gender and its connection with literature. (Creating)

Module I: Selected Poetry (25 lectures)
Emily Dickinson ‘I cannot live with you’, ‘I’m wife; I’ve finished that’ Sylvia Plath ‘Daddy’ ‘Lady Lazarus’
Eunice De Souza ‘Advice to Women’, ‘Bequest’

Module II: Selected Fiction and Short Fiction (25 lectures)
Alice Walker The Color Purple
Charlotte Perkins Gilman ‘The Yellow Wallpaper’ Katherine Mansfield ‘Bliss’

Module III: Selected Non-fiction (25 lectures)

Suggested Readings

Mapping of COs to Syllabus

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EGLY0134: LITERARY THEORY (5-1-0) (CREDITS: THEORY- 06)

Course Outcomes
1. Define these modern theories. (Remembering)
2. Explain genesis and growth of the modern critical theories in the context of literary texts. (Understanding)
3. Utilize the contemporary theories in the critical analysis of various literary texts. (Applying)
4. Analyse the theories and generate a new approach of looking at literary texts. (Analysing)
5. Evaluate the texts in terms of their political, social, psychoanalytical, feministic and economic implications. (Evaluating)
6. Develop a more profound critical approach after the study of these theories. (Creating)

Module I: Marxism (18 lectures)

Module II: Feminism (18 lectures)
Elaine Showalter, ‘Twenty Years on: A Literature of Their Own Revisited’, in A Literature of Their Own: British Women Novelists

Module III: Poststructuralism (18 lectures)

Module IV: Postcolonial Studies (21 lectures)

Suggested Readings
2. Peter Barry, Beginning Theory (Manchester: Manchester University Press, 2002).

Mapping of COs to Syllabus

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EGPL0135: PARTITION LITERATURE (5-1-0) (CREDITS: THEORY- 06)

Course Outcomes
1. Define partition literature and its characteristic features (Remembering)
2. Explain the socio-political context of partition and its representation in literature (Understanding)
3. Apply critical insight in the reading and interpretation of various writings on partition (Application)
4. Analyse the concepts of colonialism, nationalism, communalism based on their reading of the texts under study (Analysis)
5. Evaluate complex issues like homelessness and exile vis-à-vis women, children and impact of partition on them through the reading of literature (Evaluation)
6. Develop a critical insight regarding partition and its commonalities, complexities and expression in literature (Creating)

Module I: Selected Novels (30 lectures)

Module II: Selected Short Stories (30 lectures)

Module III: Selected Poetry (15 lectures)

Suggested Readings and Screenings:

Films
*Garam Hawa* (dir. M. S. Sathy, 1974).
*Subarnarekha* (dir. Ritwik Ghatak, 1965)

Mapping of COs to Syllabus

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**EGTW0136: TRAVEL WRITING (5-1-0) (CREDITS: THEORY 06)**

Course Outcomes
1. Define travel writing and its specific characteristics (Remembering)
2. Describe the emergence and development of travel writing as a literary genre (Understanding)
3. Apply theories post-colonialism, orientalism and transculturation in their reading of the selected literary texts
4. Illustrate the commonalities in travel writing with reference to the politics of the perspective of an ‘insider’ and ‘outsider’
5. Assess the thematic concerns of the travel writers across time and space (Evaluation)
6. Create a comprehensive knowledge of the process of creating travel narrative in relation to ethnography, gender, religion and globalization (Creating)

Module I: Selected Writings I (40 lectures)
- Ibn Battuta: ‘The Court of Muhammad bin Tughlq’, Khuswant Singh’s *City Improbable: Writings on Delhi*, Penguin Publisher
- Al Biruni: Chapter LXIII, LXIV, LXV, LXVI, in *India by Al Biruni*, edited by Qeyamuddin Ahmad, National Book Trust of India
- Mark Twain: *The Innocent Abroad* (Chapter VII, VIII and IX), (Wordsworth Classic Edition)

Module II: Selected Writings II (35 lectures)
- Rahul Sankrityayan: *From Volga to Ganga* (Translation by Victor Kierman), (Section I to Section II) Pilgrims Publishing

Suggested Readings

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**EGAU0137: AUTOBIOGRAPHY (5-1-0) (CREDITS: THEORY- 06)**

**Course Outcomes**
1. Define life writing. (Remembering)
2. Illustrate the different types of life writing (Understanding)
3. Apply the narrative techniques while reading a piece of life writing. (Applying)
4. Analyse the life of an author/writer critically. (Analysing)
5. Evaluate a representative biographical text using the literary techniques. (Evaluating)
6. Discuss the different styles of writing a biography. (Creating)

**Module I: Selected Writings I (35 lectures)**

**Module II: Selected Writings II (40 lectures)**
Binodini Dasi’s *My Story and Life as an Actress*, pp. 61-83 (New Delhi: Kali for Women, 1998).

**Suggested Readings:**

**Mapping of COs to the Syllabus**

**DETAILED SYLLABUS - MA ENGLISH**

**EGEP0001: CHAUCER TO ELIZABETHAN PERIOD - POETRY, DRAMA AND ROMANCE (4-0-0) (CREDITS: 04)**

**Course Outcomes:**
1. Define the fundamental concepts of the three genres of Poetry, Drama and Romance from the age of Chaucer to Elizabethan period (Remembering).
2. List the representative writers and their texts of the fourteenth century (Understanding).
3. Experiment the characteristic features and forms of Poetry, Drama and Romance from the age of Chaucer to Elizabethan period (Applying).
4. Categorize the socio-political background and factors that influenced and shaped the literary texts of the period (Analyzing).
5. Evaluate the given text critically in its literary context, use of various literary devices, thematic and symbolic significance.
and the use of Language and style (Evaluating).

6. Estimate the given texts as literary works of the corresponding age (Creating).

Module I: Selected Poetry (25 lectures)
   a. Geoffrey Chaucer’s “Prologue” to The Canterbury Tales
   b. Edmund Spenser’s The Faerie Queene (Book III)
   c. William Shakespeare’s Sonnets No. 18, 29, 34
   d. Philip Sidney’s Astrophel and Stella

Module II: Selected Drama (20 lectures)
   a. Christopher Marlowe’s The Jew of Malta
   b. Ben Jonson’s The Alchemist

Module III: Selected Romance (15 lectures)
   Sir Thomas More’s Utopia

Suggested Readings
1. Texts of Selected Poetry, Drama and Romance.

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EGLS0002: LITERARY AND SOCIAL HISTORY OF ENGLAND - CHAUCER TO ELIZABETHAN PERIOD (3-0-0) (CREDITS: 03)

Course Outcomes:
1. Define the different Periods involved in the Literary and Social History of England from the Medieval to Elizabethan age (Remembering).
2. List the chronological changes that intervened in the history of England during fourteenth and early fifteenth century (Understanding).
3. Use the characteristic features, significant changes, development and modes indicating transition from the Medieval life, The Black Death to the Elizabethan theatre in the reading of the given texts (Applying).
4. Identify the various socio-political factors responsible for these developments and their influences in the shaping of the Literature of the period (Analyzing).
5. Explain the various literary and socio-political influences for the literature production at the various stages from the Medieval age to the coming of Elizabethan theatre (Evaluating).
6. Estimate the contextual background involved in the shaping up of various literary works (Creating).

Module I (15 lectures)
   a. The Church and Medieval Life
   b. Towns and Villages in Medieval England
   c. Feudalism
   d. The English Manorial System and Medieval Agriculture

Module II (15 lectures)
   a. The Black Death and its Aftermath
   b. Medieval English Theatre
   c. Medieval Romance
   d. Fabliau, Lyric, Dream Allegory and Ballad
Module III (15 lectures)
a. Caxton and the Printing Press
b. Renaissance and the Literature: The University Wits, the Elizabethan Prose, the Metaphysical Poetry, etc.
c. Reformation
d. The Elizabethan Theatre

Suggested Readings

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EGSD0003: SHAKESPEAREAN DRAMA I - COMEDY AND HISTORY PLAYS (4-0-0) (CREDITS: 04)

Course Outcomes:
1. Define a Shakespearean Drama as a literary genre (Remembering).
2. Explain the significant stages in the texts of Shakespearean Comedy and a Historical play (Understanding).
3. Identify and differentiate a given text as a work of Shakespearean Comedy or a Historical play (Applying).
4. Analyse the theme, plot and characterization, use of literary devices and settings in a given Shakespearean text as a work of Comedy or History (Analyzing).
5. Evaluate the characteristic features and creative energy of Shakespeare through the study of a Comedy and a Historical play (Evaluating).
6. Compile the content, style and the literary aspects of the given Shakespearean text as a work of Comedy or History (Creating).

Module I: Comedies (25 lectures)
a. Shakespeare’s The Tempest
b. Shakespeare’s A Midsummer Night’s Dream

Module II: History Plays (25 lectures)
a. Shakespeare’s Henry V
b. Shakespeare’s Julius Caesar

Module III : Shakespearean Criticism (10 lectures)

Suggested Readings
1. Texts prescribed in the Course.

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EGRP0004: RHETORIC AND PROSODY (2-0-0) (CREDITS: 02)

Course Outcomes:
1. Recall the different figures of speech based on Comparison (Remembering)
2. Classify the differences between Metonymy and Synecdoche (Understanding)
3. Apply the rules of prosody in scanning a piece of poetry (Applying)
4. Distinguish between Irony and Sarcasm (Analysing)
5. Explain the different figures of speech used in a passage (Evaluating)
6. Discuss the dominant types of meters used in English versification (Creating)

Module I: Introduction to Rhetoric (10 lectures)
Rhetoric; Difference between Grammar and Rhetoric; Relation between Rhetoric and Emotion; Rhetoric and Oratory; Prosody; Difference between Poetry and Prose; Syllable, Foot, Accent, Pitch; Primary and Secondary accent; Rules governing Accent; Rhythm, Rhyme, Metre; Scansion

Module II: Figures of Speech (10 lectures)
Contribution of Figures of Speech to Literary Expression, Classification of Figures of Speech, Figures based on Similarity or Resemblance, Association, Contrast or Difference, Imagination, Indirectness, Sound, Construction; Miscellaneous Figures of Speech

Module III: Prosody: Different kinds of Metre and Poetry (10 lectures)
Types of Metre; Special Metres; Types of Poetry

Suggested Readings:
3. Corbett, Edward P.J. and Connors, Robert J. Classical Rhetoric for the Modern Student. OUP.

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EGTS0005: T.S. ELIOT (3-0-0) (CREDITS: 03)

Course Outcomes:
1. Define Modern poetry as a literary genre and T.S. Eliot as a Modernist poet (Remembering)
2. Outline the style and characteristic features of T.S Eliot poetry (Understanding)
3. Identify the salient features of Modern poetry through the works of T.S.Eliot (Applying)
4. Analyse T.S. Eliot’s works in terms of theme, technique, prosody, approach, focus, vision and influences (Analysing)
5. Evaluate the influences, impact and effectiveness of the works of T.S. Eliot (Evaluating)
6. Discuss and summarize the various literary and poetic aspects of his works against the individual and socio-political propensities (Creating)

Module I: Introduction to T.S. Eliot. (10 lectures)
Module II: Prescribed Texts of T.S. Eliot (35 lectures)

b. *The Murder in the Cathedral*

Suggested Readings:
1. The prescribed texts in the course

Mapping of COs to Syllabus:

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EGTH0006: THOMAS HARDY (3-0-0) (CREDITS: 03)

Course Outcomes:
1. Define English Victorian novel and Thomas Hardy as a Victorian novelist (Remembering)
2. Demonstrate the characteristic features of Thomas Hardy’s fiction (Understanding)
3. Identify the Victorian elements and modernist features in the works of Thomas Hardy (Applying)
4. Analyse critically Hardy’s style through the theme, plot, characterization and settings found in the prescribed texts (Analysing)
5. Evaluate Hardy’s works in terms of the philosophical content, Historical perspective, literary aspect and language and style (Evaluating)
6. Discuss and summarize the thematic content, approach, literary aspects, and socio-political background of the period in Hardy’s fiction (Creating)

Module I: Introduction to Thomas Hardy (10 lectures)

Module II: Prescribed Texts of Thomas Hardy (35 lectures)

a. *Tess of D’Urbervilles*
b. *Far From the Madding Crowd*
c. “The Three Strangers”

Suggested Readings
1. The prescribed texts.

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EGET0007: ENGLISH LANGUAGE TEACHING (3-0-0) (CREDITS: 03)

Course Outcomes:
1. Define the vast body of Language teaching methodologies (Remembering)
2. Demonstrate the different approaches to teaching of English as a second language (Understanding)
3. Apply theoretical assumption as well as practical language teaching skills while dealing with second language learners in the classroom (Applying)
4. Analyse the specific issues such as the First and Second Language acquisition, Mother tongue interference in learning a foreign language, TG Grammar, Psychological and Sociological perspectives in Language learning, Role of technology in language learning (Analysing)
5. Compare and estimate the utility and feasibility of different language teaching methodologies and techniques in different language teaching- learning situations with proper forms of testing (Evaluating)
6. Design as well as adapt on the syllabuses of second language teaching and constructing lesson plans for dealing with language learners of different linguistic backgrounds (Creating)

Module I: Introduction to English Language Teaching (10 lectures)
Introduction, Fundamental concepts of Language Teaching, Historical Perspective of ELT, Language Pedagogy. Elements of the Structure of English Language.

Module II: Methods and Approaches of Teaching English (20 lectures)
Theoretical aspects of Language Acquisition and Learning; Language Skills assessment; Psychological approach to language teaching in a bilingual/ multilingual context; Use of Technology in Language Teaching; Educational Technology; Testing and Evaluation.

Module III: Grammar and Practical Language Skills (10 lectures)
Parts of Speech; Articles and Prepositions; Degrees of Comparison; Direct and Indirect Speech; Sentence patterns; Letter Writing; Report Writing; Reading Comprehension; Listening and Speaking; English Speech Sounds – Vowels and Consonants, Stress and Intonation patterns; Language Games; Vocabulary Expansion; Telephonic Conversation; Teaching English for Academic and Business Purpose.

Module IV: Language through Literature (5 lectures)
Role of Literature in Language Learning; Teaching of Literature; Use of Language Model.

Suggested Readings
1. Ray Mackay, A Basic Introduction to English Language Teaching; Oxford, 2018.

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EGRR0008: RESTORATION TO ROMANTIC PERIOD – POETRY AND DRAMA (4-0-0) (CREDITS: 04)

Course Outcomes:
1. Define various genres of literature, viz. poetry and drama and identify the recurrent themes of the Restoration and Romantic era. (Remembering)
2. Apply the historical onset while reading the texts. (Applying)
3. Analyse the themes and compare as well as contrast the different characters of the selected dramas. (Analysing)
4. Interpret the selected literary works and critically evaluate the plot, theme and character of the dramas and the theme and figures of speech in the poems. (Evaluating)
5. Assess and evaluate the selected dramas and poems vis-à-vis their context and socio-political and cultural background. (Evaluating)
6. Invent a new interpretation of the texts. (Creating)

Module I: Selected Poetry (25 lectures)
Module I: Literary Criticism: Key Ideas and Concepts – Plato to Dryden (10 lectures)

Module II: Literary Criticism and Theory: Key Ideas and Concepts – Johnson to F. R. Leavis and Select Twentieth Century Perspectives (20 lectures)

Module III: Selected Critical Texts (30 lectures)
- Poetics: Aristotle
- Biographia Literaria (Chapter 13): Samuel Taylor Coleridge
- “Tradition and the Individual Talent”: T. S. Eliot

Suggested Readings

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### EGEP0001: CHAUCER TO ELIZABETHAN PERIOD - POETRY, DRAMA AND ROMANCE (4-0-0) (CREDITS: 04)

#### Course Outcomes
1. Define the literary form of drama, especially tragedy and tragi-comedy. (Remembering)
2. Interpret the selected literary works, i.e. the Shakespearean tragedy and tragi-comedy and they are able to explain the plot, theme and character of the dramas. (Understanding)
3. Apply critical reading skills to the two very distinct forms of Shakespeare’s drama. (Applying)
4. Analyse selected texts for a better understanding of the genius of William Shakespeare. (Analysing)
5. Assess and critically appreciate the selected dramas. (Evaluating)
6. Negotiate with the complexity of ideas wined around plot, theme and character of the selected dramas. (Creating)

#### Module I: Tragedy (30 lectures)
- William Shakespeare: *Macbeth*
- William Shakespeare: *King Lear*

#### Module II: Tragi-Comedy (30 lectures)
- William Shakespeare: *The Merchant of Venice*
- William Shakespeare: *The Winter’s Tale*

#### Suggested Readings

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### EGAL0011: APPROACHES TO LANGUAGE AND LITERARY RESEARCH (3-0-0) (CREDITS: 03)

#### Course Outcomes
1. Explain basic concepts of research and its methodologies. (Understanding)
2. Identify research topics and select and define appropriate research problems and parameters. (Remembering)
3. Organize and conduct research in an appropriate manner. (Applying)
4. Analyse literary works from various genres by applying various theories and approaches. (Analysing)
5. Assess and evaluate the various works of literature to write research reports and papers. (Evaluating)
6. Discuss, summarize and critically appreciate the various approaches to language and literary research. (Creating)

#### Module I: Introduction (10 lectures)
Meaning of Research; Objectives of Research; Motivation in Research; Different types of Research Methods; Research Methods
Module II: Hypothesis and Data Collection (10 lectures)
Formulation of Hypothesis; Types of Hypothesis; Methods of Testing Hypothesis; Determining Sample design; Methods of Sampling; Methods of Collection of Data (Primary Data and Secondary Data); Processing and Analysis of Data; Types of Analysis

Module III: Critical Approaches to Literature (15 lectures)
Russian Formalism and New Criticism; Feminism and Gay and Lesbian Studies; Psychoanalysis; Marxism; Archetypal Criticism; Narratology; Race Ethnicity and Postcolonial Studies; Structuralism; Post-structuralism; Deconstruction; Ecocriticism; Cultural Studies.

Module IV: Analysis and Report-Writing (10 lectures)
Testing of Hypothesis; Interpretation; Different techniques of Interpretation; Citation and Bibliography; Writing and Presentation of Report

Suggested Readings
5. MLA Handbook for Writers of Research Papers.

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EGTR0012: CLASSICS IN TRANSLATION (3-0-0) (CREDITS: 03)

Course Outcomes
At the end of this course students will be able to:
1. Define the history, theories, and methodologies in Translation Studies. (Remembering)
2. Illustrate fundamental questions related to translation of the major poets of classical literatures of Roman, Greek and Sanskrit. (Understanding)
3. Apply various theories and methods of translation. (Applying)
4. Examine critically the translated literary texts, critically analyse the themes and the style of literary expression in the selected texts. (Analysing)
5. Evaluate the high intrinsic quality of the classics and their fundamental importance in shaping ancient literary standards and cultural ideals. (Evaluating)
6. Discuss, summarize and critically appreciate the selected classics in translation. (Creating)

Module I: Introduction to Translation Studies (20 lectures)
Introducing Translation; History of Translation Theories; Significance of Translation in a Multi- Linguistic and Multi-Cultural Society/World; Different Types/ Modes of Translation (Semantic, Literal, Literary, Functional, Communicative, Technical); Understanding the dynamics and challenges in Translation.

Module II: Selected Texts (25 lectures)
b. Homer: Odyssey
c. Kalidasa: Abhijnana Shakuntalam

Suggested Reading:

**Mapping of COs to Syllabus**

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**EGIW0013: INDIAN WOMEN WRITERS (3-0-0) (Credits: 03)**

**Course Outcomes**
1. Define the literature by women in India in English. (Remembering)
2. Summarize and critically appreciate the selected literary works and find out the commonalities in terms of themes and issues. (Understanding)
3. Apply feminist theories and feminist reading techniques to critically interpret and assess the selected texts. (Applying)
4. Analyse the contribution of women writers to the Indian English literary tradition. (Analyzing)
5. Judge the essence of women’s literature and appreciate the gamut of women’s lives and concerns as represented in literature. (Evaluating)
6. Construct a critical reading of the poetry, drama, short stories and novels produced by women of India in different historical periods. (Creating)

**Module I: Selected Poets (12 lectures)**
- Toru Dutt: “Sita”
- Sarojini Naidu: “The Gift of India”
- Kamala Das: “The Old Playhouse”

**Module II: Selected Playwrights and Short Story Writers (15 lectures)**
- Manjula Padmanabhan: *Harvest*
- Mahasweta Devi: “Draupadi”

**Module III: Selected Novelists (18 lectures)**
Easterine Kire: *Mari*

**Suggested Readings**

**Mapping of COs to Syllabus**

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**EGNE0014: NORTH-EAST INDIAN LITERATURE IN ENGLISH (3-0-0) (CREDITS: 03)**

**Course Outcomes**
1. Define the vast body of writings in English from Northeast of India. (Remembering)
2. Interpret the emerging trends of literature from northeast of India in its different genres- poetry, fiction and translation (Understanding)
3. Apply theoretical assumption as well as critical reading skills to the study of vibrant areas of Northeast literature. (Applying)
4. Examine the most significant topics like colonialism, identity and unity, cultural loss, ethnic conflicts, universality in the literature of Northeast region before and after British Colonial Period (Analysing)
5. Explain different literary themes and recurrent issues reflected in the vast body of Northeast writings in English. (Evaluating)
6. Elaborate on the existing critical views on Northeast India’s literary texts with reference to the Modern and Postmodern Theories on Literature. (Creating)

Module I: Selected Poetry (15 lectures)
   a. Easterine Kire: “Riddu Riddu” & “Narcissus”
   b. Robin Ngangom: “My Invented Land”
   c. Nongkynrih Mona Zote: “Rez”

Module II: Selected Fiction/Non-Fiction Writers (30 lectures)
   a. Mamang Dai: The Legends of Pensam
   b. Mitra Phukan: The Collector’s Wife

Suggested Readings

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EGVP0015: VICTORIAN TO POST-MODERN PERIOD— POETRY, DRAMA & FICTION (4-0-0) (CREDITS: 04)

Course Outcomes
1. Define the socio-cultural set up of England from Victorian to Post-Modern era. (Remembering)
2. Illustrate the Victorian, Modern and Post-modern elements and themes prominent in the prescribed texts. (Understanding)
3. Develop and apply theoretical interpretations of the prescribed texts. (Applying)
4. Analyse the various prominent genres of the era, background of the texts and the authors. (Analysing)
5. Assess and evaluate the plot, theme, characters and context of the texts under study. (Evaluating)
6. Construct a critical reading based on historic aspects evident in the texts. (Creating)

Module I: Victorian Period: Poetry, Fiction, and Drama (20 lectures)
   a. “Ulysses”: Alfred Lord Tennyson
   b. Wuthering Heights: Emile Bronte.
   c. Playboy of the Western World: J.M. Synge

Module II: Modern Period: Poetry, Fiction, and Drama (20 lectures)
   a. “Wreck of the Deutschland”: G. M. Hopkins
   b. Heart of Darkness: Joseph Conrad
   c. Pygmalion: G. B. Shaw

Module III: Post-Modern Period: Poetry, Fiction, and Drama (20 lectures)
   a. “Digging”: Seamus Heaney
   b. The French Lieutenant’s Woman: John Fowles
   c. Waiting for Godot: Samuel Beckett

Suggested Readings
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EGPL0016: POST-COLONIAL LITERATURE— POETRY, DRAMA & FICTION (3-0-0) (CREDITS: 03)

Course Outcomes
1. Recall the various critical elements in adherence to the Post-colonial literature. (Remembering)
2. Illustrate the historical context of Post-colonial literature and the use of racist and colonial undertones in the texts under study. (Understanding)
3. Identify the texts on the basis of the historical background, socio-political conditions of the respective time period and establish a connectedness across the commonalities of the theme and structure of the texts under study. (Applying)
4. Analyse the various postcolonial theories and literary concepts from texts written in corresponding time frames and by authors coming from varied socio-linguistic milieu. (Analysing)
5. Evaluate the significance of Post-colonial literature from the historical, socio-political and literary perspective and its evolution within a relevant theoretical framework along with the writer’s psyche and contribution towards it. (Evaluating)
6. Formulate the understanding of world literatures from the postcolonial perspective. (Creating)

Module I: Introduction to Post-colonial Studies (8 lectures)
Historical background of Post-colonial Studies, Post-colonial theory, Decolonization, Globalization, Hybridization, identity, culture, ‘othering’.

Module II: Selected Texts (10 lectures)
a. *Orientalism*: Edward Said (Selections)
b. *Nation and Narration*: Homi K. Bhabha

Module III: Selected Novels (12 lectures)
a. *The Shadow Lines*: Amitav Ghosh
b. *Foe*: J. M. Coetzee

c. *Phenomenal Woman*: Maya Angelou

Module IV: Selected Drama and Poetry (15 lectures)
a. *A Dance of the Forests*: Wole Soyinka
b. “Vultures”: Chinua Achebe
c. “Phenomenal Woman”: Maya Angelou

Suggested Readings
1. “The Danger of a Single Story” (Transcript) by Chimamanda Adichie.

Mapping of COs to Syllabus

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Course Outcomes
1. Define intricacies of American literature. (Remembering)
2. Explain diversified range of subjects portrayed in American literature. (Understanding)
3. Organize a comparative study between literature from the conventional European colonial powers and a colonised yet culturally and politically dominant nation like America. (Applying)
4. Discover the colonial experience of America and its post-colonial recuperation (Analysing)
5. Interpret the complexities of race and identity as expressed through the indigenous cultures of the American society in the post-colonial context (Evaluating)
6. Develop a critical perspective towards the contemporary reading of a colonial text (Creating)

Module I: Introduction (10 lectures)
The Colonial Period ("Declaration of Independence", 1776), American Nationalism, Romanticism, Transcendentalism (Selections from Emerson), Selections from *Studies in American Indian Literature* by Paula Gunn Allen

Module II: Drama (10 lectures)
a. *Who is Afraid of Virginia Woolf*: Edward Albee
b. *Death of a Salesman*: Arthur Miller

d. *The Scarlet Letter*: Nathaniel Hawthorne

Module III: Novels (15 lectures)
a. 

b. 

c. 

d. 

Module IV: Poems (10 lectures)
a. "When Lilacs Last in the Dooryard Bloom'd": Walt Whitman
b. "The Raven": Edgar Allan Poe
c. "The Red Part": Linda Hogan

Suggested Readings

Mapping of COs to Syllabus

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**EGLT0018: LITERARY AND CRITICAL THEORY (4-0-0) (CREDITS: 04)**

Course Outcomes
1. Define contemporary critical theories. (Remembering)
2. Explain the genesis and growth of the modern critical theories in the context of literary texts. (Understanding)
3. Construct awareness of contemporary as well as Indian theories of literary aesthetics and utilize the theories to generate new approaches of looking at literary texts. (Applying)
4. Examine texts on the basis of their understanding of critical theoretical paradigms related to literature (Analysing)
5. Evaluate the texts in terms of their political, social, psychoanalytical, feministic and economic implications. (Evaluating)
6. Develop a more profound critical approach after the study of these theories. (Creating)

Module I: Canonical literary theories and theorists (20 lectures)
b. Post- modernism with reference to “The Death of the Author”: Roland Barthes
c. Marxist literary theory with reference to *Ideology and the State Apparatuses* (extract): Louis Althusser
d. Post-structuralism with reference to *The Order of Discourse* (extract) : Michel Foucault

Module II: Important texts (10 lectures)
a. “Myth, Fiction and Displacement”: Northrop Frye
b. Selections from Seven Types of Ambiguity: William Empson
c. Selections from Culture and Society, 1780-1950: Raymond Williams

Module III: Critical essays and concepts (30 lectures)

a. “Castration or Decapitation?”: Hélène Cixous
b. “Discourse in the Novel” from The Dialogic Imagination: M. M. Bakhtin
c. Selections from Practicing New-historicism: Stephen Greenblatt
d. “What Makes an Interpretation Acceptable”: Stanley Fish
e. “Trans-corporeal Feminisms and the Ethical Space of Nature”: Stacy Alaimo
f. Excerpts from The Natyashastra: Bharata Muni

Suggested Readings

Mapping of COs to Syllabus

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EGGN0019: GENDER AND LITERATURE (2-0-0) (CREDITS: 02)

Course Outcomes
1. Define the various thoughts and theories pertaining to feminist writings and feminism. (Remembering)
2. Explain the themes and topics and relate it to real life situations. (Understanding)
3. Develop new ideas by connecting the various topics taught. (Applying)
4. Analyse the various movements related to gender issues and new developments in gender studies in literature. (Analyzing)
5. Evaluate the interdisciplinary aspect in various texts. (Evaluating)
6. Discuss the meanings, ideas and thoughts regarding gender and its connection with literature. (Creating)

Module I: Selected Feminist Writings (12 Lectures)

a. “Vindication of the Rights of Woman”: Mary Wollstonecraft (Excerpts)
b. “The Laugh of the Medusa”: Helene Cixous
c. The Second Sex: Simone de Beauvoir (Selections)
d. The Gender Trouble: Judith Butler (Selections)

Module II: Selected Fiction (12 Lectures)

a. Funny Boy: Shyam Selvadurai
b. Sunlight on a Broken Column: Attia Hussain

Module III: Selected Short Story and Poetry (6 Lectures)

b. “Purdah”: Imtiaz Dharker

Suggested Readings

Mapping of COs to Syllabus

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EGLS0020: LINGUISTICS AND STYLISTICS I (3-0-0) (Credits: 03)

Course Outcomes
1. Define the key concepts of Linguistics. (Remembering)
2. Illustrate the differences between Stylistics and Linguistics. (Understanding)
3. Identify and explain the different levels of language. (Applying)
4. Analyse Linguistics and Traditional Grammar. (Analysing)
5. Recommend Stylistics as an interdisciplinary field of study. (Evaluating)
6. Discuss the different branches of Stylistics. (Creating)

Module I: Introduction to Linguistics (35 lectures)

Module II: Introduction to Stylistics (10 lectures)
Definition, Nature and Scope of Stylistics, Stylistics, Linguistics and Literary Criticism, Major Thinkers in Stylistics, Objectives of this discipline, Stylistics and levels of language, Stylistics and Style, Different branches of Stylistics, Stylistics as an interdisciplinary field

Suggested Readings

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EGIM0021: INTRODUCTION TO MODERN EUROPEAN LITERATURE I (3-0-0) (CREDITS: 03)

Course Outcomes
1. Recall the vast body of writings of European Literature. (Remembering)
2. Interpret the emerging trends of European Literature through the genres of poetry and fiction. (Understanding)
3. Apply critical reading skills to study the emerging and vibrant areas of literature at a wider range. (Applying)
4. Analyse the specific issues such as the double challenge of truth and liberty, of identity and unity, of cultural loss and recovery, of ethnic specificity and aesthetic universality in the writings of contemporary European writers. (Analysing)
5. Evaluate the core issues as depicted in the literature of Modern Europe. (Evaluating)
6. Develop critical understanding of various texts. (Creating)

Module I: Major Aesthetic Developments (10 lectures)
Constructivism, Realism, Symbolism, Naturalism, Aestheticism, Futurism, Vorticism, Imagism, Expressionism, Dadaism, Surrealism, Cynicism, Skepticism, Resistance, Despair and Alienation

Module II: Selected Modern European Poetry (15 lectures)
b. “The Apple Orchard”: Rainer Maria Rilke
Module III: Modern European Fiction (20 lectures)
   a. *Crime and Punishment*: Fyodor Dostoevsky
   b. *The Castle*: Franz Kafka

Suggested Readings

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EGAL0022: COLONIAL AND POST-COLONIAL AFRICAN LITERATURE I (3-0-0) (CREDITS: 03)

Course Outcomes
1. Define the complexities of race, gender and identity related to African literature. (Remembering)
2. Illustrate the vast body of writings in English from Africa. (Understanding)
3. Apply critical reading skills to interpret the vibrant area of literature. (Applying)
4. Analyse the specific issues such as colonialism, identity and unity, cultural loss, ethnic specificity and universality in the literature of Africa during and after the Colonial Period. (Analysing)
5. Evaluate the specific issues pertaining to the colonial experience and literature of Africa. (Evaluating)
6. Discuss various African literary texts from a critical perspective. (Creating)

Module I: Selected Poetry (10 lectures)
   a. “Koening of the River”: Derek Walcott
   b. “The Fisherman’s Invocation”: Gabriel Okara

Module II: Fiction (20 lectures)
   a. *No Longer at Ease*: Chinua Achebe
   b. *Purple Hibiscus*: Chimamanda Ngozi Adichie

Module III: Drama (15 lectures)
   a. *The Lion and the Jewel*: Wole Soyinka
   b. *The Dilemma of a Ghost*: Ama Ata Aidoo

Suggested Readings

Mapping of COs to Syllabus

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EGIW0023: INDIAN WRITING IN ENGLISH – POETRY, DRAMA & FICTION (4-0-0) (CREDITS: 04)

Course Outcomes
1. Define the literature produced in India in English. (Remembering)
2. Illustrate and comment on poetry, drama, short stories and novels produced in India in their various socio-cultural contexts. (Understanding)
3. Identify and explain the various critical theories involved in the production of various indigenous texts. (Applying)
4. Analyse the techniques, style of writing and contribution of various writers to the Indian English literary tradition. (Analysing)
5. Evaluate the Indian writings in English and their representation of the Indian ethos on a global forum and critically interpret the evolution of English language in India (Evaluating)
6. Discuss the selected literary works and find out the commonalities in terms of themes and issues. (Creating)

Module I: Selected Poetry (10 lectures)
a. “Philosophy”: Nissim Ezekiel
b. “The Looking Glass”: Kamala Das
c. “A River”: A.K. Ramanujan
d. “A Poem for Mother”: Robin Ngangom
e. “Indian Summer”: Jayanta Mohapatra

Module II: Selected Drama & Short Story (15 lectures)
a. Morning Raga: Mahesh Dattani
b. “The Road to Salvation”: Munshi Premchand

Module III: Selected Fiction (20 lectures)
a. Coolie: Mulk Raj Anand
b. Fasting, Feasting: Anita Desai

Module IV: Selected Travel Writing and Non-fiction (15 lectures)
a. In an Antique Land: Amitav Ghosh
b. “Language and Spirit” Foreword to Kanthapura: Raja Rao

Suggested Readings

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EGSA0024: SOUTH-ASIAN LITERATURE (4-0-0) (CREDITS: 04)

Course Outcomes
1. Define the South Asian literary milieu. (Remembering)
2. Outline the literary, social, political and cultural dynamics of these texts. (Understanding)
3. Apply the knowledge from these texts to assess the socio-cultural aspect of these areas. (Applying)
4. Examine the texts with reference to the classic literary texts that they have studied earlier. (Analysing)
5. Evaluate the overall political and social implications of the area as suggestive in these texts. (Evaluating)
6. Discuss the emotions and aspirations of the writers from South Asia reflected in their writings. (Creating)

Module I: Introduction (20 lectures)
Geo-political conditions, Historical background of South Asian Literature, Imperialism, Colonialism, Nationalism, Orientalism, Decolonization, Specific issues with reference to history, politics and linguistic inventiveness in the literature of South-Asian countries.

Module II: Selected Poetry (10 lectures)
b. Selected poems from ‘Masnavi’: Rumi

Module III: Selected Fiction (30 lectures)
a. Ice Candy Man: Bapsi Sidhwa
b. The Kite Runner: Khaled Hosseini
c. The Bones of Grace: Tahmima Anam

Suggested Readings

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EGLS0025: LINGUISTICS AND STYLISTICS II (3-0-0) (CREDITS: 03)

Course Outcomes
1. Define the role of language in the contemporary world. (Remembering)
2. Interpret and stylistically appreciate works of literature. (Understanding)
3. Apply sound, word and sentence structure in transcribing a word or analysing sentence. (Applying)
4. Analyse the structure of a word or sentence linguistically and stylistically and read the various genres critically. (Analysing)
5. Assess and evaluate the structure of language using linguistic and stylistic tools. (Evaluating)
6. Compose phonetically using stress and intonation patterns. (Creating)

Module I: Phonology, Morphology, Syntax and Semantics: Basic Concepts (35 lectures)

Module II: Reading in Stylistics (10 lectures)
Language and Literature, Levels of language at work, Sentence styles: development and illustration, Interpreting patterns of sound, Techniques of speech and through presentation, Dialogue in drama, Style in poetry: an exploration, A sociolinguistic model of narrative, Exploring metaphors in different kinds of texts, Style variation in narrative, Stylistics and media, An application of cognitive stylistics in poetry, Literature as discourse, Stylistic appreciation of poetry/prose

Suggested Readings

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**EGEL0026: INTRODUCTION TO MODERN EUROPEAN LITERATURE II (3-0-0) (CREDITS: 03)**

**Course Outcomes**
1. Relate the characteristics of modern European literature with the readings of other modern European texts (Remembering)
2. Interpret different representative texts of European literature- poetry, fiction and Drama. (Understanding)
3. Identify modernist aspects of contemporary European literatures (Applying)
4. Analyse the modernist issues such as humanism, individualism, meaninglessness of life, liberty and identity, cultural loss and recovery and aesthetic universality in the literature from different nations of Europe. (Analysing)
5. Evaluate the overall Western modern philosophy in the works of the various writers of the area. (Evaluating)
6. Discuss the changing trends and movements of literature as reflected in the selected texts. (Creating)

**Module I: Selected Modern European Poetry (20 lectures)**

a. “Lament for a Bullfighter”: Federico Garcia Lorca
b. “To his Own Beloved Self”: Vladimir Mayakovsky

c. **Six Characters in Search of an Author**: Luigi Pirandello
b. **Rosencrantz and Guildenstern are Dead**: Tom Stoppard

**Module III: Modern European Fiction (10 lectures)**

a. **The Stranger**: Albert Camus
b. **The Tin Drum**: Gunter Grass

**Suggested Readings**

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**EGPC0027: COLONIAL AND POST-COLONIAL AFRICAN LITERATURE II (3-0-0) (CREDITS: 03)**

**Course Outcomes**
1. Define the complexities of race, gender and identity related to African literature. (Remembering)
2. Interpret the emerging genres of African English literature- poetry, and fiction (Understanding)
3. Apply theoretical assumption as well as critical reading skills to the study of African literature. (Applying)
4. Analyse the post-colonial issues of identity unity, cultural loss, ethnic specificity, universality in the literature of Africa in both Colonial and post-colonial contexts. (Analysing)
5. Assess the plot, theme, characters and context of the selected texts. (Evaluating)
6. Create an intense theoretical paradigm for the reading of the text. (Creating)

**Module I: Selected Poetry (10 lectures)**

a. “On Being Brought from Africa to America”: Phillis Wheatley
Module II: Selected Fiction (20 lectures)

- *Infinite Riches*: Ben Okri
- *July’s People*: Nadine Gordimer

Module III: Selected Non-Fiction (15 lectures)

- "On Abolition of the English Department": Ngugi wa’Thiong’o

Suggested Readings


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EGSL0200: SERVICE LEARNING - LANGUAGE COMMUNICATION (2-0-0) (CREDIT: 02)

**Course Outcomes**

1. Describe the nature of Service Learning and the principles of Community University Engagement (Remembering)
2. Understand the importance of engagement with nearby communities and develop a mutual partnership in terms of the sharing of knowledge with the local communities (Understanding)
3. Apply the principles of Community University Engagement in the linguistic study of local communities in terms of spoken English and study of speech expressions (Applying)
4. Analyze the linguistic expressions of the communities and the gap of communication in terms of English language (Analyzing)
5. Evaluate the expressions of the communities and summarize the socio-cultural constructs behind the expressions under Service-learning study. (Evaluating)
6. Design a project report on their understanding of Service learning and involvement with the communities. (Creating)

Module I: Understanding Service Learning (15 lectures)

Introduction to Service Learning; Understanding Community University Engagement; Historical Overview of Community University Engagement in India; Principles of Community University Engagement; Forms of Community University Engagement; Community Based Participatory Research; Social Responsibility of Higher Education Institutions of India

Module II: Interaction with Communities (15 lectures)

Foundations of English grammar; English phonetic symbols (vowels and consonants); Common idioms and phrases in English; Understanding the Key concepts of languages: the socio-cultural context; Exploring different speech communities; Learning unique linguistic expressions; Exploring idioms and phrases; the socio-cultural construct that binds them; Basics of translation; Field Visit; Assessment: Assignment writing and Submission

Suggested Readings


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Module I: Introduction to Seminar (2 Lectures)

Basics of Seminar:
- Definition of Seminar
- Type of Seminars: Students Seminar, National Seminar, International Seminar: Purpose of the seminar
- The object of study
- The scope of study

Module II: Introduction to Seminar (3 Lectures)

Methodology:
- Steps to write a seminar paper/Research Methodology
- Topics of the seminar paper. Presentation
  - How to present a seminar paper: paralinguistic features
  - Mode of Presentation: Essay-type Presentation, Paper Presentation, Powerpoint(Ppt.) Presentation

Module III: Practical (15 Lectures)
- Two presentations per period
- Each will be allotted 10-15 minutes for presentation. Followed by a discussion and commentary on the paper presented

Suggested Readings:

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EGSM6001: SEMINAR AND PRESENTATION I (0-0-1) (Credit: 01)

Course Outcomes:
1. Define academic writing, seminar presentation and publication (Remembering)
2. Identify research topics for sustained and rigorous investigation so that original write- ups can be developed (Understanding)
3. Assess and evaluate the various works of literature to write research reports and papers (Applying)
4. Prepare write-ups for scholarly journals by doing analysis of textual evidence (Analysing)
5. Estimate critical reading, research, discussion and composition around a particular topic/theme or subject (Evaluating)
6. Synthesize and expand their abilities to absorb, synthesize and construct arguments in a close-knit community (Creating)

Module I: Introduction to Seminar (2 Lectures)

Basics of Seminar:
- Definition of Seminar
- Type of Seminars: Students Seminar, National Seminar, International Seminar: Purpose of the seminar
- The object of study
- The scope of study

Module II: Introduction to Seminar (3 Lectures)

Methodology:
- Steps to write a seminar paper/Research Methodology
- Topics of the seminar paper. Presentation
  - How to present a seminar paper: paralinguistic features
  - Mode of Presentation: Essay-type Presentation, Paper Presentation, Powerpoint(Ppt.) Presentation

Module III: Practical (15 Lectures)
- Two presentations per period
- Each will be allotted 10-15 minutes for presentation. Followed by a discussion and commentary on the paper presented

Suggested Readings:

Mapping of COs to Syllabus:

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EGSP6002: SEMINAR AND PRESENTATION II (0-0-1) (CREDIT: 01)

Course Outcomes:
1. Define academic writing, seminar presentation and publication (Remembering)
2. Identify research topics for sustained and rigorous investigation so that original write- ups can be developed (Applying)
3. Estimate and expand their abilities to absorb, synthesize and construct arguments in a close-knit community (Evaluating)
4. Assess and evaluate the various works of literature to write research reports and papers (Evaluating)
5. Develop critical reading, research, discussion and composition around a particular topic/theme or subject (Creating)
6. Compose write-ups for scholarly journals by doing analysis of textual evidence (Creating)

Module I: Making an Argument in Research Paper (3 lectures)
- Beginning: Choosing a topic
- Body of the Research Paper
c. Review of Literature  
d. Developing an argument  
e. Bringing a critical interpretation into writing  
f. Framing the Conclusion  
g. Referencing and Citation  
h. Bibliography

Module II: Practical (17 lectures)  
  a. Two presentations per period  
  b. Each will be allotted 10-15 minutes for presentation  
  c. Followed by a discussion and commentary on the paper presented

Suggested Readings  

Mapping of COs to Syllabus

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EGPP6003: PROJECT PHASE I (1-0-1) (CREDITS: 02)

Course Outcomes  
1. Define academic writing, research paper and publication. (Remembering)  
2. Identify research topics for sustained and rigorous investigation so that original write-ups can be developed. (Understanding)  
3. Estimate and expand their abilities to absorb, synthesize and construct arguments in a close-knit community. (Applying)  
4. Analyse the various works of literature to write research reports and papers. (Analysing)  
5. Evaluate critically through reading, research, discussion and composition around a particular topic/ theme or subject. (Evaluating)  
6. Compose write-ups for scholarly journals by doing analysis of textual evidence. (Creating)

Module I: Conceptualizing, Planning and Preparing a Research Paper (15 lectures)  
- Introduction to academic/ research writing  
- Avoiding Plagiarism in research  
- Selection of a research topic  
- Developing an outline of the research paper  
- Choosing an appropriate title for the research paper  
- Writing an abstract  
- Review of Literature  
- Developing an argument  
- Bringing a critical interpretation into writing  
- Drawing inferences/ framing a conclusion  
- MLA Handbook 8th Edition  
- Referencing and Citation  
- Bibliography

Module II: Practical- Writing and editing a Research Paper (15 Lectures)  
- Draft of the abstract  
- Draft of the literature review  
- First draft of the research paper  
- Second draft of the research paper  
- The final research work
Suggested Reading

Mapping of Course Outcomes

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EGPP6004: PROJECT PHASE II (2-0-6) (CREDITS: 08)

Course Outcomes
1. Define academic writing, dissertation and publication. (Remembering)
2. Identify research topics for sustained and rigorous investigation so that original write-ups can be developed. (Understanding)
3. Estimate and expand their abilities to absorb, synthesize and construct arguments in a close-knit community. (Applying)
4. Analyse the various works of literature to conduct detailed analytical research. (Analysing)
5. Evaluate critically through reading, research, discussion and composition around a particular topic/ theme or subject. (Evaluating)
6. Compose scholarly write-ups by conducting detailed, in-depth analysis of a research area. (Creating)

Module I: Conceptualizing, Planning and Preparing a Research Topic (30 lectures)
- Introduction to Project work and Dissertation writing
- Topic and Proposal
- Literature review
- Perspective/ Theoretical framework
- Chapterisation
- Resources
- Limitation and Scope
- Critical interpretation and Documentation
- MLA Handbook 8th Edition
- In-text Citation
- Bibliography/ Referencing
- Plagiarism

Module II: Practical- Writing and editing a Research Paper (90 Lectures)
- Working Proposal
- Final Proposal
- Abstract
- Outline of the Dissertation
- Draft of the literature review
- First draft of the Chapters
- Second draft of the Chapters
- The final Dissertation

Suggested Reading

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VALUE ADDED COURSES

EGES0138: EFFECTIVE COMMUNICATION SKILLS (1-0-1) (CREDITS: 02)

Course Outcomes
1. Describe the types of communication. (Remembering)
2. Differentiate from a variety of social functions including greetings, introductions and farewells, making and responding to requests, suggestions, invitations and apologies, conducting simple transactions in shops and offices, asking for and giving directions, etc. (Understanding)
3. Illustrate the daily routines in a series of simple phrases and sentences. (Applying)
4. Categorize the form and function of the basic official correspondences. (Analysing)
5. Evaluate formal and informal writings, preparing reports, letters, memorandum, notices, agenda, minutes etc. (Evaluating)
6. Formulate the rationale of descriptive, narrative, expository and argumentative writing. (Creating)

Module I: Communication and Grammar skills (8 lectures)
Language and communication: Differences between speech and writing, Distinct features of speech, Distinct features of writing, Parts of Speech, Person, Gender, Number, Use of Tense, Aspect and Modals, Degrees of comparison, Sentence types, Negation and Relative Clauses, Narration, Voice change, Proverbs, Vocabulary, Proper use of words, Idioms, Accentuation, Intonation, Understanding Various Englishes.

Module II: Developing Communicative Skills (7 lectures)
Introductory, developmental, transitional and concluding paragraphs: Coherence and cohesion, Descriptive, narrative, expository and argumentative writing, Introduction to soft skills, people and social skills, presentation, interaction and effective communication.
Official letter, Paragraph writing, Note-making, Topic Sentence, Telephonic Conversation, Group Discussion regarding job interview & C. V. Writing, formal and informal writings, reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes.

Module III: Self-Learning (15 lectures)
Practice and drill sessions, online learning via tutorials (link to be provided by the teacher in-charge), self- assessment of progress, submission of assessment reports to the teacher.

Suggested Readings

Mapping of Course Outcomes

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EGML0028: MYTH IN LITERATURE (2-0-0) (CREDITS: 02)

Course Outcomes
1. Remember some of the recurrent classical myths in literature (Remembering)
2. Understand that myths have strong metaphoric function (Understanding)
3. Understand how the application of the myth in the select texts throws more light in understanding the complex ideas therein (Applying)
4. Co-relate the original story in the myth to the story in the corresponding literature (Analyzing)
5. Rate the potentiality of the myth in leveraging literary ideas (Evaluating)
6. Adopt the myth as vehicle of thought in creative writings (Creating)

Module I: Myth Concepts (7 lectures)
Myth, mythology, mytheme, archetype, archetypal, archetypal criticism, mythopoeia, myth critics

Module II: Recurring Myths (15 lectures)
Myth of: Zeus (Jupiter/Jove), Venus (Aphrodite), Cupid (Eros), Adonais, Hercules, Odysseus, Achilles, Oedipus, Electra, Helen, Diana, Hera, Orpheus and Eurydice, Hades, Leda and Swan, Trojan War

Module III: Myth in Literature—significance of select myth (8 lectures):
Geoffrey Chaucer: Myth of Thisbe and Dido in Legend of Good Women
P.B. Shelley: Myth of Adonais in “Adonais”
W.B. Yeats: Myth of Leda and Swan in “Lead and the Swan”
T.S. Eliot: Myth of Phiomela, Cleopatra and Tiresias The Waste Land

Suggested Readings
1. Frye, Northrop. “Myth, Fiction and Displacement”

Mapping of Course Outcomes

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SCHOOL OF HUMANITIES AND SOCIAL SCIENCES  
DEPARTMENT OF ECONOMICS

VISION
To envision excellence in quality education and moulding intellectually competent persons in economics for creating novel ideas through innovative teaching and research contributing to the modern society.

MISSION
- Empower the students with critical understanding of economic theory, analytical treatment and empirical interpretations of economic issues.
- Make the students aware of recent and ongoing developments in the field of economics.
- Enhance the skill and efficiency of the students for better employability in competitive job markets.

PROGRAMME OUTCOMES – BA ECONOMICS
PO 1: Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO 2: Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
PO 3: Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO 4: Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO 5: Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO 6: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
PO 7: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PROGRAMME SPECIFIC OUTCOMES – BA ECONOMICS
PSO 1: Knowledge of Economic System: An ability to understand economic theories and functioning of basic microeconomic and macroeconomic systems.
PSO 2: Statistical and Mathematical Skills: Acquaint with collection, organization, tabulation and analysis of empirical data.
  a. Ability to use basic mathematical and statistical tools to solve real economic problems.
PSO 3: Econometric Applications: Acquaint with basic and applied econometric tools and methods used in economics. The aim of this course is to provide a foundation in applied econometric analysis and develop skills required for empirical research in economics. It also covers statistical concepts of hypothesis testing, estimation and diagnostic testing of simple and multiple regression models.
PSO 4: Development Perspectives: Delineate the developmental policies designed for developed and developing economics. The course also acquaints with the measurement of development with the help of theories along with the conceptual issues of poverty and inequalities.
PSO 5: Environmental Strategy and Management: This course emphasises on environmental problems emerging from economic development. Economic principles are applied to valuation of environmental quality, quantification of environmental damages, tools for evaluation of environmental projects such as cost-benefit analysis and environmental impact assessments.
PSO 6: Perspectives on Indian Economy: Acquaint with basic issues of Indian economy and learn the basic concept of monetary analysis and financial marketing in Indian financial markets. This course reviews major trends in economic indicators and policy debates in India in the post-Independence period.

Mapping of Courses to POs/PSOs – BA (Honours)

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MASTER OF ARTS - MA ECONOMICS

Programme Outcomes – MA Economics

PO 1: Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO 2: Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO 3: Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO 4: Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO 5: Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO 6: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO 7: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

Programme Specific Outcomes – MA Economics

PSO 1: Knowledge of Economic Structure: Ability to understand theories of basic economic structure and enhanced policymaking. It also provides detailed knowledge of Indian Economy especially in post independence period.

PSO 2: Applications of Mathematical and Econometric Methods: To acquaint with the basic and applied mathematical and econometric methods to solve real economic problems. This develops skills required for empirical research.

PSO 3: Growth and Sustainable Development Outlook: To acquaint with in-depth knowledge of growth and sustainable development policies and strategies.

PSO 4: Understanding of Trade and Financial Policies: To equip with the fundamental strategies and principles governing trade and relations across countries.

PSO 5: Perspective of Sectoral Knowledge: To equip with the knowledge of sectoral behaviour, sector specific theories and policies.

PSO 6: Population and Behavioural Studies: To understand the principles of population and human decision making behaviour guided by cognitive skills.

Mapping of Courses to POS/PSOS – MA ECONOMICS

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DEPARTMENT OF ECONOMICS

DETAIL SYLLABUS – BA ECONOMICS

THEORY COURSES

ENPF0020: PUBLIC ECONOMICS (5-1-0)

COURSE OUTCOMES
1. Define the main concepts in public economic policies. (Remembering)
2. Explain the concepts of public goods, public expenditures and taxation. (Understanding)
3. Identify the main issues of budgeting and fiscal policies. (Applying)
4. Evaluate economic concepts of income redistribution. (Analyzing)
5. Explain the evaluation of budget deficit and public debt. (Evaluating)
6. Discuss the working principle of fiscal federalism in India. (Creating)

Module I: Public Economic Theory (38 hours)

a. Fiscal Functions: An Overview; Meaning and Scope of Public Economics; Need for Public Sector; Allocation, Distribution and Stabilization Functions of Government; Co-ordination and Conflict of Functions
c. Externalities: Meaning and Type of Externalities; Market Failure and Externalities; Internalization of Externalities – Corrective Taxes and Subsidies; Assignment of Property Rights – The Coase Theorem
d. Taxation: Its Economic Effects; Dead Weight Loss and Distortion; Efficiency and Equity Considerations; Tax Incidence; Optimal Taxation

Module II: Indian Public Finances (37 hours)

a. Tax System – Main Features of India’s Tax System; Changing Tax Structure of India; Major Tax Reforms since 1991
b. Budget; Deficits and Public Debt – Stages of Budget Preparation; Revenue and Capital Budget; Concept of Deficits – Budgetary Deficit, Revenue Deficit, Fiscal Deficit, Primary Deficit; Budgetary Trend in India; Study of Latest Union Budget; Necessity of Public Debt; Characteristics of India’s Public Debt; India’s Internal and External Debt Liabilities; Problems of Public Debt Policy
c. Fiscal Federalism in India: Meaning; Inter Governmental Resource Transfer – Trend and Techniques; Role of Finance Commission; Critical Evaluation of Finance Commission’s Awards; Recommendations of the Latest Finance Commission

Suggested Readings

Mapping of COs to Syllabus

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ENIE0021: INDIAN ECONOMY-I (5-1-0)
COURSE OUTCOMES
1. Learn the basic understanding of Indian economy. (Remembering)
2. Understand the Indian economy since independence. (Understanding)
3. Identify the main issues in Indian Setup. (Applying)
4. Evaluate the impact development paradigm in the Indian Scenario. (Analyzing)
5. Explain shortcomings of the policy and programme for economic development. (Evaluating).
6. To understand the relation between India and the world economy as well as its neighboring countries. (Creating)

Module I: Economic Development since Independence (20 hours)

Module II: Population and Human Development (19 hours)
Demographic Trend and Issues – Meaning and Scope of Demography; Density of Population; Measures of Population Change; Structure and Distribution; Population as a Factor of Economic Development; National Population Policy; Demographic Dividend; Human Development Indicators; Human Development Index; India’s Human Development Record in Global Perspective; Education in India – Features, Trends, Issues; Health – Trends and Issues; Malnutrition in India

Module III: Growth and Distribution (20 hours)

Module IV: International Comparisons (17 hours)
India’s Economic Interaction with the World Economy; A Comparative Assessment of India’s Development Experience with Singapore, South Korea, China, Pakistan, Bangladesh, Sri Lanka, Nepal, Taiwan and Vietnam

Suggested Readings

Mapping of COs to Syllabus

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ENIE0024: INTERNATIONAL ECONOMICS (5-1-0)

COURSE OUTCOMES
1. Know the key principles of international economics. (Remembering)
2. Understand the main theories of international economics. (Understanding)
3. Apply the theories and models of international trade for economic growth and global welfare. (Applying)
4. Analyse the links between trade, international finance, economic growth and globalization, with a particular emphasis on the experiences of developing countries. (Analysing)
5. Evaluate international trade policies regarding increase in exports, international debt, and international institutions to solve domestic economic problems. (Evaluating)
6. Design and develop economists’ arguments concerning international trade and policies. (Creating)

Module I: Introduction (15 hours)
International Economics – Meaning, Importance and Subject Matter; Gains from Trade; Overview of World Trade; Globalization of the World Economy; International Flow of Goods, Services, and Capital; Current International Economic Problems and Challenges

Module II: Theories of International Trade (25 hours)
The Ricardian Theory of Trade; Specific Factor Model of Trade; Heckscher-Ohlin Models; New Trade Theories; The International Location of Production; Firms in the Global Economy – Outsourcing and Multinational Enterprises

Module III: Trade Policy (20 hours)
Instruments of Trade Policy; Trade Restrictions – Tariffs and Optimum Tariff; Nontariff Trade Barriers; Partial and General Equilibrium Analysis of a Tariff; Economic Integrations – Free Trade Areas, Customs Unions, Common Markets, Optimum Currency Area, Economic Union; Dumping; Political Economy of Trade Policy; Controversies in Trade Policy

Module IV: International Macroeconomic Policy (15 hours)

Suggested Readings

Mapping of COs to Syllabus

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ENIY0025: INDIAN ECONOMY-II (5-1-0)

COURSE OUTCOMES
1. Define the Macroeconomic Policies and their Impact Indian Economy. (Remembering)
2. Explain the policies and Performance in Agriculture. (Understanding)
3. Identify the policies and performance in Industry. (Applying)
4. Evaluate the impact of various development policies in Agriculture and Industry in the Indian Scenario. (Analyzing)
5. Explain the trends and performance in service sectors. (Evaluating)
6. Discuss their understanding of the usefulness of various development policies. (Creating)

Module I: Macroeconomic Policies and their Impact (20 hours)
Fiscal Policy – Fiscal Reform Measures in the Context of India’s New Economic Policy, Fiscal Responsibility and Budget Management (FRBM) Act; Monetary Reforms and its Impact; Black Money and Parallel Economy in India – Consequences and Corrective Government Intervention; Trade and Investment Policy – Export Import Policy, Foreign Trade Policy; Current and Capital Account Convertibility; Labour Regulation

Module II: Policies and Performance in Agriculture (20 hours)
Changing Structure of Indian Agriculture; Sustainable Agriculture – Concept and Constraints; Diversification of Agriculture; Agrarian Structure and Technology; Green Revolution and its Impact on Agricultural Development; Land Reforms and Agricultural Growth in India; Role of Rural Credit in Agrarian Sector; Agricultural Marketing and Strategy for Development; Trade – WTO and Agriculture; Agricultural Pricing Policy in India; Pricing and Procurement of Agricultural Products

Module III: Policies and Performance in Industry (20 hours)
Pattern of Industrialization; Industrial Growth and Productivity in the Post Reform Period; Diversification of Industries; New Industrial Policy and Economic Reforms in India; Disinvestment and Privatization; Development of MSME Sector; Globalization and Competition; Foreign Investment in the Industrial Sector

Module IV: Trends and Performance in Services (15 hours)
Role of the Service Sector in the Indian Economy, Growth and Composition of the Service Sector; Formal and Informal Enterprises in Service Sector; Trend and Growth of Banking and Insurance; Balance of Payments Position – Pre and Post Reform Period; Trade in Services and WTO

Suggested Readings

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ENEE0026: ENVIRONMENTAL ECONOMICS (5-1-0)

COURSE OUTCOMES
1. Define the basic concepts of environmental economics. (Remembering)
2. Understand the environmental issues in relation to the theory of externalities. (Understanding)
3. Apply principles concerning the environmental problems and policies. (Applying)
4. Analyze environmental problems using economic principles. (Analysing)
5. Evaluate the diverse methods of environmental valuation for sustainable development. (Evaluating)
6. Develop an approach to examine the contemporary environmental issues from an economists’ viewpoint. (Creating)

Module I: Introduction (10 hours)
Environmental Economics – Meaning, Nature, Scope; Interlinkage between Economy and Environment; Population and Environment; Poverty and Environment

Module II: The Theory of Externalities (10 hours)
Pareto Optimality and Market Failure in the Presence of Externalities; Property Rights and the Coase Theorem

Module III: The Design and Implementation of Environmental Policy (15 hours)
Overview; Pigouvian Taxes and Effluent Fees; Tradable Permits; Choice between Taxes and Quotas under Uncertainty; Implementation of Environmental Policy

Module IV: International Environmental Problems (10 hours)
Trans-Boundary Environmental Problems; Economics of Climate Change; Trade and Environment

Module V: Measuring the Benefits of Environmental Improvements (20 hours)
Non-Market Values – Use Value, Option Value, Bequest Value; Measurement Methods – Willingness to Pay and Willingness to Accept Compensation; Risk Assessment and Perception

Module VI: Sustainable Development (10 hours)
Sustainable Development – Basic Concepts and Measurement; Perspectives from Indian Experience

Suggested Readings
3. Roger Perman, Yue Ma, James McGilvray and Michael Common, Natural Resource and Environmental Economics, Pearson
ENME0028: INTRODUCTORY MICROECONOMICS (5-1-0)

COURSE OUTCOMES
1. Define basic concepts of microeconomics. (Remembering)
2. Classify economics from the perspective of individual decision making as consumers and producers. (Understanding)
3. Apply some basic principles of microeconomics. (Applying)
4. Draw inferences from interactions of supply and demand. (Analyzing)
5. Interpret the characteristics of perfect and imperfect markets. (Evaluating)
6. Discuss the use of microeconomic tools for analysing real time situations. (Creating)

Module I: Exploring the Subject Matter of Economics (10 hours)
Why Study Economics? Scope and Method of Economics; The Economic Problem – Scarcity and Choice, The Question of What to Produce, How to Produce and How to Distribute Output; Science of Economics; The Basic Competitive Model; Prices, Property Rights and Profits; Incentives and Information; Rationing; Opportunity Sets; Economic Systems; Reading and Working with Graphs

Module II: Supply and Demand: How Markets Work, Markets and Welfare (15 hours)
Markets and Competition; Determinants of Individual Demand/Supply; Demand/Supply Schedule and Demand/Supply Curve; Market vs. Individual Demand/Supply; Shifts in the Demand/Supply Curve; Demand and Supply Together; How Prices Allocate Resources; Elasticity and its Application; Controls on Prices; Taxes and the Costs of Taxation; Consumer Surplus; Producer Surplus and the Efficiency of the Markets

Module III: The Households (15 hours)
The Consumption Decision – Budget Constraint, Consumption and Income/Price Changes, Demand for all Other Goods and Price Changes; Description of Preferences (Representing Preferences with Indifference Curves); Properties of Indifference Curves; Consumer’s Optimum Choice; Income and Substitution Effects; Labour Supply and Savings Decision – Choice between Leisure and Consumption

Module IV: The Firm and Perfect Market Structure (8 hours)
Behaviour of Profit Maximizing Firms and the Production Process; Short Run Costs and Output Decisions; Costs and Output in the Long Run

Module V: Imperfect Market Structure (12 hours)
Basic forms; Price and Output Determination under Monopoly and Monopolistic Competition; Monopoly and Anti-trust Policy; Excess Capacity under Monopolistic Competition; Government Policies towards Competition

Module VI: Input Markets (15 hours)
Labour and Land Markets – Basic Concepts (Derived Demand, Productivity of an Input, Marginal Productivity of Labour, Marginal Revenue Product); Demand for Labour; Input Demand Curves; Shifts in Input Demand Curves; Competitive Labour Markets; Labour Markets and Public Policy

Suggested Readings
ENIE0028: INTRODUCTORY MICROECONOMICS (5-1-0)

COURSE OUTCOMES
1. Define basic concepts of Micro Economics. (Remembering)
2. Classify economics from the perspective of individual decision making as consumers and producers. (Understanding)
3. Apply some basic principles of microeconomics. (Applying)
4. Draw Inferences from interactions of supply and demand. (Analyzing)
5. Interpret the characteristics of perfect and imperfect markets. (Evaluating)
6. Discuss the use of Micro-Economic tools for analysing real time situations. (Creating)

Module I: Exploring the Subject Matter of Economics (15 hours)
Why Study Economics? Scope and Method of Economics; The Economic Problem – Scarcity and Choice, The Question of What to Produce, How to Produce and How to Distribute Output; Science of Economics; The Basic Competitive Model; Prices, Property Rights and Profits; Incentives and Information; Rationing; Opportunity Sets

Module II: Supply and Demand: How Markets Work, Markets and Welfare (15 hours)
Markets and Competition; Determinants of Individual Demand/Supply; Demand/Supply Schedule and Demand/Supply Curve; Market vs. Individual Demand/Supply; Shifts in the Demand/Supply Curve; Demand and Supply Together; How Prices Allocate Resources; Elasticity and its Application; Consumer Surplus; Producer Surplus

Module III: The Household Behaviour and Consumer’s Choice (12 hours)
The Consumption Decision – Budget Constraint, Consumption and Income/Price Changes, Demand for all Other Goods and Price Changes; Description of Preferences (Representing Preferences with Indifference Curves); Properties of Indifference Curves; Consumer’s Optimun Choice; Income and Substitution Effects

Module IV: The Firm and Perfect Market Structure (8 hours)
Behaviour of Profit Maximizing Firms and the Production Process; Short Run Costs and Output Decisions; Costs and Output in the Long Run

Module V: Imperfect Market Structure (12 hours)
Basic forms; Price and Output Determination under Monopoly and Monopolistic Competition; Monopoly and Anti-trust Policy

Module VI: Input Markets (15 hours)
Labour and Land Markets – Basic Concepts (Derived Demand, Productivity of an Input, Marginal Productivity of Labour, Marginal Revenue Product); Demand for Labour; Input Demand Curves; Shifts in Input Demand Curves; Competitive Labour Markets; Labour Markets and Public Policy

Suggested Readings

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ENIS0029: INTRODUCTORY MACROECONOMICS (5-1-0)

COURSE OUTCOMES
1. Define basic concepts of macroeconomics including national income, money and inflation. (Remembering)
2. Understand the relationship among the macroeconomic variables like GDP, money supply, inflation and related concepts of closed economy. (Understanding)
3. Apply basic mathematical formulae to measure national income and its related terms. (Applying)
4. Analyze the quantity theory of money and Keynesian model of income determination for real life economic decision making. (Analyzing)
5. Interpret the various role of monetary and fiscal policy in credit control and inflation. (Evaluating)
6. Design macroeconomic models or tools for analyzing real time economic situations. (Creating)

Module I: Introduction to Macroeconomics and National Income Accounting (22 hours)
Basic issues studied in Macroeconomics; Measurements of Gross Domestic Product; Income, Expenditure and the Circular Flow; Real vs. Nominal GDP; Price Indices

Module II: Money (18 hours)
Functions of Money; Quantity Theory of Money – Classical and Modern Approach; Determination of Money Supply and Demand; Credit Creation; Tools of Monetary Policy

Module III: Inflation (15 hours)
Meaning and Types; Demand Pull and Cost Push; Inflationary Gap; Inflation and its Social Costs; Anti-inflationary Measures; Hyperinflation; Deflation – Meaning, Effects; Inflation vs. Deflation

Module IV: The Closed Economy in the Short Run (20 hours)
Classical and Keynesian Systems; Simple Keynesian Model of Income Determination; IS-LM Model; Fiscal and Monetary Multipliers

Suggested Readings

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ENMT0029: MATHEMATICAL METHODS FOR ECONOMICS–I (5-1-0)

COURSE OUTCOMES
1. Define basic concepts of mathematical tools for economics. (Remembering)
2. Classify the mathematical tools for economics. (Understanding)
3. Apply some mathematical tools for economics into various theories of Economics. (Applying)
4. Draw inferences using the mathematical tools. (Analyzing)
5. Interpret the applications wherever optimization techniques are used in decision-making. (Evaluating)
6. Discuss the use of mathematical tools for logical rationalization or refuting arguments. (Creating)

**Module I: Preliminaries (10 hours)**

Logic and Proof Techniques; Variables; Sets and Set Operations; Relations; Functions and their Properties; Limit of a Function; Number Systems

**Module II: Functions of one Real Variable (20 hours)**

a. Graphs; Elementary Types of Functions – Quadratic, Polynomial, Power, Exponential, Logarithmic; Sequences and Series – Convergence, Algebraic Properties and Applications; Continuous Functions – Characterizations, Properties with Respect to various Operations and Applications

b. Differentiable Functions – Characterizations, Properties with Respect to various Operations and Applications; Second and Higher Order Derivatives – Properties and Applications

**Module III: Single-variable Optimization (15 hours)**

Geometric Properties of Functions – Convex Functions, Their Characterizations and Applications; Local and Global Optima – Geometric Characterizations, Characterizations using Calculus and Applications

**Module IV: Integration of Functions (15 hours)**

Meaning and Significance; Basic Rules of Integration; Indefinite and Definite Integrals; Integration by Parts and Partial Fraction

**Module V: Difference Equations (15)**

Basic forms; Finite Differences; Linear Difference Equations – Homogenous and Non-homogenous; Solution of First Order Difference Equation

**Suggested Readings**


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**ENME0030: INTRODUCTORY MACROECONOMICS (5-1-0)**

**COURSE OUTCOMES**

1. Define basic concepts of macroeconomics including national income, money and inflation. (Remembering)
2. Understand the relationship among the macroeconomic variables like GDP, money supply, inflation and related concepts of closed economy. (Understanding)
3. Apply basic mathematical formulae to measure national income and its related terms. (Applying)
4. Analyze the quantity theory of money, Keynesian model of income determination, IS-LM model and its application for real life economic decision making. (Analyzing)
5. Interpret the various role of monetary and fiscal policy in credit control and inflation. (Evaluating)
6. Design and develop macroeconomic models or tools for analyzing real time economic situations. (Creating)

**Module I: Introduction to Macroeconomics and National Income Accounting (22 hours)**

Basic Issues Studied in Macroeconomics; Measurements of Gross Domestic Product; Income, Expenditure and the Circular Flow; Real vs. Nominal GDP; Price Indices; National Income Accounting for an Open Economy; Balance of Payments – Current and Capital Accounts

**Module II: Money (18 hours)**

Functions of Money; Quantity Theory of Money – Classical and Modern Approach; Determination of Money Supply and Demand; Credit
Creation; Tools of Monetary Policy

Module III: Inflation (15 hours)
Meaning and Types; Demand Pull and Cost Push; Inflationary Gap; Inflation and its Social Costs; Anti-inflationary Measures; Hyperinflation; Deflation – Meaning, Effects; Inflation vs. Deflation

Module IV: The Closed Economy in the Short Run (20 hours)
Classical and Keynesian Systems; Simple Keynesian Model of Income Determination; IS-LM Model; Fiscal and Monetary Multipliers

Suggested Readings

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ENMS0031: MATHEMATICAL METHODS FOR ECONOMICS-II (5-1-0)

COURSE OUTCOMES
1. Define the basic concepts of mathematics like set, function, matrix algebra etc. used in economic analysis. (Remembering)
2. Explain the usage of the basic concepts of mathematics in Economics. (Understanding)
3. Apply the mathematical techniques to elucidate the problems of economic theory. (Applying)
4. Analyse the economic theory and draw inferences in context of mathematical techniques. (Analysing)
5. Explain the need of mathematical techniques in understanding real economic theory. (Evaluating)
6. Develop or build mathematical models to solve numerical problems in economic theory. (Creating)

Module I: Differential Equations (15)
Meaning and Types; Homogeneous and Non-homogeneous and their Solutions; Linear and Nonlinear; Solution of Linear Differential Equation; Application to Dynamic Market Model

Module II: Linear Algebra (18 hours)
Vector Spaces – Algebraic and Geometric Properties, Scalar Products, Norms, Orthogonality; Linear Transformations – Properties; Systems of Linear Equations – Properties of their Solution Sets; Matrix Representations and Elementary Operations; Determinants and Properties; Matrix Inversion; Applications

Module III: Functions of Several Real Variables (20 hours)
Geometric Representations - Graphs and level Curves; Differentiable Functions – Characterizations, Properties with Respect to various Operations and Applications; Second Order Derivatives – Properties and Applications; The Implicit Function Theorem, and Application to Comparative Statics Problems; Homogeneous and Homothetic Functions – Characterizations and Applications

Module IV: Multi-variable Optimization (22 hours)
b. Constrained Optimization with Equality Constraints – Geometric Characterizations, Lagrange Characterization using Calculus and Applications

Suggested Readings

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ENIC0032: INTERMEDIATE MICROECONOMICS – I (5-1-0)

COURSE OUTCOMES
1. Identify the concepts and terms of microeconomics. (Remembering)
2. Classify the role of economic agents and their interdependence. (Understanding)
3. Use basic principles of microeconomics. (Applying)
4. Illustrate the behaviour of consumer and producer in different situations. (Analyzing)
5. Interpret the production techniques under perfect markets. (Evaluating)
6. Discuss the use of microeconomic tools for examining real life problems. (Creating)

Module I: Consumer Theory - I (20 hours)
Utility – Cardinal vs. Ordinal Utility; Cardinal Utility Theory – Marginal and Total Utility, Equi-marginal Utility; Consumers’ Equilibrium; Marginal Valuation; Consumers’ Demand Curve; Ordinal Utility Theory - Preference of Consumers; Indifference Curve; Budget Constraint; Utility Maximisation; Consumers’ Equilibrium; Income Effects and Substitution Effects of a Price Change; Slutsky Equation; Price Consumption Curve; Income Consumption Curve; Derivation of Demand Curve from Price Consumption Curve

Module II: Consumer Theory - II (25 hours)
Choice Under Risk and Uncertainty – Uncertainty and Probability Distributions; Expected Value and Expected Utility; Maximising Expected Utility; Expected Utility Hypothesis; Expected Utility Functions and Attitudes towards Risk – Risk Neutral, Risk Averse Risk Preference, Certainty Equivalent and Risk Premium; Demand for Risky Assets; Reducing Risks; Intertemporal Choice – Saving and Borrowing; Revealed Preference Approach – Strong and Weak Axioms; Properties of Demand Function

Module III: Production and Costs (18 hours)
Technology and Production Function; Isoquants; Production with One and More Variable Inputs; Law of variable Proportion; Returns to Scale; Economies and Diseconomies of Scale; Short Run and Long run Costs; Cost Curves in the Short Run and Long Run; Equilibrium of the Firm

Module IV: Review of Perfect Competition (12 hours)
Review of Perfect Competition - Equilibrium of the Firm and Industry in the Short Run and Long Run; The Derivation of Long Run Industry Supply Curve; Constant, Increasing, and Decreasing Cost Industry; Perfect Competition and Allocative Efficiency

Suggested Readings

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ENIC0033: INTERMEDIATE MACROECONOMICS – I (5-1-0)
COURSE OUTCOMES
1. Describe the concepts of macroeconomics and its related terms. (Remembering)
2. Identify the aggregate variables and their interdependences in a closed as well as in an open economy. (Understanding)
3. Apply aggregate variables and concepts in examining the real-life situation. (Applying)
4. Evaluate the role of aggregate variables in the smooth functioning of an economy. (Analyzing)
5. Elucidate the effects of aggregate changes on overall growth and development of an economy. (Evaluating)
6. Formulate macroeconomic models for analyzing real-life situations. (Creating)

Module I: Aggregate Demand and Aggregate Supply Curves (20 hours)
Concept of Aggregate Demand and Aggregate Supply; Derivation of Aggregate Demand and Aggregate Supply Curves; Interaction of Aggregate Demand and Supply; The Theory of Effective Demand; Simple Keynesian Model of Income Determination; Saving and Investment Functions; Investment Multiplier

Module II: Inflation, Unemployment and Expectations (25 hours)
Inflation – Types, Causes, Effects; Measures to Control Inflation; Structural Theories of Inflation; Inflation in Developing Countries; Inflation-unemployment Trade-off – Phillips Curve; Adaptive Expectations; Rational Expectations; Policy Ineffectiveness Debate

Module III: Open Economy Models (30 hours)
Short-run Open Economy Models; Mundell-Fleming Model; Exchange Rate Determination; Purchasing Power Parity; Asset Market Approach; Dornbusch’s Overshooting Model; Monetary Approach to Balance of Payments; International Financial Markets; Inflation and Unemployment in the Open Economy

Suggested Readings

Mapping of COs to Syllabus

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ENSM0034: STATISTICAL METHODS FOR ECONOMICS (5-1-0)

COURSE OUTCOMES
1. Recall basic concepts of Statistics. (Remembering)
2. Classify the different types and the methods of analyzing data. (Understanding)
3. Apply various Statistical Tools analyzing data. (Applying)
4. Draw Inferences from data. (Analyzing)
5. Interpret the inferences drawn from data. (Evaluating)
6. Predict the inferences drawn from the data. (Creating)

Module I: Introduction and Overview (10 hours)
Populations and Samples; Population Parameters and Sample Statistics; Measures of Location and Variation to Describe and Summarize Data; Population Moments and their Sample Counterparts

Module II: Elementary Probability Theory (15 hours)
Sample Spaces and Events; Probability Axioms and Properties; Addition and Multiplication Theorem of Probability, Counting Techniques; Conditional Probability and Bayes’ Rule; Independence of Events

Module III: Random Variables and Probability Distributions (15 hours)
Defining Random Variables; Probability Distributions; Expected Values of Random Variables and of Functions of Random Variables;
Properties of Commonly used Discrete and Continuous Distributions (Uniform, Binomial, Normal, Poisson and Exponential Random Variables)

Module IV: Random Sampling and Jointly Distributed Random Variables (15 hours)
Density and Distribution Functions for Jointly Distributed Random Variables; Computing Expected Values of Jointly Distributed Random Variables; Covariance and Correlation Coefficients

Module V: Sampling (10 hours)
Principal Steps in a Sample Survey; Methods of Sampling; Role of Sampling Theory; Properties of Random Samples; Errors in Statistics – Sampling vs. Non-sampling Errors

Module VI: Point and Interval Estimation (10 hours)
Estimation of Population Parameters using Methods of Moments and Maximum Likelihood Procedures; Properties of Estimators; Confidence Intervals for Population Parameters

Suggested Readings

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ENDP0035: DATA COLLECTION AND PRESENTATION (2-0-0)

COURSE OUTCOMES
1. Define the key terms related to data and its related concepts. (Remembering)
2. Understand the principles of sampling techniques and data collection methods. (Understanding)
3. Apply the various sampling technique and statistical measures in real life problems with the help of computer applications. (Applying)
4. Analyse the computer-based statistical results for better interpretation of the problem. (Analysing)
5. Evaluate the statistical results employing various types of diagrams and charts with the help of computer applications. (Evaluating)
6. Design and develop statistical tools or methods for real life applications in economics and other social sciences. (Creating)

Module I: Introduction to Data (5 hours)
Data – Meaning and Nature; Types of Data – Nominal, Ordinal, Interval and Ratio; Sources of Data – Primary and Secondary Data; Analysis of Data – Quantitative and Qualitative Data; Time Aspect of Data – Cross Sectional, Time Series and Pooled Data; Accuracy of Data; Concept of Variable

Module II: Sampling Design and Data Collection (5 hours)
Sample and Population; Sampling and Sampling Techniques; Random and Non-Random Sampling; Choice of Sampling Technique; Collections of Primary Data – Questionnaire Method, Use of Schedules, Interview Methods; Collection of Secondary Data – Sources and Advantages; Focus Group Discussion; Sampling Error

Module III: Data Processing and Presentation (10 hours)
Processing of Data- Data Entry, Data Screening, Validation and Cleaning; Data Coding and Classification; Data Organization and Presentation – Frequency Table, Cross Tabulation; Diagrammatic Presentation of Data; One Dimensional Diagrams – Single Bar, Subdivided Bar, Multiple Bar; Two Dimensional Diagrams – Histogram and Pie Diagram; Three Dimensional Diagrams - Rectangular and Cube Diagrams; Pictograms; Cartograms; XY Scatter Plot; Line Diagram; Radar Diagrams; Significance of Diagrams; Limitations of Diagrams

Module IV: Data Management with Computer Applications (10 hours)
Working with MS Word – Creating, Saving and Opening Documents in MS Word; Editing and Formatting; Previewing and Printing Word Document; Working With MS Excel – Creating, Saving and Opening Worksheets in MS Excel; Editing and Formatting; Using Formulas – Entering Formulas, Auto Sum and Other Common Auto-Formulas, Copying Formulas and Functions, Relative, Absolute, and Mixed Cell
References; Previewing and Printing Worksheet; Making Graphs and Charts; Multiple Worksheets-Concepts, Creating and Using, Data Analysis and Display; Working with Presentation - Creating, Saving and Opening Slides; Editing and Formatting; Customizing Slides; Previewing and Presenting

Suggested Readings

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ENIE0036: INDIAN ECONOMY – I (5-1-0)

COURSE OUTCOMES
1. Learn the basic understanding of Indian economy. (Remembering)
2. Understand the Indian economy since independence. (Understanding)
3. Identify the main issues in Indian Setup. (Applying)
4. Evaluate the impact development paradigm in the Indian Scenario. (Analyzing)
5. Explain shortcomings of the policy and programme for economic development. (Evaluating).
6. To understand the relation between India and the world economy as well as its neighboring countries. (Creating)

Module I: Economic Development since Independence (20 hours)

Module II: Population and Human Development (19 hours)
Demographic Trend and Issues – Meaning and Scope of Demography; Population as a Factor of Economic Development; National Population Policy; Demographic Dividend; Human Development Index; India’s Human Development Record in Global Perspective; Education in India – Trends and Issues; Health – Trends and Issues; Malnutrition in India

Module III: Growth and Distribution (20 hours)

Module IV: International Comparisons (16 hours)
India’s Economic Interaction with the World Economy; A Comparative Assessment of India’s Development Experience with Singapore, South Korea, China, Pakistan, Bangladesh, Sri Lanka, Nepal, Taiwan and Vietnam

Suggested Readings

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ENMB0037: MONEY AND BANKING (5-1-0)

**COURSE OUTCOMES**
1. Assess the components of a financial system with respect to real economy linkages and financial market participants (Remembering)
2. Understand the impact of central bank monetary policy on financial systems and the overall economy (Understanding)
3. Appraise the roles of financial intermediaries as both brokers and asset transformers (Applying)
4. Assess the development of financial markets and securities in response to market participant requirements (Analyzing)
5. Evaluate the different financial intermediation and risk management services that financial institutions provide and the need for governmental regulation (Evaluating)
6. Develop the knowledge of working of the central bank of the country in maintaining the financial target of the economy (Creating)

**Module I: Money and Functions of Money (12 hours)**
Concept of Money; Functions of Money; Theories of Demand for Money; Type of Money – M1, M2, M3, M4 and H

**Module II: Financial Institutions, Markets, Instruments and Financial Innovations (18 hours)**
Role of Financial Markets and Institutions; Money and Capital Markets; Organization, Structure and Reforms in India; Role of Financial Derivatives
Problem of Asymmetric Information – Adverse Selection and Moral Hazard

**Module III: Interest Rates (14 hours)**
Determination of Interest Rate; Sources of Interest Rate Differentials; Types of Interest Rate – Compound and Simple Interest Rate; Theories of Term Structure of Interest Rates; Interest Rates in India

**Module IV: Banking System in India (16 hours)**
Indian Banking System; Changing Role and Structure; Banking Sector Reforms; Credit Creation System of Commercial Bank; The Evolution of Commercial Banks, Regional Rural Bank in India; NABARD

**Module V: Central Banking and Monetary Policy (12 hours)**
Functions; Balance Sheet; Goals of Central Bank, Instruments of Monetary Control – Quantitative Control; Repo Rate; Reverse Repo Rate; CRR; SLR; Qualitative Control; Margin Requirements; Credit Rationing; Regulation of Consumer Credit; Moral Suasion; Publicity and Publication; Monetary Management in an Open Economy; Current Monetary Policy of India

**Suggested Readings**

**Mapping of COs to Syllabus**

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EENE0038: ENVIRONMENTAL ECONOMICS (5-1-0)

**COURSE OUTCOMES**
1. Define the basic concepts of environmental economics. (Remembering)
2. Understand the environmental issues in relation to the theory of externalities. (Understanding)
3. Apply environmental principles concerning the environmental problems and policies. (Applying)
4. Analyze environmental problems using economic principles. (Analyzing)
5. Evaluate the diverse methods of environmental valuation for sustainable development. (Evaluating)
6. Develop an approach to examine the contemporary environmental issues from an economists’ viewpoint. (Creating)

Module I: Introduction (20 hours)
Key Environmental Issues and Problems, Economic Way of Thinking about these Problems; Basic Concepts from Economics; Pareto Optimality and Market Failure in the Presence of Externalities; Property Rights and Other Approaches

Module II: The Design and Implementation of Environmental Policy (20 hours)
Overview; Pigouvian Taxes and Effluent Fees; Tradable Permits; Implementation of Environmental Policies in India and International Experience; Transboundary Environmental Problems; Economics of Climate Change

Module III: Environmental Valuation Methods and Applications (25 hours)
Valuation of Non-market Goods and Services – Theory and Practice; Measurement Methods; Cost-benefit Analysis of Environmental Policies and Regulations

Module IV: Sustainable Development (10 hours)
Sustainable Development – Basic Concepts and Measurement; Perspectives from Indian Experience

Suggested Readings

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ENMI00039: INTERMEDIATE MICROECONOMICS – II (5-1-0)

COURSE OUTCOMES
1. Recall the basic concepts of applied microeconomics. (Remembering)
2. Understand how the microeconomic concepts work in individual decision-making process (Understanding)
3. Apply the basic principles of applied microeconomics. (Applying)
4. Draw inferences from interactions of rivals in game theory. (Analyzing)
5. Interpret the characteristics of imperfect market structures. (Evaluating)
6. Discuss the use of applied microeconomic tools in real life. (Creating)

Module I: General Equilibrium, Efficiency and Welfare (20 hours)
Exchange Economy – Basic Concept; Pareto Optimality; Edgeworth Box; Equilibrium under Pure Exchange; Efficiency under Pure Exchange; Pareto Efficiency in Production; The Production Possibility Curve; Social Indifference Curves and Allocation of Resources; Pareto Efficiency and Market Failure; Externalities

Module II: Market Structure (20 hours)
Monopoly Equilibrium; Pricing with Market Power; Degree of Monopoly Power; Price Discrimination under Monopoly; Equilibrium of Multi-
Module III: Game Theory (20 hours)
Game Theory – Basic Ideas; Two-person Zero-Sum Game; Dominant Strategy; Prisoners’ Dilemma; Nash Equilibrium; Tit- for-tat Strategy; Non-Zero Sum Game – Basic Ideas, Examples; The Concept of Repeated Game; Competitive Strategy

Module IV: Market Failure (15 hours)
Externalities – A Simple Bilateral Model of Externality; Public Goods; Free Rider Problem; Markets with Asymmetric Information; Markets for Lemon; Moral Hazard

Suggested Readings

Mapping of COs to Syllabus

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ENMA0040: INTERMEDIATE MACROECONOMICS – II (5-1-0)

COURSE OUTCOMES
1. Recall the ideas and concepts of macroeconomics. (Remembering)
2. Classify macroeconomics from the perspective of policy making. (Understanding)
3. Apply some basic principles of macroeconomics. (Applying)
4. Draw inferences from interactions between macroeconomic thoughts and real life situation. (Analyzing)
5. Interpret the characteristics of economic growth. (Evaluating)
6. Discuss the use of macroeconomic tools for analysing real time situations. (Creating)

Module I: Economic Growth (20 hours)
Overview of Classical Growth Theory; Harrod-Domar Growth Model; Solow Model; Golden Rule; Convergence Debate: Technological Progress and Elements of New (Endogenous) Growth Theory

Module II: Microeconomic Foundations (30 hours)

- Consumption: Keynesian Consumption Function; Fisher’s Theory of Optimal Intertemporal Choice; Life-cycle and Permanent Income Hypotheses; Rational Expectations and Random-walk of Consumption Expenditure
- Investment: Determinants of Business Fixed Investment; Residential Investment and Inventory Investment; Marginal Efficiency of Capital and Investment
- Demand for money: Pre-Keynesian and Post-Keynesian Theories of Demand for Money; Demand for Money and Inflation

Module III: Fiscal and Monetary Policy (15 hours)
Active or Passive; Monetary Policy – Objectives, Targets; Rules vs. Discretion – Time Consistency; Government Budget Constraint; Government Debt and Ricardian Equivalence

Module IV: Schools of Macroeconomic Thoughts (10 hours)
Classical Thoughts; Keynes Criticism; Keynesian Thoughts; New Classicals and New Keynesians

Suggested Readings
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ENIS0041: INTRODUCTORY ECONOMETRICS (5-1-0)

COURSE OUTCOMES
1. Define the basic concepts like definition, scope and nature of econometrics. (Remembering)
2. Explain the concepts of simple and multiple linear regressions. (Understanding)
3. Apply OLS method to estimate regression parameters. (Applying)
4. Analyse the results of regression models with hypothesis testing. (Analysing)
5. Evaluate the regression models for violations of classical assumptions and specification bias. (Evaluating)

CO6 Create and design regression models to test hypothesis of real economic problems. (Creating)

Module I: Nature and Scope of Econometrics (8 hours)
Basics of Econometrics – Meaning and Methodology; Relation with Mathematical Economics and Statistics; Applications of Econometrics; Nature of Econometrics

Module II: Statistical Concepts (12 hours)
Normal Distribution; \( \chi^2 \), t and F Distributions; Estimation of Parameters; Properties of Estimators; Testing of Hypotheses – Defining Statistical Hypotheses; Distributions of Test Statistics; Testing Hypotheses related to Population Parameters; Type I and Type II Errors; Power of a Test; Tests for Comparing Parameters from Two Samples

Module III: Simple Linear Regression Model - Two Variable Case (15 hours)
Estimation of Model by Method of Ordinary Least Squares; Properties of Estimators; Goodness of Fit; Tests of Hypotheses; Scaling and Units of Measurement; Confidence Intervals; Gauss-Markov Theorem; Forecasting

Module IV: Multiple Linear Regression Model (15 hours)
Estimation of Parameters; Properties of OLS Estimators; Goodness of Fit – R\(^2\) and Adjusted R\(^2\); Partial Regression Coefficients; Testing Hypotheses – Individual and Joint; Functional forms of Regression Models; Qualitative (Dummy) Independent Variables

Module V: Violations of Classical Assumptions - Consequences, Detection and Remedies (15 hours)
Multicollinearity – Consequences, Detection, Remedies; Heteroscedasticity – Consequences, Detection, Remedies; Serial Correlation – Consequences, Detection, Remedies

Module VI: Specification Analysis (10 hours)
Omission of a Relevant Variable; Inclusion of Irrelevant Variable; Tests of Specification Errors

Suggested Readings

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ENSD0042: STATISTICAL DATA ANALYSIS (2-0-0)

COURSE OUTCOMES
1. Define the key statistical terms and concepts related to data. (Remembering)
2. Understand the principles of statistical measures. (Understanding)
3. Apply the various statistical measures and their forecasting techniques in real life problems. (Applying)
4. Analyse the various statistical results like hypothesis testing and forecasting in practice. (Analyzing)
5. Evaluate the statistical results employing various hypothesis testing tools with various statistical packages like SPSS and STATA. (Evaluating)
6. Design and develop statistical tools or methods for real life applications in social sciences. (Creating)

Module I: Basic Statistical Tools (7 hours)
Measures of Central tendency - Arithmetic Mean (Simple and Weighted), Geometric Mean, Harmonic Mean, Median, Mode, Quartiles, Merits and Demerits of Measures of Central Tendency; Measures of Dispersion - Concepts of Measures of Dispersion, Range, Quartile Deviation, Standard Deviation, Variance, Properties of Variance, Coefficient of Variation; Merits and Demerits of Measures of Dispersion

Module II: Statistical Tools for Forecasting (7 hours)
Regression – Simple Linear Regression Line, Interpretation of Regression Coefficients, Properties of Regression Coefficients, Residuals and their Properties; Correlation – Karl Pearson’s Correlation Coefficient and its Properties, Spearman Rank Correlation Coefficient; Time Series Analysis – Components of Time Series, Additive and Multiplicative Models, Determination of Trend, Construction of Seasonal Indices and Forecasting

Module III: Statistical Inferences (9 hours)
Population Parameter and Sample Statistic; Point and Interval Estimation; Hypothesis – Concept of Null And Alternative Hypothesis, Simple and Composite Hypothesis, Characteristics of Good Hypothesis; Statistical Errors – Type I and Type II Errors; Critical Region, Size and Power of a Test; Level of Significance and P-value; Hypothesis Testing – Formulation of Statistical Hypotheses, Testing Hypotheses Related to Population Parameters; Sampling Distribution of a Statistic; Important Distributions for Statistical Inference – Z (Normal) Distribution, T Distribution, F Distribution and χ² Distribution and their Practical Uses

Module IV: Introduction to Statistical Packages (7 hours)
Introduction to Statistical Package – SPSS and STATA; Working with SPSS/STATA – Preparing the Data File, Creating Data File and Entering Data, Defining the Variables, Entering Data, Modifying Data File, Import File, Screening and Cleaning Data; Analysis with SPSS/STATA – Frequency and Cross Tabulation, Descriptive/Summary Statistics, Estimating Correlation Coefficient and Regression Coefficients, Constructing Basic Diagrams

Suggested Readings
2. Agarwala, B.L., Basic Statistics, New Age International, 2019

Mapping of COs to Syllabus

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ENIE0043: INDIAN ECONOMY-II (5-1-0)

COURSE OUTCOMES
1. Define the Macroeconomic Policies and their Impact Indian Economy. (Remembering)
2. Explain the policies and Performance in Agriculture. (Understanding)
3. Identify the policies and performance in Industry. (Applying)
4. Evaluate the impact of various development policies in Agriculture and Industry in the Indian Scenario. (Analyzing)
5. Explain the trends and performance in service sectors. (Evaluating)
6. Discuss their understanding of the usefulness of various development policies. (Creating)

Module I: Macroeconomic Policies and their Impact (20 Hours)
Fiscal Policy – Fiscal Reform Measures in the Context of India’s New Economic Policy; Monetary Reforms and its Impact; Black Money and Parallel Economy in India – Consequences and Corrective Government Intervention; Trade and Investment Policy – Export Import Policy, Foreign Trade Policy; Labour Regulation

Module II: Policies and Performance in Agriculture (20 Hours)
Changing Structure of Indian Agriculture; Sustainable Agriculture – Concept and Constraints; Diversification of Agriculture; Impact of Technology on Agriculture; Green Revolution and its Impact on Agricultural Development; Land Reforms and Agricultural Growth in India; Agricultural Credit – Role and Sources of Credit; Agricultural Marketing and Strategy for Development; Trade – WTO and Agriculture; Agricultural Pricing Policy in India

Module III: Policies and Performance in Industry (20 Hours)
Pattern of Industrialization; Industrial Growth and Productivity in the Post Reform Period; New Industrial Policy and Economic Reforms in India; Disinvestment and Privatization; Development of MSME Sector; Globalization and Competition; Foreign Investment in the Industrial sector

Module IV: Trends and Performance in Services (15 Hours)
Role of the Service Sector in the Indian Economy; Growth in and Composition of the Service Sector; Formal and Informal Enterprises in Service Sector; Trend and Growth of Banking and Insurance; Balance of Payments Position – Pre and Post Reform period; Trade in Services and WTO

Suggested Readings
1. Shankar Acharya, Macroeconomic Performance and Policies 2000-8, in Shankar Acharya and Rakesh Mohan (Editors),
3. Rakesh Mohan, India’s Financial Sector and Monetary Policy Reforms, in Shankar Acharya and Rakesh Mohan, editors,

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ENHI0044: ECONOMIC HISTORY OF INDIA 1857-1947 (5-1-0)

COURSE OUTCOMES
1. Understand the economic structure during colonial period. (Remembering)
2. Explain the agrarian structure in the post-independence period. (Understanding)
3. Identify their texts and link the different positions of macroeconomic trends. (Applying)
4. Evaluate the contribution of railways and industry. (Analyzing)
5. Explain the government and fiscal policies under colonial rule. (Evaluating)
6. Discuss the usefulness of railways and industries in the development process of Indian economy. (Creating)

Module I: Introduction: Colonial India: Background and Introduction (15 hours)
An Overview of Economic Structure and Policies of Pre-independence Era; The Laws of Inheritance; Socio-cultural Attitudes and India’s Economic Backwardness; Drain Theory; Economic Ideas of Ranade and Gandhi

Module II: Macro Trends (15 hours)
National Income – Trend and Composition; Population – Growth, Age Structure and Sex Composition; Changing Occupational Structure

Module III: Agriculture (15 hours)
Agrarian Structure and Land Relations; Agricultural Markets and Institutions – Credit and Irrigation; Land Systems; Commercialization of Agriculture – Causes and Consequences; Trends in Performance and Productivity; Famines

Module IV: Railways and Industry (15 hours)
Railways; The De-industrialization Debate; Industrial Development during the Imperial Era – Cotton, Jute, Steel, Tea Plantation; Evolution of Entrepreneurial and Industrial Structure; Nature of Industrialisation in the Interwar Period; Constraints to Industrial Breakthrough; Labour Relations

Module V: Economy and State in the Imperial Context (15 hours)
The Imperial Priorities and the Indian Economy; Drain of Wealth; International Trade, Capital Flows and the Colonial Economy – Changes and Continuities; Government and Fiscal Policy

Suggested Readings
5. Irfan Habib, Indian Economy 1858-1914, A People’s History of India, Vol.28,
7. John Hurd, Railways, CEHI, Chapter 8, pp.737-761

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ENPF0045: PUBLIC FINANCE (5-1-0)

COURSE OUTCOMES
1. Define the main concepts in public finance. (Remembering)
2. Explain the analytical grasp of government taxes: direct and indirect taxes, (Understanding)
3. Identify the main issues in government expenditure. (Applying)
4. Evaluate economic concepts of public finances. (Analyzing)
5. Explain the diagrammatic analysis to demonstrate and compare the economic welfare effects of various government policy options. (Evaluating)
6. Discuss their understanding of the usefulness and problems related to government revenues and expenditures. (Creating)

Module I: Fiscal Functions (15 hours)
Public Finance; Meaning and Scope, Normative Approach to Public Finance – Allocation, Distribution and Stabilization function of government, coordinating the functions; Pareto Efficiency, Equity vs. Efficiency

Module II: The theory of Public Goods (15 hours)
Public Goods – Meaning and characteristics; Public Goods and Market Failure; Type of public goods-Pure and Impure Public Goods, The
Free Rider Problem and Market Failure; Efficient Allocation of Public Goods – The Lindahl Equilibrium

Module III: Externalities (15 hours)
Meaning and Types of Externalities; Externalities vis-a-vis Public Good, Internationalization of Externalities; Correctivetaxes and Subsidies; Assignment of Property Rights – The Coase Theorem

Module IV: Incidence of Taxation and Excess Burden of Tax (15 hours)
Direct and Indirect Tax; Concepts of Taxation; Tax Rate, Buoyancy and Elasticity of a Tax; Proportional, Progressive and Regressive Taxation; Concept of Shifting and Incidence, Forward and Backward Shifting, The Demand and Supply Theory of Incidence Excess Burden of Tax: Meaning and Types

Module V: Issues from Indian Public Finance (15 hours)
Working of Monetary and Fiscal Policies; Fiscal Policies- Definition and Objectives; Instruments of Fiscal Policy; Adopting Monetary Policy to Complement Fiscal Policy; Reforms in the Indirect Tax Structure- Goods and Service Tax, Budget and Deficits; Types of Deficits and their Significance

Suggested Readings

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ENDE0046: DEVELOPMENT ECONOMICS-I (5-1-0)

COURSE OUTCOMES
1. Define the various concepts of growth and development. (Remembering)
2. Compare and explain the difference between growth and development. (Understanding)
3. Identify the various growth theories. (Applying)
4. Analyse the aspects of measuring development. (Analysing)
5. Justify the use of HDI over other measures of development. (Evaluating)
6. Improve the understanding of the development process. (Creating)

Module I: Conceptions of Development (20 hours)
Development – Meaning and Definition; Difference between Growth and Development; Objectives of Development; Three Core Values of Development; Shortcomings of use of Per Capital Income as Index of Economic Development; Modern view of Economic Development – Human Development Index, Basic Needs Approach, Sen’s Capabilities Approach; Top-down Development; Inclusive Development and Sustainable Development

Module II: Growth Models and Empirics (18 hours)
Growth Models and their Relevance to the UDCs; Harrod and Domar’s Model of Economic Growth; The Knife Edge Problem; Solow’s
Module III: Poverty and Inequality: Definitions, Measures and Mechanisms (20 hours)
Understanding Poverty – Concept and Definition; Measuring Poverty, Poverty Line, Head Count Ratio, Poverty Gap Ratio, Squared Poverty Gap Ratio, Multidimensional Poverty Index, Human Poverty Index; Measurement of Income Inequality – Economic Growth and Income Inequality, Kuznets Hypothesis, Lorenz Curve, Gini Coefficient

Module IV: Political Institutions and the Functioning of the State (17 hours)
The Determinants of Democracy; Alternative Institutional Trajectories and their Relationship with Economic Performance; Within-country Differences in the Functioning of State Institutions; State Ownership and Regulation; Government Failures and Corruption

Suggested Readings
1. Todaro & Smith, Economic Development, Pearson Education

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ENHE0047: ECONOMICS OF HEALTH AND EDUCATION (5-1-0)

COURSE OUTCOMES
1. Learn the key importance of health and education in development process (Remembering)
2. Understanding the micro economics concept in relation to health sector (Understanding)
3. Evaluating the health care programme and policy to provide decision concerning the allocation of resources (Applying)
4. Explain the health system in the context of Indian scenario (Analyzing)
5. Evaluate the importance of investment in education to increase human capital. It also gives lights on direct and indirect benefits of education in development of society. (Evaluating)
6. Develop the knowledge of educational financing from the point of view of Economics (Creating)

Module I: Role of Health and Education in Human Development (10 hours)
Health and Education Outcomes and their Relationship with Economic Development; Investing in Health and Education – Physical Capital vs. Human Capital; Education & Health as Joint Investments for Development; Importance of Health & Education in Poverty Alleviation

Module II: Microeconomic Foundations of Health Economics (15 hours)
Demand for Health – Production Function of Health, Grossman’s Model of Demand for Health; Determinants of Demand for Health & Health Care; Supply of Health Care – Health Care Delivery System; Health Insurance Market; Difference between Private and Social Health Insurance; Causes of Market Failure in the Provision of Health Services – Moral Hazard, Adverse Selection, Supplier-induced Demand, Externalities; Rationale for Government Intervention in the Health Sector; Issues of Equity and Inequality

Module III: Evaluation of Health Programs (10 hours)
Economic Evaluation of Health Care – Cost Minimization Analysis, Cost Effectiveness Analysis, Cost Benefit Analysis, Cost Utility Analysis; Burden of Disease – HALE, QALYs and DALYs

Module IV: Health Sector in India: An Overview (12 hours)
Overview of Health Care in India; Health System of India; Health Outcomes – Indicators of Health Outcomes, Socio- economic Determinants of Health; Health Financing Concept and Scope in India; Policies for Achieving Health for All

Module V: Education: Investment in Human Capital (14 hours)
Rate of Return to Education; Private and Social; Quality of Education; Education and Economic Growth; Cost of Education – Expenditure on Education; Signaling or Human Capital; Theories of Discrimination
Module VI: Education Sector in India: An Overview (14 hours)
Literacy Rates; School Participation; School Quality Measures; Gender and Caste Discrimination in India; The Approaches of Education Planning – Social Demand Approach, Social Justice Approach, Rate of Returns Approach, Man Power Planning Approach; Educational Planning in Developing Countries with Special Reference to India

Suggested Readings

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ENAE0048: APPLIED ECONOMETRICS (5-1-0)

COURSE OUTCOMES
1. Define the advanced topics like empirical research, regression diagnostics, dynamic econometric models and panel data models. (Remembering)
2. Explain the dynamic econometric models and panel data models with diagnostics. (Understanding)
3. Apply estimation methods to determine parameters of dynamic and panel data models. (Applying)
4. Analyse the results of dynamic and panel data models along with regression diagnostics. (Analysing)
5. Evaluate the dynamic regression models and panel data models with software package. (Evaluating)
6. Create and design dynamic regression models and panel data models to test hypothesis of real economic problems. (Creating)

Module I: Stages in Empirical Econometric Research (15 hours)
Statement of the Problem; Review of Literature; Research Design and Methodology; Data Collection; Data Analysis; Interpretation

Module II: Regression Diagnostics and Specification (10 hours)
Misspecification; Functional Forms; Model Selection

Module III: Advanced Topics in Regression Analysis (20 hours)
Dynamic Econometric Models: Distributed Lag Models; Autoregressive Models; Instrumental Variable Estimation; Simultaneous Equation Models

Module IV: Panel Data Models (20 hours)
Methods of Estimation; Fixed Effects Model; Random Effects Model

Module V: Introduction to Econometric Software Package (10 hours)
GRETL; E-VIEWS; STATA (any one)

Suggested Readings

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ENTM0049: TOPICS IN MICROECONOMICS – I (5-1-0)

COURSE OUTCOMES
1. Identify the body of basic game theory concepts that enables economic analysis. (Remembering)
2. Explicate the uses and the concepts of basic game theory. (Understanding)
3. Apply game techniques to elucidate economic problems. (Applying)
4. Assess the role of game theory in context of mathematical techniques. (Analyzing)
5. Explain the solution concepts for game theory with a variety of economic applications. (Evaluating)
6. Develop basic game tools to analyze real economic problems. (Creating)

Module I: Normal form Games – I (20 hours)
The Normal form – Basic Ideas; Dominant and Dominated Strategies; Iterated Elimination of Strictly Dominated Strategies; Iterated Elimination of Weakly Dominated Strategies; Dominance Solvability; Pure and Mixed Strategies; Nash Equilibrium

Module II: Normal form Games – II (20 hours)
Symmetric Games – Player-symmetry, Strategy-symmetry, Symmetry Principle; Symmetric Single Population Games; Symmetric Equilibrium; Applications of Normal form Games

Module III: Extensive form Games with Perfect Information – I (15 hours)
Formalizing Perfect Information Extensive form Games – The Game Tree; Perfect Information Extensive form Strategies

Module IV: Extensive form Games with Perfect Information – II (20 hours)
Sub-game Perfection; Sub-game Perfect Nash Equilibrium in Finite Games; Backward Induction in Finite Games; Generalized Backward Induction Procedure; Commitment; Bargaining; Other Applications

Suggested Reading:

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ENPO0050: POLITICAL ECONOMY – I (5-1-0)

COURSE OUTCOMES
1. Provide students with basic conceptual tools and frameworks for analyzing economic development issues. (Remembering)
2. Give students a basic understanding of the economic development process in several regions of the world. (Understanding)
3. The students understand the practical applicability of the economics theories to complex economic issues. (Applying)
4. Develop the ability to evaluate the determinants of economic growth including institutions, human capital, international trade, and financial development. (Analyzing)
5. Examine various strategies that governments could employ to promote growth, such as poverty relief programs, public investment in education, intellectual property right protection, and industrial policies. (Evaluating)
6. Enable to examine the working of various institutional frameworks and their evolution in different phases of Economics reforms. (Creating)

Module I: Introduction and Historical Overview (15 hours)
Perspective on Political Economy with a Historical Overview; Capitalist Development in the Pre-second World War Period; Golden Age – Factors Contributing to Golden Age; Review of Economic Growth of Asian Countries during Golden Age
Module II: Changing Dynamics of Capitalist Production, Organizational Form. (15 hours)
Fordist and Post-Fordist Production; Inclusive vs. Extractive Institutions; Obstacles to Institutional Change; Changing Dynamics of Organization; Production, Markets and Labour Process, The Changing Nature of Job Security and Labour Rights

Module III: The State in the Era of Globalization (12 hours)
Different Views on Globalization; Welfare Development and Autonomy; Globalization and the Limits of the Welfare State; Traditional Trade Share to GDP; Job Creation; Foreign Direct Investment; Development and State Autonomy

Module IV: The Changing Role of Finance and social Dimension (15 hours)

Module V: New Perspectives of Political economy (15 hours)
Gender in Work; Gender and Wage Discrimination; Accumulation and Globalization; Issues in Environment and Sustainability; GHG Emission, Climate Change, Energy Use, Property Rights Protection; Decision Tree; Contract Enforcement and the Hold-Up Problem; Solutions to Contract Failure

Suggested Readings
5. David Harvey, A Brief History of Neoliberalism, OUP, 2005.

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ENFM0051: MONEY AND FINANCIAL MARKETS (5-1-0)

COURSE OUTCOMES
1. Assess the components of a financial system with respect to real economy linkages and financial market participants(Remembering)
2. Understand the impact of central bank monetary policy on financial systems and the overall economy.(Understanding)
3. Appraise the roles of financial intermediaries as both brokers and asset transformers. (Applying)
4. Assess the development of financial markets and securities in response to market participant requirements.(Analyzing)
5. Evaluate the different financial intermediation and risk management services that financial institutions provide and the need for governmental regulation. (Evaluating)
6. Develop the knowledge of working of the central bank of the country in maintaining the financial target of the economy. (Creating)

Module I: Money and functions of money (12 hours)
Concept of Money; Functions of Money; Medium of Exchange, Unit of Account, Store of Value; Theories of Demand for Money; Type of Money – M1, M2, M3, M4 and H Theory of Money Supply

Module II: Financial Institutions, Markets, Instruments and Financial Innovations (18 hours)
Role of Financial Markets and Institutions; Problem of Asymmetric Information – Adverse Selection and Moral Hazard; Money and
Capital Markets: Organization, Structure and Reforms in India; Role of Financial Derivatives

**Module III: Interest Rates (14 hours)**
Determination of Rate of Interest; Importance of Interest; Sources of Interest Rate Differentials; Compound and Simple Interest Rate; Theories of Term Structure of Interest Rates; Interest Rates in India

**Module IV: Banking System in India (16 hours)**
Indian Banking System – Changing Role and Structure; Banking Sector Reforms; The Evolution of Commercial Banks, Credit Creation System of Commercial Bank; Regional Rural Bank in India; Non-Performing Asset

**Module V: Central Banking and Monetary Policy (12 hours)**
Functions, Balance Sheet; Goals of Central Bank, Instruments of Monetary Control; Qualitative and Quantitative Measures of Credit Control; Monetary Management in an Open Economy; Current Monetary Policy of India

**Suggested Readings**

**Mapping of COs to Syllabus**

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**ENDE0052: DEVELOPMENT ECONOMICS-II (5-1-0)**

**COURSE OUTCOMES**
1. Define the key concept of demography (Remembering)
2. Explain the concept of land, labour, and credit market in order to understand the problem faced by developing countries. (Understanding)
3. Identify the sustainable development issues for sustainable growth. (Applying)
4. Analyze the role of globalization in the process of development. (Analyzing)
5. Explain the governance of communities and organizations in developing countries. (Evaluating)
6. Discuss various aspects of process of development. (Creating)

**Module I: Demography and Development (20 hours)**
Meaning and Scope of Demography; Demographic Concepts – Birth and Death Rates, Age Structure, Fertility and Mortality, Life Expectancy at Birth, Sex Ratio; The Theory of Demographic Transition – Demographic Transitions During the Process of Development; Gender Bias in Preferences and Outcomes and Evidence on Unequal Treatment Within Households; Connections between Income, Mortality, Fertility Choices and Human Capital Accumulation; Migration

**Module II: Land, Labour and Credit Markets (18 hours)**
The Distribution of Land Ownership; Land Reform and its Effects on Productivity; Contractual Relationships between Tenants and Landlords; Land Acquisition; Nutrition and Labour Productivity; Informational Problems and Credit Contracts; Microfinance; Interlinkages between Rural Factor Markets

**Module III: Individuals, Communities and Collective Outcomes (15 hours)**
Individual Behaviour in Social Environments; Multiple Social Equilibria; Governance in Organizations and in Communities; Individual Responses to Organizational Inefficiency
Module IV: Environment and Sustainable Development (12 hours)
Defining Sustainability for Renewable Resources; Brief History of Environmental Change; Common-Pool Resources; Environmental Externalities and State Regulation of the Environment; Economic Activity and Climate Change

Module V: Globalization (10 hours)
Concept of Globalization; Globalization in Historical Perspective; Economics and Politics of Multilateral Agreements; Trade; Production Patterns and World Inequality; Trade and Development Strategies – Import Substitution vs. Export Promotion; Financial Instability in a Globalized World

Suggested Readings

Mapping of COs to Syllabus

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ENPC0053: POLITICAL ECONOMY – II (5-1-0)

COURSE OUTCOMES
1. The students get the idea of the origin of Capitalism thoughts (Remembering)
2. Develop the knowledge of the relation between the capitalist economics and monopolist capitalism working. (Understanding)
3. Realization of working of the state in a capitalist economy (Applying)
4. Development the idea of the origin of economics in Indian context of Chanakya’s Arthashastra. (Analyzing)
5. Evaluating the various conflicts of economics and political thoughts over the various phase of time. (Evaluating)
6. Develop the knowledge of various class conflicts in India during the colonial period. (Creating)

Module I: Analyzing Social Change in Historical Perspective (18 hours)
The Method of Historical Materialism; Transition from Feudalism to Capitalism – Factors Responsible for Transition of Feudalism to Capitalism; Capitalism as a Historical Process – Characteristic of Capitalism, Industrial Revolution and Capitalism; Alternative Perspectives

Module II: Capitalism as an Evolving Economic System (17 hours)
Basic Features; Accumulation and Crisis; Modern Corporation; Monopoly Capitalism – Process of Concentration and Centralization of Capital, Competitive Process, Capitalist Relation

Module III: The State in Capitalism (17 hours)
The State and the Economy; Contestation and Mutual Interdependence; The State as an Arena of Conflict; Imperialism – The Basic Foundations

Module IV: Class relationship in India (20 hours)
Early Indian Economic Thought – Chanakya’s Arthashastra; Colonial Economic Policies; Class Politics and Indian States – Class Politics, Minority Politics, Types of Politics and Economic Performance; Demand Polity and Command Polity

Suggested Readings

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ENCC0054: COMPARATIVE ECONOMIC DEVELOPMENT (1850-1950) (5-1-0)

COURSE OUTCOMES
1. Learn the key importance of comparative economic development issues (Remembering).
2. Develop the understanding of key comparative economic (Understanding)
3. Show a clear awareness of the historical underpinning of economic development in Britain, Japan and China. (Applying)
4. Describe and analyze the main sectors and institutions in each of these contemporary economies. (Analyzing)
5. Evaluate the key factors of the agricultural revolution experienced by Great Britain and the rise of Industries. (Evaluating)
6. Improve the understanding of the industrial working class and their growth. (Creating)

Module I: Introduction and Perspectives on Comparative Economic Development (10)
Introduction to Comparative World Economic History; Perspectives on World Economic History; Why Study Comparative World Economic History?

Module II: An Overview of Economic Development of the countries selected for case studies (20)
Britain – Pre requisites for Industrial Revolution and the Socio-economic Climate in Britain that was Conducive to its Industrial Growth; CHINA – Ming and Qing Dynasty; An Overview of the Agricultural Sector; JAPAN – Imperial Rule Paving way for Samurai Governance; Rise of EDO Governance – An Overview of the Agricultural Sector

Module III: Agriculture (10)
Agrarian Surplus and the Role of the Peasantry in Economic Development; Agricultural Revolution

Module IV: Industry (10)
The Industrial Revolution in Britain; Spread of Industrial Revolution Worldwide; Movement towards Industrial Growth; Industrialization in Late Industrializers

Module V: The Factory System and Making of the Industrial Working Class (15)
Division of Labour; Structure of Industrial Authority; Organisation of Work and Industrial Production; Relationship between Workers and Managers

Module VI: The Role of the State in Industrial and Developmental Transition (10 hours)
Market Failures and Importance of State Intervention; Role of the State in Developmental Transition Especially in Agricultural and Industrial Sectors; State and Corruption; Role of the State in India for Economic Development – Development Plans and Policy Choices, Allocation of Resources in Industry and Agriculture

Suggested Readings

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ENFI0055: FINANCIAL ECONOMICS (5-1-0)

COURSE OUTCOMES
1. Define the various components of Financial System. (Remembering)
2. Explain the various concepts related to the investment theory. (Understanding)
3. Identify the capital asset pricing models. (Applying)
4. Compare the various concepts of options and derivatives. (Analysing)
5. Explain the importance corporate finance and related concepts. (Evaluating)
6. Discuss pattern and working principles of corporate finance.

Module I: Investment Theory and Structure of Interest rates: Deterministic cash-flow streams (15 hours)
Basic theory of Interest; Discounting and Present Value; Internal Rate of Return; Evaluation Criteria; Fixed-Income Securities; Bond Prices and Yields; Interest Rate Sensitivity and Duration; Immunisation; The Term Structure of Interest Rates; Yield Curves; Spot Rates and Forward Rates

Module II: Models of Single-period random cash flows (15 hours)
Random Asset Returns; Portfolios of Assets; Portfolio Mean and Variance; Mean-Variance Portfolio Analysis – The Markowitz Model, The Two-Fund Theorem; Risk-Free Assets and The One-Fund Theorem

Module III: Capital Asset Pricing Model (12 hours)
The Capital Market Line; The Capital Asset Pricing Model; The Beta of an Asset and of a Portfolio; Security Market Line; Use of The CAPM Model in Investment Analysis and as a Pricing Formula

Module IV: Options and Derivatives (18 hours)
Introduction to Derivatives and Options; Forward and Futures Contracts; Options; Other Derivatives; Forward and Future Prices; Stock Index Futures; Interest Rate Futures; The Use of Futures for Hedging; Duration-Based Hedging Strategies; Option Markets; Call and Put Options; Factors Affecting Option Prices; Put-Call Parity; Option Trading Strategies: Spreads; Straddles; Strips and Straps; Strangles; The Principle of Arbitrage; Discrete Processes and The Binomial Tree Model; Risk- Neutral Valuation

Module V: Corporate Finance (15 hours)
Patterns of Corporate Financing – Common Stock, Debt, Preferences, Convertibles; Capital Structure and the Cost of Capital; Corporate Debt and Dividend Policy; The Modigliani- Miller Theorem

Suggested Readings
Mapping of COs to Syllabus

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**ENTM0056: TOPICS IN MICROECONOMICS – II (5-1-0)**

**COURSE OUTCOMES**
1. Identify the body of game theory concepts that enables economic analysis. (Remembering)
2. Explicate the uses and the concepts of game theory. (Understanding)
3. Apply Bayesian game techniques to elucidate economic problems. (Applying)
4. Assess the role of information in formulating game theory. (Analyzing)
5. Explain the solution concepts for game theory with a variety of economic applications. (Evaluating)
6. Develop game techniques to analyze real economic problems. (Creating)

**Module I: Repeated Games (25 hours)**
The Basic Idea; Finitely Repeated Games vs. Infinitely Repeated Games; Finitely Repeated Games and Backward Induction; Infinitely Repeated Games; History Dependent Strategies; One-step Deviation Property; The Repeated Prisoners’ Dilemma; Idea of Folk Theorem – Nash Folk Theorem

**Module II: Simultaneous-move Games with Incomplete Information (Bayesian Games) (16 hours)**
Strategies; Solving Bayesian Games; Information and Bayesian game; Bayesian Nash Equilibrium; Public Good Provisions; Auctions; Other Applications of Bayesian Games

**Module III: Extensive form Games with Imperfect Information (22 hours)**
Strategies; Principles for the Equivalence of Extensive Games; Mixed and Behavioral Strategies; Sequential Equilibrium – Strategies and Beliefs; Games with Observable Actions; Applications

**Module IV: Information Economics (12 hours)**
Adverse Selection – Consequences, Solutions, Numerical Example with Private Information; Moral Hazard – Consequences, Solutions; Signaling Games

**Suggested Readings**

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**ENDI6001: DISSERTATION/PROJECT**

**Course Description:**
The UG students would be required to do project work and submit dissertation. The project work is to be related to the specialization area chosen by the student. Dissertation submitted by the students would be evaluated by External Examiners appointed by the University.

**Course Objectives:**
The aim of the course is to equip the students with presentation skills and develop academic writing skill. Moreover, the students will also be able to apply the statistical research training acquired in the taught element of the program by designing an appropriate research strategy and research methodology to carry out the research. The students will also learn how to apply the statistical and econometric tools in their own research.
The Structure of the Course:
In Dissertation, the students have to independently think of a research idea and, by the end of the semester, have to defend a research proposal based on the idea i.e. need to present the Synopsis by the end of the sixth semester. The dissertation will include original research question(s) if any, critical review of the relevant literature, analytical tools employed in response to the research questions, data analysis and interpretation. Finally, the students need to submit the dissertation to the university authority maintaining all instructions provided by the university. Under the process, the students will be guided by an assigned supervisor of the department to do the work.

Structure of Dissertation

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DETAILED SYLLABUS - MA ECONOMICS

THEORY COURSES

ENML0046: MICROECONOMIC ANALYSIS (4-0-0)

COURSE OUTCOMES
1. Describe the detail concepts of microeconomics (Remembering)
2. Illustrate the behaviour of economic agents as well as the behaviour of the firms (Understanding)
3. Apply microeconomic concepts and theories to analyse real-life situations (Applying)
4. Illustrate the interactions of Microeconomics with other branches of Economics (Analyzing)
5. Elucidate the effects of economic policies on microeconomic behaviour and thus on the overall economic activities (Evaluating)
6. Develop ideas and critical insights for analysing real-life economic problems (Creating)

Module I: Choice under Risk and Uncertainty (12 hours)
The von-Neumann-Morgenstern Axioms; Expected Utility Theory; Risk Aversion; Certainty Equivalent and Risk Premium;
Reducing Risk – Diversification, Insurance, Information; Comparative Risk Aversion; The Demand for Risky Assets; The State Preference
Approach to Choice under Uncertainty

Module II: Imperfect Market Structure: Oligopoly (15 hours)
Basic Market Structure; Non-collusive Oligopoly – Cournot, Bertrand, Stackelberg, Paul Sweezy; Collusive Oligopoly –
Cartels, Price Leadership, Single Basing-point Price; The Mark-up Rule

Module III: Factor Pricing and Income Distribution (15 hours)
Review of Factor Pricing under Perfectly Competitive Markets; Factor Pricing Under Imperfectly Competitive Markets; Monopolistic and
Monopsonistic Powers; Labour Union and Collective Bargaining; Bilateral Monopoly; Elasticity of Factor Substitution; Technological
Progress and Factor Share; Pricing of Fixed Factors – Rents and Quasi Rents

Module IV: The Theory of Public Choice (10 hours)
Pareto Optimality; Social Welfare Functions – Bergson & Samuelson, Arrow; Maximisation of Social Welfare;
Compensation Criteria; Arrow’s Impossibility Theorem; The Theory of Second Best; Social vs. Private Costs and Benefits

Module V: Market Failures (8 hours)
Externalities and Inefficiency; A Simple Bilateral Externalities; Public Goods and Free Riders Problems; Imperfect Markets; Asymmetric
Information and Markets for Lemons; Moral Hazard; Adverse Selection; Signaling

Suggested Readings
Edition, 2010
7. N. Gregory Mankiw, Economics: Principles and Applications, India edition by South Western, a part of Cengage Learning,Cengage

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ENMY0047: MACROECONOMIC ANALYSIS (4-0-0)
COURSE OUTCOMES
1. Describe the detail concepts of macroeconomics and its related terms. (Remembering)
2. Identify the behaviour of macroeconomic variables and their interdependences in a closed as well as in an open economy. (Understanding)
3. Apply macroeconomic variables and concepts in examining the real-life situation (Applying)
4. Evaluate the role of macroeconomic variables in smooth functioning of an economy and its dynamics. (Analyzing)
5. Elucidate the effects of macroeconomic changes and policies on overall growth and development of an economy. (Evaluating)
6. Formulate and develop macroeconomic models and tools for analyzing real-life macroeconomic situations. (Creating)

Module I: Consumption and Investment Functions (12 hours)
Theories of Consumption – Absolute Income, Relative Income, Life Cycle, Permanent Income; Theories of Investment – The Present Value Criterion for Investment, Marginal Productivity of Capital, The Marginal Efficiency of Capital and Investment, Financial Theory of Investment; Lags in Investment; Portfolio Disequilibrium and the Transmission Mechanism

Module II: Money Demand, Inflation and Unemployment (15 hours)
Post-Keynesian Theories of Demand for Money – Friedman, Patinkin, Baumol, Tobin; Determinants of Money Supply; Patinkin’s Real Balance Effect; Theories of Inflation; Inflation and Unemployment – Phillips Curve Analysis; Trade-off vs. No Trade-off – Tobin, Friedman; The Inflationary Pressure Curve; Adaptive and Rational Expectations; Okun’s Law; Keynesianism vs. Monetarism

Module III: New-Classical Macroeconomics (10 hours)
Main Features of New-Classical Model; Rational Expectation – Barrow’s View; Rational Expectations and the Real Business Cycles – Kydland, Prescott; Expectations of Future Variables – Sargent, Muth; Macroeconomic Imbalances; Lucas Aggregate Supply Function; The Rational Expectations Hypothesis and its Critique

Module IV: Cyclical Fluctuation (8 hours)
Characteristics of Cyclical Fluctuation; Business Cycle in Market Economies; Short-Term vs. Long-Term Growth Trend; Theories of Business Cycles – Samuelson, Hicks, Kaldor, Schumpeter; Impact of Recession on Trade Imbalances

Module V: Open Economy Macroeconomics (15 hours)
IS-LM Analysis in Open Economy; Mundell-Fleming Model; Marshall-Lerner Condition; Interest-Rate Differentials; Inflation and Unemployment in the Open Economy; Fiscal Policies with Exchange Rate and Inflation; Floating Exchange Rates with Zero and Perfect Capital Mobility; Exchange Rate Expectations; Exchange Rate Overshooting

Suggested Readings

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ENMM0048: Mathematical Methods in Economics (4-0-0)

COURSE OUTCOMES
1. Identify the body of basic mathematics that enables economic analysis (Remembering)
2. Explicate the usage of the concepts of mathematics in Economics (Understanding)
3. Apply mathematical techniques to elucidate economic problems (Applying)
4. Assess the role of economic theory and draw inference in context of mathematical techniques (Analysing)
5. Explain the solution concepts for economic problems with a variety of economic applications (Evaluating)
6. Develop or build mathematical models to analyse real economic problems (Creating)
Module I: Optimization with Equality Constraint (12 hours)
Solving Equality Constrained Optimization without Lagrange Multiplier; Lagrange Characterization – Single and Multi- constraint Cases; Complementary Slackness Condition; Sensitivity Analysis; Income Expansion Path

Module II: Optimization with Inequality Constraint and Input-Output Model (13 hours)
Binding and Non-binding Constraints; Solution with One and Two Inequality Constraints; Kuhn-Tucker Method; Mixed Constraints – Solution with Equality and Inequality Constraints; Basic Structure of Input-Output Model; Open and Closed Model; Hawkins-Simon Condition; Static and Dynamic Model

Module III: Difference and Differential Equations (15 hours)
Solution of First Order Difference Equations; Economic Applications; Solution of Second Order Difference Equations – Homogeneous and Non-Homogeneous Equations; Economic Applications of Second Order Homogenous and Non- Homogeneous Equation – Cobweb Market Model, Market Model with Inventory, Determining Dynamic Market Equilibrium Price; Plotting Differential Equation – Phase Diagram

Module IV: Basic Game Theory (20 hours)
Appraisal of Normal Form Games; Games with Perfect Information – Strategic Games, Nash Equilibrium and Existence Properties, Application to Market Equilibrium and Pricing; Extensive Form Games with Perfect Information – Pure Strategy and Nash Equilibrium, Sub-game Perfect Equilibrium, Backward Induction, Bargaining Game (Split-the-Pie); Extensive Form Games with Imperfect Information – Principles for the Equivalence of Extensive Games, Mixed and Behavioural Strategies, Nash Equilibrium; Repeated Games – Finitely Repeated Games and Backward Induction, Infinitely Repeated Games; Dependent Strategies

Suggested Readings
1. Allen, R.G.D., Mathematical Analysis for Economists, Macmillan and Co Ltd.
4. J. M. Henderson and R. E. Quandt, Micro-economic Theory – A Mathematical Treatment

Mapping of COs to Syllabus

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ENEO0049: ECONOMICS OF DEVELOPMENT (4-0-0)

COURSE OUTCOMES
1. Define the key aspects of economic development. (Remembering)
2. Explain the role of various measurement of economic development. (Understanding)
3. Identify the various theories and approaches to economic development. (Applying)
4. Analyse the uses of various development theories of growth. (Analyzing)
5. Explain the importance of development theories. (Evaluating)
6. Discuss the various key aspects of dualistic development theories and its applicability. (Creating)

Module I: Measurement of Economic Development (10 Hours)

Module II: Theories and Approaches to Economic Development (17 Hours)
Evolution in the Concept of Economic Development – Growth to Sustainable Development; Approaches to Development – Income Approach and Criticism; Sen’s Capability Approach; Establishment Space in Economic Development; Theories of Economic Development – Karl Marx and Development of Capitalist Economy; Theory of Social Change; Surplus Value and Profit

Module III: Theories of Growth (15 Hours)
Summary of Classical Growth Models – Structural Model and Limitations; A Brief Review of Neo-classical Growth Models – Production Function in Neo-classical Growth; Instability of Growth; Solutions of Instability Problem; The Convergence Debate; Endogenous Growth
Models – Arrow, Uzawa-Locus, Romer; The New Economic Geography – Krugman

Module IV: Development Strategies and Dualistic Pattern of Development (18 Hours)
Big Push – Rosenstein-Rodan; Balanced Growth – Nurks; Unbalanced Growth – Hirschman; Critical Minimum Efforts – Leibenstein; Structural Change Models – Lewis, Fei- Renis; Rural-Urban Migration- The Harris-Todaro Model; Core- Periphery Models; The Process of Cumulative Causation – Myrdal; Neo-Colonial Dependence Model

Suggested Readings

Mapping of COs to Syllabus

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ENMB0050: MONEY AND BANKING (3-0-0)

COURSE OUTCOMES
1. Learn basic ideas of monetary theory and the effects of monetary variables on the macroeconomic system. (Remembering)
2. Understand the working of non-banking financial institution and international financial institutions. (Understanding)
3. Develop the ability to understand the role of monetary forces and real forces and their interconnection in shaping and influencing the monetary and related policies both at the national and international levels. (Applying)
4. Understand the working of Indian banking system and the interconnectivity of the banks. (Analyzing)
5. Enable to evaluate the trend of financial reform in the field of financial inclusion. (Evaluating)
6. Understand the various determinant of demand and supply of money and its role in balancing the growth of the economy. (Creating)

Module I: Supply and Demand for Money (11 hours)
Money Supply – Theoretical and Empirical Attempts to Define Money; Components of Money Supply; Money Creation by the Banking System; High Powered Money and Money Multiplier; Measures of Money Supply and Liquidity in India; Balance Sheet of Central Bank; Demand for Money; Interest Sensitivity of Demand for Money – A Review of Classical, Keynesian and Monetarist Theories of Demand for Money

Module II: Theories in Rate of Interest (12)
Term Structure of Interest Rates; Expectations Theory; Liquidity Premium Theory; Structure of Interest Rates in India; Monetary Policy – Targets, Goals and the Trade Offs among Alternate Goals; Lags in Operation; Keynesian and Monetarist Views on Transmission Mechanism; Rules vs. Discretion

Module III: Banking Structure in India (11 hours)
Central Banking – Main Functions; Policy Tools, Recent Monetary Policy of RBI; Money Aggregates Targeting: Interest Targeting and Inflation Targeting Approaches of RBI; Autonomy of RBI; Commercial Banking – Types of Commercial Banks in India; Credit Creation Process; Major Developments in Commercial Banking in India since Reforms (including Mergers); Recent Developments on Financial Inclusion; Performance of Private and Public Banks

Module IV: Non-Banking Financial Institutions (11 hours)
Role, Growth and Structure of Non-Banking Financial Institutions (NBIs) in India; Types and Control of Non-Banking Financial Companies (NBFCs); International Monetary System: IMF as provider of International Liquidity; Constituents of International Money and Capital Markets

Suggested Readings

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ENIP0051: INDIAN ECONOMIC DEVELOPMENT (3-0-0)

COURSE OUTCOMES
1. Learn the key issues related to the Indian economy. (Remembering)
2. Understand the economic reforms and its impact on Indian economy. (Understanding)
3. Identify the policies and performance in different sector (Applying)
4. Evaluate the impact of various development policies in Agriculture and Industry in the Indian Scenario. (Analyzing)
5. Explain the economic reform and its impact in Indian economy. (Evaluating)
6. Discuss their understanding of the usefulness of various development policies. (Creating)

Module I: Indian Economic Development: An Overview (10 hours)

Module II: Economic Reforms (12 hours)

Module III: Sectoral Development (13 hours)
Issues and Concern in Indian Agriculture – Land Reform, Green Revolution, Agricultural Price Policy; Agriculture and WTO; Industrial Development in India – Industrial Growth since 1991, New Industrial Policy and its Impact; Trends in Exports and Imports – Foreign Trade Policy; Assessment of Performance of Service Sector in India in the Contemporary Period

Module IV: Macroeconomic Policies and their Impact in Indian Economy (10 hours)
Financial Sector Reform and Impact of Monetary Policy; Reforms in Banking Sector; Capital Market and its Reform; Reforms in fiscal Policy – Fiscal Responsibility and Budget Management (FRBM) Act; Reform in Indian Labour Market in Post-liberalization Period

Suggested Readings
2. Rakesh Mohan, India’s Financial Sector and Monetary Policy Reforms, in Shankar Acharya and Rakesh Mohan, Editors,

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ENSM0052: STATISTICAL METHODS IN ECONOMICS (4-0-0)

COURSE OUTCOMES
1. Explain in detail the measures and approaches of various statistical tools and techniques (Remembering)
2. Express the notion of pre-specified ideas about statistical parameters and methods for hypothesis testing (Understanding)
3. Explicate the idea statistical estimation and analytical techniques (Applying)
4. Gain computational skills to put into practice various statistical inferential approaches (Analysing)
5. Evaluate the underlying assumptions of various analysis tools and techniques (Evaluating)
6. Analyze the results and suggest recommendations to the decision making processes (Creating)

Module I: Distribution Theory (15 hours)
Review of Distribution Theory – Discrete and Continuous Distribution; Truncated Distribution – Poisson Only; Compound Distribution – Binomial, Poisson; Random Vectors; Joint Distributions; Variance-covariance Matrix; Transformations of Bivariate Random Variables; Bivariate Normal Distributions

Module II: Probability Theory (15 hours)
Review of Axiomatic Approach to Probability and Baye’s Theorem; Expectations of Functions of Random Variables; Moment Generating Functions; Conditional Expectation and Distribution; Conditional Variance; Applications; Characteristic Function of a Random Variable

Module III: Sampling Techniques (15 hours)
A Brief Review of Random Sampling and Estimates of a Population Mean; Ratio Method Estimation – Concept, Bias; Ratio Estimators in Simple Random Sampling and Stratified Random Sampling; Regression Method of Estimation – Concept, Bias; Regression Estimators in Simple Random Sampling and Stratified Random Sampling; Cluster Sampling – Estimation with Equal and Unequal Clusters; Sub Sampling (Two-Stage only)

Module IV: Statistical Inference (15 hours)

Suggested Readings

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ENEM0053: ECONOMETRIC METHODS (4-0-0)

COURSE OUTCOMES
1. Define the basic concepts of econometrics and statistics. (Remembering)
2. Explain the concepts of simple linear regression and its associated topics. (Understanding)
3. Apply the regression models estimating regression parameters using OLS. (Applying)
4. Analyse the results of regression models with hypothesis testing and different statistical tests. (Analysing)
5. Evaluate the regression models along with diagnostics and model specification. (Evaluating)
6. Create and design hypothesis of economic problems and advance regression models with qualitative variables. (Creating)

Module I: Linear Regression and Diagnostic Analysis (18 hours)
Overview of the Classical Linear Regression Models - Simple and Multiple; Methods of Estimation-Methods of Moments, Method of Least Squares, Maximum Likelihood Method; Properties of Estimator; Goodness of Fit - R Square and Adjusted R Square; Hypothesis Testing for Regression Coefficients; Analysis of Variance (ANOVA); Problems with Linear Regression - Specification Bias, Autocorrelation, Heteroscedasticity, Multicollinearity; Outliers – Leverage and Influence; Tests for Outliers; Test for Linearity; Tests of Omitted Variables

Module II: Advanced Models in Regression (12 hours)
Use of Instrumental and Dummy Variables; Models with Qualitative Dependent Variables – Probit, Logit and Tobit Probability Models; Simultaneous Equation Models – Nature and Problems; Simultaneity Bias; Structural, Reduced-form and Recursive Models; Identification Problem – Rank and Order Conditions; Identification and Multicollinearity; Over Identified Linear Model – Generalised Method of Moments

Module III: Estimation of Simultaneous Equation Models (10 hours)
Indirect Least Squares (ILS); Method of Instrumental Variables (IV); Two Stage Least Squares (2SLS); Limited-Information Maximum Likelihood Method; Exogeneity and Causality – Weak and Strong Exogeneity, Tests for Exogeneity, Granger Causality

Module IV: Dynamic Econometric Models (10 hours)
Lagged Variables – Meaning and Importance; Distributed Lag Models – Koyck and Almon Approaches; Autoregressive Models – Partial Adjustment Model and Adaptive Expectation Models

Module V: Basics of Time Series Analysis (10 hours)
Stationary and Nonstationary Time Series; Box-Jenkins Approach; Unit Roots Tests – Null and Alternative Hypotheses under Unit Root Tests; Cointegration and Cointegrating Regression

Suggested Readings

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ENPS0054: PUBLIC ECONOMICS (4-0-0)

COURSE OUTCOMES
1. Define the main concepts in public economic policies. (Remembering)
2. Explain the concepts of public goods, public expenditures and taxation. (Understanding)
3. Identify the main issues of budgeting and fiscal policies. (Applying)
4. Evaluate economic concepts of income redistribution. (Analyzing)
5. Explain the evaluation of public investment projects and decision making in the public sector. (Evaluating)
6. Discuss their understanding of the usefulness and problems related to government subsidies and income support. (Creating)

Module I: Government Activity and Public Economic Policies (15 hours)
DEPARTMENT OF ECONOMICS


Module II: Theories of Public Goods, Public Expenditures and Taxation (15 hours)
The Theory of Public Goods; Provision of Private Goods and Public Goods — Markets and Government; The Demand for a Pure Public Good; Efficient Output of a Pure Public Good — Partial and General Equilibrium Analysis; Individual Action; Voluntary Cooperation and Efficiency; Local Public Goods; Voting Models of Public Goods; The Theory of Public Expenditure — Tiebout, Samuelson, Buchanan; Theories of Taxation; Tax Neutrality; Direct vs. Indirect Taxes and Equity; Buoyancy and Elasticity Estimates of Taxation; Tax Efforts; The Impact of Taxes on Market Prices and Efficiency

Module III: Budgeting, Fiscal Policies and Income Redistribution (15 hours)
Program Budgeting — It’s Application; Zero-Based Budgeting; Budgeting Policies; Theory of Fiscal Policy; Fiscal Policy with Special Reference to Under-developed Countries; Federal-Fiscal Relation in India; Income Redistribution — Taxes, Government Expenditures and the Distribution of Income, Welfare, Social Security and the Social Safety Net; Demographic Changes and the Future of Social Security; The Impact of Social Security on Savings and Work Incentives; Government Subsidies and Income Support — The Basis and Trade-off

Module IV: Public Investment Projects and the Public Sector (15 hours)

Suggested Readings
3. Hyman D N, Public Finance: A Contemporary application of Theory to Policy, Thomson South Western

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ENDV0055: INDIAN ECONOMIC DEVELOPMENT AND POLICY (4-0-0)

COURSE OUTCOMES
1. Understand the recent economic reforms in Indian economy since 1991. (Remembering)
2. Explain the sector wise reform ranging from agriculture to service sector and foreign trade as well. (Understanding)
3. Identify the main issues of reform and policy debate and its performance in Indian Economy. (Applying)
4. Evaluate the impact of various development policies in Agriculture and Industry in the Indian Scenario. (Analyzing)
5. Explain the trends and performance in service sectors. (Evaluating)
6. Discuss their understanding of the usefulness of various development policies. (Creating)

Module I: Economic Reforms Since 1991 (14 hours)
Indian Economy During Reforms — An Assessment; Main Aspects of New Economic Policy and its Relevance; Recent Issues of Indian Economy – National Institution for Transforming India (NITI Aayog), Demonetization, Goods and Service Tax (GST), The Insolvency and
Bankruptcy Code (IBC), Digital India, Make in India

**Module II: Sectoral Development and Recent Reforms (18 hours)**
Issues and Concern in Indian Agriculture – Agriculture Price Policy; Farm Law, Indian Agricultural Industry Reform; Industrial reform – MSME Development, Impact of Financial Reforms on Industrial Sector; Foreign Trade – Current Position of Balance of Payments of India, Export-Import Policy (EXIM); Foreign Direct Investment (FDI); Service Sector – Reasons for Rapid Service Sector Growth, Information and Communications Technology (ICT), India’s Information Technology (IT) and ITES Industry

**Module III: Major Issues of Indian Economy (15 hours)**
Poverty, Inequality and Inclusive Growth – A Critical Assessment; Employment and Unemployment – Policy Implications; Rural Development – Role of Cooperatives, Agriculture Diversification, Organic Farming; Sustainable Economic Development; Privatization and Disinvestment Debate; Regional Imbalances

**Module IV: Performance of Indian Economy (13 hours)**
Indicators of Development – Physical Quality of Life Index (PQLI), Human Development Index (HDI), Gender Development Indexes (GDI); Inequality-Adjusted Human Development Index Indicators of India’s Economic Performance – Fiscal and Financial Sector Reforms and Recent Changes in the Policy; Recent Changes in Monetary Policy in India and its Impact; Centre State Finance Relations; Finance Commission in India

**Suggested Readings**
4. Kapila U, Indian economy since independence, Academic foundation, New Delhi

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**ENPB0056: PUBLIC FINANCE (3-0-0)**

**COURSE OUTCOMES**
1. Know about Indian tax system and its type and reforms over the years (Remembering)
2. Discuss the various types of grants available and the mechanism of availing those grants (understanding)
3. Develops analytical framework that facilitates the evaluation of public policy and subsequently inform the public debate. (Applying)
4. Evaluate the process of budget allocation and discuss the trend of government expenditure (Analyzing)
5. Examining the working of various international financial institution in the context of globalization (Evaluating)
6. Develop administrative skill with the knowledge of government fiscal policy (creating)

**Module I: Taxation and Budget: (13 hours)**
Indian Tax System; Revenue of the Union; Major Taxes in India; Base of Taxes; Direct and Indirect Taxes; Reforms in Direct and Indirect Taxes; Taxes on Goods and Services – GST; Analysis of Central and State Government Budgets; Kinds of Budget; Different Concepts of Budget Deficits; Lack of Flexibility in Central and State Budgets; Shrinking Size of Development Finance Through Budgets; Trends in Public Expenditure; Non Plan Expenditure; Growth of Subsidies Public Debt; Trends in Internal and External Debt; Crowding out of Private Investment and Activity; Devolution of Resources and Grants; Reports of Finance Commissions in India; Transfer of Resources from Centre and State to Local Bodies; Panchayati Raj Finances

**Module II: Government expenditure and Theories of Public Expenditure (11 hours)**
Public Policy and Expenditure Allocation of Resources; Provision of Public Goods; Voluntary Exchange Models; Demand Revealing Schemes for Public Goods; Contributions of Clarks; Groves and Leyard; Tiebout Model; Stabilization Policy; Keynesian Case for Stabilization Policy; Wagner’s Law of Increasing State Activities; Wiseman-Peacock Hypothesis; Pure Theory of Public Expenditure; Structure and Growth of Public Expenditure; Criteria for Public Investment; Social Cost- benefit Analysis
Module III: Deficit Financing: Concept and its Relation with Inflation (10 hours)
Deficit Financing in India; Issues Relating to Public Debt; Debt Burden Analysis and Management of Public Debt; Domar’s concept of Debt Sustainability; Public Debt in India; Need for Rule Based Fiscal Consolidation; Fiscal Responsibility and Budget Management (FRBM) Act 2003; Recent Amendments to FRBM Act

Module IV: Intergovernmental Grants in Theory and Practice (11 hours)
Growth and Decline of Federal Grants; Purposes of Grants; Correcting Spatial Externalities; Redirecting Priorities; Types of Grants – General Purpose vs. Categorical, and Project grant. Lump-sum or Matching, Open-ended vs. Close-ended, Matching Grants; Various Classification; Efficiency and Equity Effects of Grants; Indifference Analysis of Grants;

Suggested Readings

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ENRM0057: RESEARCH METHODOLOGY IN ECONOMICS (4-0-0)

COURSE OUTCOMES
1. Describe the different types of research and the needs of research in Economics (Remembering)
2. Identify the essential conditions helpful for the formulation of research hypothesis (Understanding)
3. Evaluate the various tools and techniques of sampling to collect data (Applying)
4. Gain knowledge of statistical software for analysing data (Analysing)
5. Assess the relative importance of various analytical tools and techniques (Evaluating)
6. Formulate logical arguments for a research problem (Creating)

Module I: Basics of Research (10 hours)
Meaning, Types, Characteristics and Scope of a Scientific Research; Steps Involved in Scientific Research; Literature Review and Identification of a Research Gap; Formulation and Types of Hypothesis and/or Research Questions; Objectives; Research Design; Reference and Documentation; Limitations and Ethical Issues in Research

Module II: Sample Design and Data Processing (12 hours)
Nature and Sources of Data; Types of Data – Cross Sectional, Time Series, Pooled; Accuracy of Data; Types of Sampling, Determination of Sample Size, Sampling Procedure; Choice of Sampling Technique; Errors in Sampling; Processing of Data; Validation of Field Work; Editing and Coding; Classification and Presentation

Module III: Data Analysis (15 hours)
Qualitative and Quantitative Analysis; Univariate and Multivariate Analysis; Descriptive and Inferential Analysis; Testing of Hypotheses – Single and Multiple Comparison; Non-Parametric Tests; Test for Randomness; Advanced Data Analysis Techniques; Multidimensional Scaling

Module IV: Report Writing and Interpretation of Results (10 hours)
Types of Report; Importance of Report; Steps in Report Writing; Citation Styles; Footnotes and Bibliography; Presentation and Interpretation of Results; Research Findings and Suggested Recommendations
Module V: Statistical Software for Data Analysis (13 hours)
Basics of Computer and its use in Research; Introduction to Different Software (Excel, SPSS, STATA, EViews, etc.); Entering Data in Software; Defining and Recoding Variables; Computing new Variables; Data Analysis with Statistical Software (Use Practical Examples)

Suggested Readings
2. Jerry W. Willis, Foundations of Qualitative Research: Interpretive and Critical Approaches, Sage
3. Tandon, B.C., Research Methodology in Social Sciences
4. Subramanian, N., Introduction to Computers
7. Bryman Alan, Social Research Methods, Oxford University Press, Oxford

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ENES0058: ENVIRONMENTAL ECONOMICS AND SUSTAINABILITY (4-0-0)

COURSE OUTCOMES
1. Define the basic concepts of environmental economics, including its key principles and methods. (Remembering)
2. Understand the environmental issues in relation to the theory of externalities, public goods, and welfare. (Understanding)
3. Apply environmental principles concerning the choice of instruments for controlling pollution and the relative strength and weaknesses of environmental policies based on command-and-control and market-based instruments. (Applying)
4. Analyze environmental problems using various economic techniques and to assess various environmental policies and issues. (Applying)
5. Evaluate and examine the methods developed for valuing environmental goods and services for sustainable development. (Evaluating)
6. Develop and design various approaches to examine issues in the contemporary environmental discourse from and economists’ point of view. (Creating)

Module I: Economics of Resources (12 hours)
Economics of Natural Resources; Resources and its Management; Optimal use of Renewable Resources; Common Property Resources and Open Access; Tragedy of Commons; Non-renewable Resources – Economic Issues Relating to use of Non-renewable Resources; Optimal Depletion; Backstop; Exploration and Technological Progress

Module II: Environmental Issues and Regulation (13 hours)
Problems of Market Failure - Public Goods and Externalities; Environment Degradation as Market Failure; Externality – Environmental Damage as Negative Externality; Social Choice of Optimum Pollution; Pigovian Tax; Coase Theorem; Property Rights; Pollution – Environmental Pollution as a Public Bad; Optimal Pollution; Pollution Control – Market Based Instruments, Emission Fees, Tradable Pollution Permits, Hybrid Instruments, Double Dividend Hypothesis; Environmental Policies in India

Module III: Valuation of Environmental Goods (15 hours)
Ordinary Goods vs. Environmental Goods; Use and Non-use Values; Willingness to Pay and Willingness to Accept; Valuation Methods for Environmental Goods; Direct Methods or Stated Preference Methods – Contingent Valuation; Indirect or Revealed Preference Methods – Hedonic Pricing Method, Travel Cost Method

Module IV: Global Environmental Concerns and Sustainable Development (20 hours)
Climate Change, Loss of Biodiversity, Ozone Depletion, Pollution Havens; Sustainable Development – Concept, Notions and Different Approaches to Sustainability; Measurement of Sustainability; Sustainable Accounting – United Nations’ System of Environmental and Economy Accounting; Brundtland Commission; Sustainable Industrialization; Environmental Impact Assessment; Meaning of Resource Conversation; Material Substitution; Recycling – Optimum Recycling; Waste Management; Micro Planning for Eco-preservation – Watershed and Joint Forest Management, Wildlife Management; Role of International Organizations – IPCC, UNEP, Earth System Governance Project

Suggested Readings

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### ENEG0059: AGRICULTURE ECONOMICS – ISSUES AND MANAGEMENT (4-0-0)

**COURSE OUTCOMES**

1. Draw distinctive features of agriculture which can influence the whole economy (Remembering)
2. Recognize limited resources available in the economy and realize the need of their efficient allocations through improved production techniques (Understanding)
3. Identify the new investment opportunities in agriculture to challenge economic problems like unemployment, inequality etc. (Applying)
4. Assess the role of agricultural policies to achieve harmonious development (Analysing)
5. Explain the trade-off between agriculture and non-agriculture to achieve sustainable agricultural development and insensitizing overall development (Evaluating)
6. Use of economic theories in optimizing the production and distribution of agricultural products (Creating)

**Module I: Agricultural Resources and Production (15 hours)**

Resources in Agriculture; Land as a Resource; Land Capability; Issues in Utilization of Land; Competition for Agricultural Land; Effects of Urbanization; Land Degradation; Water as a Resource; Institutional Arrangements and Issues in Water Allocation; Managing Disasters – Drought, Flood, Famine; Production Function in Agriculture; Substitutability of Factors; Farm Size and Laws of Return

**Module II: Agricultural Markets and Pricing (20 hours)**

Supply Response in Agriculture; Issues Relating to Specification of Supply Response Function – Distributed Lags; Rigidity in Farm Supply Response – Supply Response of Individual Crops and Aggregate Production; Market Supply of Subsistence and Perennials Crop; Barriers to Internal Trade; Marketing Reforms; Behaviour of Agricultural Prices – Cobweb Cycles and Demand and Supply of Agricultural Products; Marketed and Marketable Surplus; Terms of Trade between Agriculture and Non-agriculture

**Module III: Agricultural Finance (13 hours)**

Role of Agencies; Inter-linked Markets; Subsidy and Taxation in Agriculture; Regulated Markets; Crop and Livestock Insurance; Food Security and Public Distribution System; Infrastructural Development; Rural Credit and Rural Indebtedness; Need for State Intervention

**Module IV: Farm Management (12 hours)**

Farm Management Analysis – Production Function Approach, Farm-budgeting Approach; Farm Efficiency Measurements; Farm Efficiency Indicators; Productivity and Farm Size Debate; Crop Protection – Weed Control, Pest and Disease Control

### Suggested Readings

5. Penson, Capps, Rosson & Woodward, Introduction to Agricultural Economics, 7th Edition

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ENED0060: ECONOMICS OF EDUCATION (4-0-0)

COURSE OUTCOMES
1. Know Understand the concept of welfare economics and its applicability in education sector (Remembering)
2. Understand the educational financing from the point of view of Economics (Understanding)
3. Gain policy level understanding for improvement of health sector from economics prospective. (Applying)
4. Explore approaches of economic theory to health sector. (Analyzing)
5. The students can evaluate the investment pattern in education and also understand the direct and indirect benefits of education in development of society. (Evaluating)
6. Get an idea on various scopes to do research on education and health sector by applying the different economics theories. (Creating)

Module I: Economics of Education (15 hours)
Human Capital – Types, Components; Human Capital Theory; Education as an Instrument for Economic Growth; Demand for Education; Supply of Education; Determinants of Demand for Education; Costs of Education – Private Costs, Social Costs; Benefits of Education – Direct, Indirect, Social; Wastage and Stagnation in Education – Causes and Measures; Manpower Planning – Meaning, Techniques of Forecasting

Module II: Education and Budget Allocation (15 hours)
Measurement and Trends; Correlation between Alternative Measures of Wellbeing; The Concept of Knowledge Economy – The Spread of Education across the World; Budgetary Allocations across Space and Time; Institutional Design; Alternative Systems for Service Delivery; The Role of Imperfect Information, Incentives and Contracts

Module III: Education and Planning (15 hours)
Approaches to Educational Planning – Production Function Models, Manpower Requirement Approach, Input-Output Model, Gender Based Approach; Educational Planning in Developing Countries with Special Reference to India; Vocational Education in India; New Education Policy

Module IV: Discrimination and Inequality in Education (15 hours)
Models of Preference-based and Statistical Discrimination; Effective Policies to Address Historical Inequalities; Evaluating Policy Impact – The Estimation of Treatment Effects in Randomized Experiments and in Observational Data

Suggested Readings

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EVHE0061: HEALTH ECONOMICS (4-0-0)

COURSE OUTCOMES
1. Learn the detail concepts of health economics and application of economic concept in the health sector. (Remembering)
2. Develop ideas and critical understanding on the health system in the context of Indian scenario. (Understanding)
3. Identify the demand and supply gap in healthcare system to suggest healthcare professionals and policymakers. (Applying)
4. Assess the role of government in health care delivery system and identifying the scope of health financing. (Analyzing)
5. Evaluate the health care programmes and policy to provide decisions concerning the allocation of resources. (Evaluating)
6. Develop or build economic perspective for research problem in health sector. (Creating)

Module I: Basics of Health Economics (18 hours)
Concepts, Definition of Health Economics; Measures of Health Status; Topics in Health Economic Theory – Production Function of Health, Grossman’s Model of Demand for Health; Supply-side Health Economics; Theory of Health Behavior; Market of Health Insurance

Module II: Economic Evaluation in Healthcare (18 hours)

Module III: Public Policy on Health (12 hours)
Public Policy in Health Care Delivery – Role of State, Rationale for Government Intervention in the Health Sector – Public and Private sector; Health Financing; Concept and Calculating Methods of HALE, QALYs and DALYs

Module IV: Health Sector in India (12 hours)
Overview of Health Care in India; Health System of India – Post Reform Scenario; Health Outcomes; Socio-economic Determinants of Health; Different Dimension of Health - Poverty, Malnutrition, Gender Perspectives in Indian context

Suggested Readings

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ENIE0062: ECONOMICS OF INDUSTRY (4-0-0)

COURSE OUTCOMES
1. Recall the concepts of micro economics concepts of price, market type, business motives (Remembering)
2. Understand basic models of the behaviour of firms and industrial organization and how they can be applied to policy issues (Understanding)
3. Assess economic situations – particularly those determining the relationships among firms within an industry and the strategies that each firm can adopt, relate them to concrete problems and provide policy recommendations. (Applying)
4. Understand the minimal cost input factor quantities for a firm and optimal selling prices, supply quantities and resulting profits of firms in different market structures (Analyzing)
5. Discuss the need of competitive environment and the degree competition for a healthy functioning of a market. (Evaluating)
6. Develop the ability to calculate market concentration with different index and understand the relation between competition level and market concentration. (Creating)

Module I: Exploring the Subject Matter of Industrial Economics (15 hours)
Meaning, Scope, Need and Significance of the Study of Industrial Economics; Types and Choice of form of Organization; Business Motives – Alternatives Types of Motives/Goals; Industrial Profile – Private Sector, Large, Medium and Small Scale Industries; Integration; Industrial Combinations – Causes, Mergers and Amalgamations, Diversification

Module II: Theories of Industrial Location (15 hours)
Approaches to Industrial Location Analysis – Alfred Weber’s Theory, Sergent Florence’s Theory, Market Area Theory, Central Place Theory of Losch; Industrial Imbalances – Causes and Remedies; Government Policy and Approach for Backward Regions in India

Module III: Industrial Efficiency, Productivity and Pricing (15 hours)
Economic Efficiency – Meaning; Factors Determining Efficiency; Productivity – Norms and Measurement; The Competitive Environment; Market Concentration – Meaning and Measurement; Pricing in Practice – Cost-plus Pricing, Variable Cost Pricing, Target Rate of Return Pricing, The Going Rate Pricing, Transfer Pricing

Module IV: Indian Industrial Growth and Finance (15 hours)
Industrial Policy in India- Role of Public and Private Sectors; Trends in Indian Industrial Growth after 1991 Industrial Policy; Role of MSME in India; Sources of Industrial Finance – GDR, ADR; Disinvestment as a Sources of Finance; Choice of Funding – External vs. Internal Sources, Financial Statements – Balance Sheet; Profit and Loss Account; Analysis of Financial Ratios; Project Appraisal and Capital Budgeting

Suggested Readings
7. Mishra & Puri (latest edition), Indian economy, Himalaya publisher

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ENIN0063: INTERNATIONAL ECONOMICS (4-0-0)

COURSE OUTCOMES
1. Know the key concepts and practical applications of international economics including international trade and international finance. (Remembering)
2. Understand the key principles and models of international economics and know the country’s position regarding international trade, terms of trade, international debt and balance of payments and foreign exchange. (Understanding)
3. Apply the theories and models of international trade for economic growth and global welfare and critically comment on international economic policy. (Applying)
4. Analyse the links between trade, international finance, economic growth and globalization, with a particular emphasis on the experiences of developing countries. (Analysing)
5. Evaluate international trade policies regarding increase in exports, international debt, and international institutions to solve domestic problems like inflation, unemployment and value of currency etc. (Evaluating)
6. Design and develop economists' arguments and models concerning international trade policies and its analysis for various issues of the day surrounding globalization. (Creating)

Module I: International Trade Theory (18 hours)
The Law of Comparative Advantage; Production Frontier with Increasing Costs; Gains from Trade with Increasing Costs; Offer Curves; Terms of Trade; Factor Endowments and the Heckscher-Ohlin Theory; Economies of Scale, Imperfect Competition and International Trade; Stolper-Samuelson Theorem; Specific Factors Model, Leontief Paradox; Technological Gap Model; Product Cycle Theory; The Gravity Model
Module II: International Trade Policy (12 hours)
Trade Restrictions – Tariffs, Partial and General Equilibrium Analysis of a Tariff, Optimum Tariff, Tariff structure; Nontariff Trade Barriers and the New Protectionism; Economic Integrations – Free Trade Areas, Customs Unions, Common Markets, Optimum Currency Area, Economic Union, Political Union; Dumping; Retaliation Against Dumping; International Cartels

Module III: Balance of Payments and Foreign Exchange Markets (10 hours)
Balance of Payments – Current and Capital Account; Foreign Exchange Markets – Types and Functions; Exchange Rates – Exchange Rate and the Balance of Payments, Spot and Forward Rates, Currency Swaps, Futures, and Options; Foreign Exchange Risks – Hedging, Speculation, Interest Arbitrage

Module IV: International Exchange Rate Determination (10 hours)
Exchange Rate Determination – Absolute Purchasing Power Parity Theory, Relative Purchasing-Power Parity Theory; Monetary Approach to Balance of Payments and Exchange Rate – Fixed Exchange Rates, Flexible Exchange Rates; Portfolio Balance Model and Exchange Rates; Exchange Rate Dynamics

Module V: International Resources Movements and Managements (10 hours)
International Capital Flows - Foreign Portfolio Investment (FPI), Foreign direct investment (FDI); Its determinants and benefits; International Labor Migration – Motives, Welfare Effects; International Monetary System – Classic Gold Standard, Bretton Woods System, WTO and International Trade; International Debt Crisis; Recycling of Petro-Dollars; Causes of Debt Crisis; Secondary Market for Debt of Developing Countries

Suggested Readings

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ENPE0064: POPULATION ECONOMICS (4-0-0)

COURSE OUTCOMES
1. Highlight various policies on population control measures (Remembering)
2. Develop the knowledge of the different models, theories about the relationship between population growth and development (Understanding)
3. Develop the ability to relate the changes in social and political economy due to demographical changes. (Applying)
4. By the end of the course the students are expected to learn the two important concepts of Fertility and Mortality and relate the factors for change in population in a particular region. It gives an idea about calculation of different rates of fertility and mortality. (Analyzing)
5. The students will be in a position to narrate the international and internal migration of India. Identify the factors responsible for internal and international migration. (Evaluating)
6. Discuss the models of population projection and help in focusing the future policy measures (Creating)

Module I: Population and Development (15 hours)
Demography – Meaning and Scope; Evolution of Population Policy in India – The Shift in Policy from Population Control to Family Welfare, to Women Empowerment; Family Planning Strategies and their Outcomes; Measures of Population Change; Population

Module II: Distributional Pattern of Population (15 hours)
Population Trends in the Twentieth Century; Population Explosion and its Dynamics; Pattern of Age and Sex Structure in Developed and Less Developed Countries; Determinants of Age and Sex Structure; Demographic Effects of Sex and Age Structure; Economic and Social Implications; Age Pyramids Projections

Module III: Fertility, Nuptiality and Mortality (15 hours)
Fertility – Emerging Issues in Fertility Control; Fertility Analysis; Social Structure and Fertility Change; Nuptiality Concept and Analysis of Marital Status – Single Mean Age at Marriage, Synthetic Cohort Methods, Trends in Age at Marriage; Mortality – Death Rates, Crude Age-specific; Mortality at Birth and Infant Mortality Rate; Sex and Age Pattern of Mortality; Levels and Trends of Mortality rate in Developed and Less Developed Countries; Life Table Construction and Uses; Concepts of Stable Population; Methods of Population Projection

Module IV: Migration and Urbanization (15 hours)
Internal and International Migration Flows; Internal Migration its Effect on Population Growth and Pattern; Factors Affecting Migration; Theories of Migration Related to Internal Migration; International Migration Flows; Dynamics of the International Migration Process; Urbanization Growth and Distribution of Rural-urban Population in Developed and Developing Countries; Population Growth, Employment and Housing in Mega Cities in Developing Countries; Gravity Model

Suggested Readings
2. Baud, I.S.A., Form of Production and Women’s Labour, Gender Aspects of Industrialization in India and Mexico, Sage, N.D.1992,

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ENOR0065: OPERATIONS RESEARCH (4-0-0)

COURSE OUTCOMES
1. Familiar with basic ideas, characteristics and different phases of Operations Research (Remembering)
2. Describe the basic concepts of convex sets and linear programming method (Understanding)
3. Identify situations where linear and non-linear programming problem can be applied (Applying)
4. Perform sensitivity analysis to assess the magnitude of change of a linear programming (Analysing)
5. Develop strong analytical skills and logical argument to work on with complex issues (Evaluating)
6. Formulate linear programming model of a real-world problem and demonstrate the solution process (Creating)

Module I: Basics of Operations Research (10 hours)
Meaning and Definition; Phases of an Operations Research Study; Importance and Scope; Limitations of Operations Research; Operations Research in Decision Making; Application of Operations research

Module II: Assignment and Transportation Problems (15 hours)
Assignment Problem – Concept, Nature, General Formulation; Solution of Assignment Problems – Hungarian Method; Transportation Problem – Concept, Nature, General Formulation; Solution of Transportation Problems – North West Corner Method; Dual Transportation Model; Difference between Transportation and Assignment Problem

Module III: Network Analysis (15 hours)
Basic Concepts; Classic and Modern Network Models – PERT and CPM; Drawing of Network Activity; Critical Path; Determination of Floats – Total Float, Free Float and Independent Float; Social Networking Problems; Pivotal Agents in Social Networks

Module IV: Linear Integer Programming and Models of Inventory (20 hours)
Modeling with Integer Variables; Canonical and Standard forms; Branch and Bound Methods; Applications – Production Planning, Scheduling; Algorithms for Integer Optimization – Cutting Plane Methods, Approximation Algorithms; Problem of the Economic Order Quantity; Problem with Price Breaks; Static Multi-commodity Model with Limited Capacity of the Stock; Dynamic Problems – Basic Concepts

Suggested Readings
7. Martin J. Osborne, An Introduction to Game Theory, Oxford University Press

Mapping of COs to Syllabus

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<tr>
<th>Course Outcomes</th>
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ENGE0066: GENDER ECONOMICS (4-0-0)

COURSE OUTCOMES
1. Relate the demography concepts to understand the demography of female population (Remembering)
2. Articulate connections between global, regional and local issues and their relation to women’s experiences and to human rights. (Understanding)
3. Examine the various gender indices to understand the framework of policy relating to gender issues. (Applying)
4. Explore the factors responsible for gender discrimination in India (Analyzing)
5. Evaluate the role of technology and institutions in addressing the problem of gender inequalities. (Evaluating)
6. Analyze interconnection between good governance, gender budgeting, Democratic decentralization and women empowerment. (Creating)

Module I: Concept and Importance of Gender Economics (15 hours)
Importance of Gender Economics; Women in Patriarchal and Matriarchal Societies and Structures; Gender Bias in the Theories of Values; Distribution and Population; Demography of Female Population; Causes of Declining Sex Ratios and Fertility Rates in LDCs and Particularly India; Women and their Access to Nutrition, Health, Education and Community Resources and their Impact in Female Mortality and Fertility; Gender Planning Frameworks and Tools; Gender Inequality Indices – GII, MPI, WEIA, SIGI, GDI, GEM; Gender Inequalities in India; Gender and National Planning; Theories of Gender Inequality

Module II: Decision Making, Economic Activity and Women (15 hours)
Factors Affecting Decision Making by Women; Property Rights; Access to and Control Over Economic Resources and Assets; Power of Decision Making at Household, Class, Community Level; Economic Status of Women and its Effect in WPR, Income Level, Health and Education in Developing Countries; Concept and Analysis of Women’s Work – Visible and Invisible Work, Economically and Socially Productive Work; Female Contribution to National Income

Module III: Labour Market, Technology, Environment and Women (15 hours)
Factors Affecting Female Entry in Labour Market; Supply and Demand for Female Labour in Developed and Developing Countries; Studies of Female work Participation in Agricultural and Non-agricultural Rural Activities; Wage Differentials in Female Activities; Determinants of
Wage Differentials – Gender, Education, Skill, Productivity, Efficiency, Opportunity; Structure of Wage Across Regions and Economic Sectors; Impact of Technological Development and Modernization on Women’s Work Participation; Women and Environment – Female Activities and Environmental Concerns; International Agreements

Module IV: Social Security, Gender Planning and Development Policies (15 hours)
Effectiveness of Collective Bargaining; Review of Legislation for Women’s Entitlement Protection of Property Rights; Schemes for Safety net for Women; Need for Female Labour Unions; Affirmative Action for Women and Improvement in their Economic and Social Status; Gender Mainstreaming in Development Policies; Gender Sensitive Governance – Gender Budgeting, Democratic Decentralization (Panchayats) and Women’s Empowerment in India; The Kudumbashree Experience in Kerala, A comparative assessment on Gender policies between developed and developing countries (with special reference to Asian countries); Gender and technology based education institution in development and developing countries.

Suggested Readings

Mapping of COs to Syllabus

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ENFE0067: FINANCIAL ECONOMICS (4-0-0)

COURSE OUTCOMES
1. Learn the key concepts of financial economics. (Remembering)
2. Understand the fundamental concept and application of financial field. (Understanding)
3. Identifying the current financial issues and problems to provide better decision-making to investors. (Applying)
4. Illustrate the trading in the stocks market and analyze the complexities of the derivative market. (Analyzing)
5. Evaluate the financial policy and programme to provide financial advice to policymakers. (Evaluating)
6. Use of financial economics concept in solving real life problems. (Creating)

Module I: Investment Theory and Portfolio Analysis (18 hours)
Overview of Investment Evaluation Methods and Evaluation Criteria; Fixed-income Securities; Bond Prices; Spot Prices; Discount Factors; Arbitrage; Yield-to-maturity; Price Sensitivity; Interest Rate Sensitivity and Duration; The Term Structure of Interest Rates; Yield Curves; Spot Rates and Forward Rates; Portfolios of Assets – Measurement of Return and Risk; Effects of Diversification; Optimal Portfolio Choice; Mean-variance Frontier of Risky and Risk-free Asset; Portfolio Weights

Module II: Options and Derivatives (15 hours)
Options and other Derivatives – Concepts, Definitions; Interest Rate Futures; Futures and Hedging; Hedging Strategies; Option Markets – Call and Put Options; Bounds for Option Prices; Put-call Parity; Option Pricing Formula – Binomial Approach; Factors Affecting Option Prices; Option Trading Strategies; Option to Expand; Valuation of Real Option; Pricing of other Derivatives; Numerical Problems for Derivative Pricing

Module III: Corporate Finance (12 hours)
Types of Corporate Financing – Owner’s Funds, Debt Funds; Strategy of Corporate Financing and Corporate Value; The role of Capital Market in Explaining Corporate Performance; Portfolio for Corporate Bonds; Corporate Debt and Dividend Policy, The Modigliani-Miller
The Features of Indian Labour Market

**Migration as an Investment in Human Capital; Determinants of Migration; Consequences of Unemployment; Measurement of Unemployment**

**Labour Productivity**

**Module IV: Valuation of Financial Assets (15 hours)**
Concept of Value; The Time Value of Money and Asset Pricing – The Valuation of Debt Instruments; The Equilibrium Price and Quantity of Bonds – Loanable Fund Approach, Demand and Supply Approach; Valuing Stock and other Assets – Income Stocks and Growth Stocks; Equilibrium Price and Value of Stock Transactions

**Suggested Readings**

**Mapping of COs to Syllabus**

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**ENLE0069: LABOUR ECONOMICS (4-0-0)**

**COURSE OUTCOMES**
1. Define the main concepts related to labour economics. (Remembering)
2. Explain the analytical grasp of labour demand and supply. (Understanding)
3. Identify the main issues of wage determination. (Applying)
4. Analyse the theoretical issues in labour economics. (Analyzing)
5. Explain the practical applicability of theories related to labour productivity and labour mobility. (Evaluating)
6. Discuss the key issues of Indian labour market and measures to solve the problems in labour market. (Creating)

**Module I: Introduction to Labour Economics (10 Hours)**
Concept, Nature and Scope of Labour Economics; Labour Market – Concept, Labour Supply, Labour Demand; Measuring the Labour Force, Workers Preferences, Time and Budget Constraints, Hours of Work Decision; Production Function; Imperfections in the Labour Market – Job Search and Job Matching, Imperfect Information in Labour Market; Labour Flexibility

**Module II: Theories of Wage Determination (15 hours)**

**Module III: Wage Differentials, Labour Efficiency and Discrimination (15 Hours)**
Homogenous Workers and Jobs; Heterogeneous Workers and Jobs; The Hedonic Wage Function; Alternative Pay Schemes and Labour Efficiency; Theory of Optimal Fringe Benefits; Labour Efficiency – Education in the Labour Market, Schooling Model; Efficiency Wage Models; Segmentation and Discrimination in Labour Market – Race and Gender in the Labour Market, The Crowding Model, Employer and Employee Discrimination; Measuring Discrimination – The Oaxaca Decomposition; Relation between Wage and Employment; Impact of Trade Union and Collective Bargaining on Employers

**Module IV: Labour Productivity, Unemployment and Migration (10 Hours)**
Labour Productivity – Concept, Measurement; Wages, Prices and Employment; Unemployment – Frictional, Structural, Demand-deficient Unemployment; Measurement of Unemployment – The Stock-Flow Model; Reducing Unemployment – Public Policies; Labour Mobility; Migration as an Investment in Human Capital; Determinants of Migration; Consequences of Migration; The Economic Benefits of Immigration

**Module V: Issues in Indian Labour Market (10 Hours)**
Features of Indian Labour Market – Size and Composition in the Organized and Unorganized Labour Market; Major issues in the Indian
Labour Market; Labour Productivity in India; Labour Turnover and Absenteeism in India; Women and Child Labour in India; Agricultural and Rural Labour; Labour Market Institutions of Minimum Wage; Employment and Wage Policy in India; Informal Labour and Social Security Measures; Globalization and Labour Market; Labour Statistics in India

**Suggested Readings**


**Mapping of COs to Syllabus**

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**ENBE0070: BEHAVIOURAL ECONOMICS (4-0-0)**

**COURSE OUTCOMES**

1. Learn the principles and methods of Behavioural Economics (Remembering)
2. Identify the systematic departures of economic behaviour from the prediction of the neoclassical model(Understanding)
3. Get the idea of how behavioural principles have been applied to economic problems (Applying)
4. Understand the principles behind the behavioural approach for the development of analytical tools in Economics (Analysing)
5. Incorporate psychologically motivated assumptions into economic models (Evaluating)
6. Interpret how behavioural models change the predictions for equilibrium behaviour and their implications for optimal policy (Creating)

**Module I: Introduction to Behavioural Economics (10 hours)**

Behavioural Economics Meaning, Definitions; Behavioural Economics and the Standard Economic Models; Scope and Methodology of Behavioural Economics; Applications

**Module II: Decision-making under Risk and Uncertainty (13 hours)**

Preferences and Choice; Anomalies in Expected utility Theory; Alternatives to Expected Utility Theory – Disappointment, Decision-Weighting, Rank-dependent Utility; Role of Reference; Dependent Preference in Risky and Risk Free Choices

**Module III: Intertemporal Decision-making (13 hours)**

Discounted Utility Model; Alternative Choice Models – Time Preferences, Time Inconsistent Preferences; Utility and Consumption Independence; Independence of Discounting from Consumption

**Module IV: Behavioural Game Theory (13 hours)**

Nature and Equilibrium of Behavioural Game Theory; Mixed Strategies and Iterated Games; Modelling of Social Preferences; Inequality Aversion Model; Reciprocity Model

**Module V: Basic Behavioural Macroeconomics (11 hours)**

Neo-Keynesian Rational Expectation Model; Rational Expectation and Attainment of Business Cycle and Labour Market Equilibrium; Determination of Asset Price; Stability Analysis of Macroeconomic Models

**Suggested Readings**


Mapping of COs to Syllabus

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**ENNE0071: ECONOMY OF NORTH EASTERN REGION (4-0-0)**

**Course Objectives:**
This course is designed to expose the students to the overview of North East Economy. It explains the trend and performance of agriculture, industry and service sector in the context of North East scenario. It also includes the evaluation of various developmental policies for structural transformation of the region.

**Course/Learning Outcomes**
At the end of the course the students would be able to:
1. Define and understanding of macroeconomics policies and their impact of North East Economy. (Remembering)
2. Explain the policies and Performance in Agriculture. (Understanding)
3. Identify the policies and performance in Industry. (Applying)
4. Evaluate the impact of various development policies in Agriculture and Industry in the Indian Scenario. (Analyzing)
5. Explain the trends and performance in service sectors and the scope of growth of enterprises in the North Eastern region and the role of various policies in it. (Evaluating)
6. Discuss the usefulness of various development policies and the different development initiatives in the North Eastern region along with some of the reasons for its failure. (Creating)

**Module I: Overview and Characteristics of North East Economy (20 hours)**
North Eastern Region as an economy; Characteristics of the economy; Trend and Pattern of GDP growth in NER; Demographic features of the NE economy; Poverty and Inequality in NER comparison with the Indian economy; Trends of Employment and Unemployment; Recent developments in human resource.

**Module II: Agriculture in North East Economy (15 hours)**
Agriculture: features and challenges; Growth of Agricultural Sector in NE; Agricultural Finances-Sources and Limitations; Agricultural Policies of NE States; Agriculture-Industry linkage especially in NER, Problems of Agricultural Marketing in NE.

**Module III: Industry and Service Sectors in North East Economy (20 hours)**
Industry: growth, composition and challenges, Growth of Micro Small and Medium Enterprises (MSME); North East Industrial and Investment Promotion Policy (NEIIPP) 2007 & 2015; Services sector; Trends, growth and challenges; Rural economy, Diversification of rural employment; Infrastructure and regional economic development, Nature and characteristics of Public finance for NER trends and challenges.

**Module IV: Structural Transformation and Institutions in North East (20 hours)**
Institutions and economic Development; Governance and development-government failure and its correction; Local self-government and development; Community participation and development, community failure; Role of DONER and NEC; New development initiatives in NER, Vision Document 2020 and Act East Policy

**Suggested Readings:**

ENDI6003: DISSERTATION PHASE-I (2-0-0)

Course Description:
The MA students would be required to do project work and submit dissertation. The project work is to be related to the specialization area chosen by the student. Dissertation submitted by the students would be evaluated by External Examiners appointed by the University. The work for the MA dissertation is spread over Semester III and Semester IV as Dissertation Phase-I and Dissertation Phase-II respectively. The total dissertation grades are distributed between the two semesters i.e. 2 credits in Semester III and 4 credits in Semester IV equalling 6 credits in total.

Course Objectives:
The aim of the course is to equip the students with presentation skills and develop academic writing skill. Moreover, the students will also be able to apply the statistical research training acquired in the taught element of the program by designing an appropriate research strategy and research methodology to carry out the research.

The Structure of the Course:
In Dissertation Phase-I, the students have to independently think of a research idea and, by the end of the semester, has to defend a research proposal based on the idea i.e. need to present the Synopsis by the end of the third semester. The total credit in Dissertation Phase-I equals to 2 credits.

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<th>Tentative Stages to be completed</th>
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<td>1.</td>
<td>Research idea or concept note, i.e., Statement of the Problem</td>
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<td>Review of Literature</td>
<td>Second month</td>
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<td>3.</td>
<td>Research Methodology Sampling, Sample size determination, Selection of sample, Analytical tools to be used, Questionnaire preparation, Preliminary exploration of data i.e. Pilot Survey</td>
<td>Third month and Fourth month (3/4 common classes)</td>
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<td>4.</td>
<td>Synopsis Presentation Submission of Modified Synopsis to the Head of the Department</td>
<td>Before the commencement of the end semester examination (date will be notified later) Evaluation by the end of Third Semester (Based on Synopsis)</td>
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<td>Students have to collect all the required data during the semesterbreak (between 3rd and 4th semester)</td>
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ENDI6004: DISSERTATION PHASE-II (4-0-0)

Course Description:
The MA students would be required to do project work and submit dissertation. The project work is to be related to the specialization area chosen by the student. Dissertation submitted by the students would be evaluated by External Examiners appointed by the University. The work for the MA dissertation is spread over Semester III and Semester IV as Dissertation Phase-I and Dissertation Phase-II respectively. The total dissertation grades are distributed between the two semesters i.e. 2 credits in Semester III and 4 credits in Semester IV equalling 6 credits in total.

Course Objectives:
The aim of the course is to fine-tune the dissertation he/she working in the Phase-I and during the work, the students will also learn how to apply the statistical and econometric tools in their own research.

The Structure of the Course:
In Dissertation Phase-II, the student has to carry out data analysis and write the dissertation and defend it by the end of the fourth semester. The dissertation will include original research question(s) if any, critical review of the relevant literature, analytical tools employed in response to the research questions, data analysis and interpretation. Finally, the students need to submit the dissertation to the university authority maintaining all instructions provided by the university. Under the process, the students will be guided by an assigned supervisor of the department to do the work. The total credit in Dissertation Phase-II equals to 4 credits.

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<td>Validation of data, data entry and preliminary analysis of data (drawing graphs, trend lines, etc.)</td>
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<td>Main data analysis</td>
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<td>Dissertation writing and Proof reading</td>
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<td>Submission and Viva Voce</td>
<td>Evaluation by the end of Fourth Semester</td>
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DEPARTMENT OF MASS COMMUNICATION

VISION:
To be a centre of excellence in teaching, learning and research committed to mould ethical and socially responsible media professionals and entrepreneurs who can deliver professional content for diverse media platforms.

MISSION:
The Department of Mass Communication seeks to:
• Achieve excellence in teaching, learning and research.
• Promote critical thinking and problem-solving skills.
• Equip learners by combining the theoretical aspects with creative innovation and entrepreneurship practices.
• Mould ethical and socially responsible media professionals and entrepreneurs.
• Provide knowledge base and consultancy services to the community in the field of media and communication.

B.A. (Honours) MASS COMMUNICATION
The B.A Mass Communication programme of Assam Don Bosco University is a three-year (six semesters) programme consisting of theory and practical components, taught and learned through a combination of lectures, hands-on training and project execution.

PROGRAMME OUTCOMES – BA MASS COMMUNICATION
PO 1: Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO 2: Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
PO 3: Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO 4: Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO 5: Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO 6: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
PO 7: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PROGRAMME SPECIFIC OUTCOMES – BA MASS COMMUNICATION
PSO 1: Knowledge of Communication: An ability to define and identify the various fields of mass communication.
PSO 2: Developing Critical Understanding: An ability to understand the theories and practices of communication that prepares learners for future careers in media or for further studies.
PSO 3: Developing Technical Skills: An ability to apply media technology skills as well hone written and spoken communication skills essential for various media platforms.
PSO 4: Enhancing Professional Skills: An ability to analyse and assess responsibilities as professionals in the field of media.
PSO 5: Creating Multimedia Content: An ability to create media programmes for varied media audience needs.

MAPPING OF COURSES TO PO/PSO

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721|ADBU| Regulations and Syllabus|2022-23|
M.A. MASS COMMUNICATION
The M.A Mass Communication programme of Assam Don Bosco University is a two-year (four semesters) programme consisting of theory and practical components, taught and learned through a combination of lectures, hands-on training, seminar, guest lecture, industry-academia interface and project execution. The programme offers specialization in the area of Print Media, Electronic Media and Communication for Development.

PROGRAMME OUTCOMES – MA MASS COMMUNICATION
PO 1: Critical Thinking: Gain conceptual and theoretical knowledge and learn to critically think and analyze the dynamics and contemporary phenomenon of mass communication.
PO 2: Scientific Temper: Develop logical and creative thinking for the solutions in Print media, electronic media and Communication for development.
PO 3: Effective Communication: Develop the communication skills, theoretical and practical knowledge among the students in print, digital and development communication.
PO 4: Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO 5: Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO 6: Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through service learning and social commitment.
PO 7: Environment and Sustainability: Understand the environment issues and promote sustainable development goals.
PO 8: Self-directed and Life-long Learning: Engage in higher studies, research and professional work and be a life-long learner in context of media studies.

PROGRAMME SPECIFIC OUTCOME: MA MASS COMMUNICATION
PSO 1: Understanding Communication and its Concepts: An ability to define the meaning, purpose of communication and demonstrate the theoretical knowledge in the field of mass communication.
PSO 2: Application of Knowledge: Apply communication skills and practices in context of social and cultural milieu of the North-eastern region.
PSO 3: Developing Critical Aptitude: An ability to test and analyze research findings by demonstrating critical thinking and problem-solving skills.
PSO 4: Enhancing Professional Skills: An ability to develop professional skills and use in the field of print media, electronic media and development communication.
PSO 5: Creating Multimedia Content: An ability to create media programmes for varied media audience needs.
# MAPPING OF COURSES TO PO/PSO

## MA Mass Communication

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### Specialization – Electronic Media

| 3.2.1  | Audio-Video Editing                      | M   | H   | H   | M   | M   | M   | H   | M   | H    |       |      |      |
| 3.2.2  | Television and Video Production          | M   | H   | M   | M   | M   | H   | M   | M   | M    |       |      |      |
| 3.2.3  | Sound for Media                         | M   | H   | H   | M   | M   | M   | H   | M   | H    |       |      |      |

### Specialization – Print Media

| 3.3.1  | Political Communication                 | H   | H   | M   | M   | H   | M   | H   | H   | H    |       |      |      |
| 3.3.2  | News Reporting and Editing              | H   | H   | H   | H   | H   | M   | H   | H   | H    |       |      |      |
| 3.3.3  | Health and Environmental Communication  | H   | H   | M   | H   | H   | H   | H   | H   | M    |       |      |      |

### Specialization – Communication for Development

| 3.4.1  | Programme Management                    | H   | M   | H   | H   | H   | M   | L   | H   | M   | M    | M   | M    |
| 3.4.2  | Situation Analysis for Communication Strategy | H   | H   | H   | H   | M   | M   | H   | H   | H    |       |      |      |
| 3.4.3  | Planning Models and Communication Approaches | H   | H   | H   | H   | M   | H   | M   | H   | H    |       |      |      |
| 4.1    | Media and Cultural Studies              | H   | M   | H   | M   | H   | M   | H   | H   | H    |       |      |      |
| 4.2    | Internship                              | H   | H   | H   | H   | H   | H   | H   | H   | H    |       |      |      |

### Specialization – Electronic Media

| 4.2.1  | Film Appreciation                       | H   | H   | M   | M   | M   | L   | H   | M   | M    |       |      |      |
| 4.2.2  | Final Project                           | H   | H   | H   | H   | H   | M   | M   | M   | M    |       |      |      |

### Specialization – Print Media

| 4.3.1  | Business Journalism                     | H   | H   | H   | H   | H   | M   | H   | H   | H    |       |      |      |
| 4.3.2  | Final Project                           | H   | H   | H   | H   | H   | M   | H   | H   | H    |       |      |      |

### Specialization – Communication for Development

| 4.4.1  | Project Monitoring and Evaluation       | H   | H   | H   | H   | H   | M   | H   | M   | H    |       |      |      |
| 4.4.2  | Final Project                           | H   | H   | H   | H   | H   | M   | H   | M   | H    |       |      |      |

## VALUE ADDED COURSES (BA/MA)

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DETAILED SYLLABUS

MCMC0131: INTRODUCTION TO MEDIA AND COMMUNICATION (5-1-0)

COURSE OUTCOMES
1. Define the basic terms related to Communication (Remembering)
2. Classify different types & models communication (Understanding)
3. Analysis of the communication and its effect (Evaluating)
4. Analyse the emerging trends in communication industry (Analyse)
5. Apply theories and models in communication planning (Creating)

Module 1: Media and Everyday Life (12 Lectures)
Television, Print, Radio, Advertisement, Digital media, The internet – discussion around media and everyday life, Discussions around mediated and non-mediated communication.

Module 2: Communication and Mass Communication (13 Lectures)
Forms of communication, Levels of communication, Mass communication and its process, Normative theories of the Press, Media and the public sphere.

Module 3: Mass Communication and Effects Paradigm (20 Lectures)
Direct effects – propaganda and mass society theory, Limited effects – individual difference theory and personal influence theory, Cultural effects – agenda setting; spiral of silence; cultivation analysis, Critique of the effect’s paradigm and emergence of alternative paradigm.

Module 4: Four Models of Communication (15 Lectures)
Transmission models, Ritual or Expressive models, Publicity model, Reception model.

Module 5: Suggestive Student Projects/Presentations (30 Lectures)
Presentations on everyday engagement with the media environment. Presentations on the forms and stages of communication in the contemporary context and its relevance in the current media ecology.

Suggested Readings
6. Mass Communication Theory, McQuail Dennis, Sage Publications
8. Understanding Media Theory, Kevin Williams, 2017, Bloomsbury Academic India

Mapping of COs to Syllabus
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**Module 3: Understanding the structure and construction of news (20 Lectures)**
Organising a news story, 5W’s and 1H, Inverted pyramid, Criteria for newsworthiness, principles of news selection, use of archives, sources of news, use of the Internet.

**Module 4: Different Mediums-a comparison (15 Lectures)**
Language and principles of writing: Basic differences between the print, electronic and online journalism, data and investigative journalism, citizen journalism.

**Module 5: Role of Media in Democracy (10 Lectures)**
Responsibility to Society, Press and Democracy, Contemporary debates and issues relating to media, ethics in journalism.

**Suggested Readings**
1. An Introduction to Journalism, Carole Flemming and Emma Hemingway, 2006, Vistara Publications
7. The Journalistic Hand Book, M.V Srivastava, Sterling Publishers
8. Writing Tools: 50 Essential Strategies for every writer, Roy Peter Clark, 2006, Little Brown

**Mapping of COs to Syllabus**

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**MCHM0133: HISTORY OF THE MEDIA (5-1-0)**

**COURSE OUTCOMES**

1. Discuss the history of print media and its role in Indian freedom movement (Remembering)
2. Understand history and development of television industry (Understanding)
3. Analyse the emerging trends in the media and information industry (Analyse)
4. Evaluate the development of the media and information industry (Evaluate)

**Module 1: History of Print Media (20 lectures)**

**Module 2: Media in the Post-Independence Era (17 lectures)**
Emergency and Post Emergency Era, Changing Readership, Print Cultures, Language Press.

**Module 3: Sound Media (20 lectures)**
Emergence of radio Technology, the coming of Gramophone, Early history of Radio in India, History of AIR: Evolution of AIR Programming, Penetration of radio in rural India- Case studies, Patterns of State Control; the Demand for Autonomy, FM: Radio Privatization, Music: Cassettes to the Internet.

**Module 4: Visual Media (18 lectures)**
The early years of Photography, Lithography and Cinema, From Silent Era to the talkies, Cinema in later decades, the coming of Television and the State’s Development Agenda, Commercialization of Programming (1980s) Invasion from the Skies: The Coming of Transnational Television (1990s), Formation of Prasar Bharati.

**Suggested Readings**
5. Radio Farm Forum as a Tool of Change in Indian Villages, In, Neurath P. Economic Development of Cultural Change, Vol 10, No. 3 (pp 275-283)

Mapping of COs to Syllabus

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MCVC0134: VISUAL COMMUNICATION (4-0-0)

COURSE OUTCOMES
1. Define and analyse the concepts and theories of visual communication (Remembering)
2. Illustrate the fundamentals of design (Understanding)
3. Apply the knowledge of the elements and principles of design to solve real world design problems (Applying)
4. Analyse the various design requirements for various purposes (Analyse)
5. Evaluate how specific visual arts and design convey meaning (Evaluating)
6. Create and compose artistic ideas and works of art with internal and external meaning (Creating)

Module 1: Introduction to Visual Communication (10 Lectures)
Visual communication - Definition; nature and functions, Characteristics and types of visual communication, Advantages and disadvantages, Techniques of visual communication.

Module 2: Design (10 Lectures)
Graphic design, Digital design, Graphic design Vs. Digital design, Typography - Fonts and typefaces, Computer configuration, Scanner, Digital tablet, Printer, Paper size - type and quality, Formats and Resolution, Raster vs. Vector images

Module 3: Fundamentals of Design (15 Lectures)
Gestalt theory, Definition, approaches and centrality of design, Elements of Design – symmetry; rhythm; contrast; balance; mass and scale, Perception, Illusions.

Module 4: Principles of Visual Communication (15 Lectures)
Principles of Visual Communication; Colour psychology and theory, Semiotics, Sign and code, Index and symbol, Dyadic and triadic model of sign, Types of code, Branches of semiotics, Denotation, Connotation and Myth.

Suggested Readings
2. Designing for Print, C. Conover, 2011, John Wiley and Sons
5. Lateral Thinking: Creativity Step by Step, Edward De Bono, Harper and Row Publishers

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COURSE OUTCOMES
1. Define the meaning and concept of communication (Remembering)
2. Demonstrate a holistic understanding of the principles of professional communication (Understanding)
3. Demonstrate presentation skills using a range of materials including text, visual, sounds and technology (Understanding)
4. Develop professional writing skills in business letters, email, press release, articles (Applying)
5. Explain the nature and importance of body language and listening skills in acts of communicative intention (Evaluating)
6. Build the essential skills to effectively work in various professional contexts (Creating)

Module 1: Theories & Language of Communication (20 Lectures)
Theory of Communication, Types and modes of Communication, Effective Communication, Mis-Communication, Barriers and Strategies, Verbal and Non-verbal (Spoken and Written), Personal, Social and Business, Intra-personal, Interpersonal and Group communication.

Module 2: Professional writing (20 Lectures)
Principles and elements of professional writing, Types of writing - business letters/correspondences; professional emails; press releases; reports; features/articles, Copy-editing and proof-reading; Digital content curation

Module 3: Professional Presentation Skills (15 Lectures)
Presentation skills, 7P’s of presentation, Use of visual aids in a presentation, Non-verbal communication in a presentation situation

Module 4: Speaking & Listening Skills (20 Lectures)
Strategies for effective oral communication, developing the right speaking skills - one-to-one conversations; interview; group and public speaking; handling criticism, Effective listening skills and interpretation

Module 5: Suggestive projects & Presentation (15 Hours)
Assignment, Presentation, Seminar, Group Presentation on communication model, writing business letter, email, press release, report writing, news feature, article, copy editing, monologue, group discussion, interviewing, public speaking and other allotted topics.

Suggested Readings
1. Active Listening 101: How to Turn Down Your Volume to Turn Up Your Communication Skills, Emilia Hardman, 2012, Kindle Edition

Mapping of COs to Syllabus

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MCBJ0136: BASICS OF COMMUNICATION AND JOURNALISM (5-1-0)

COURSE OUTCOMES
1. Define the concept, meaning and functions of communication and news (Remembering) CO2 Classify different types of news media (Understanding)
2. Apply the concepts and techniques of journalism in news reporting (Applying)
3. Analyse ethical issues in journalism (Analysing)
4. Explain the roles and responsibilities of media persons (Evaluating)
5. Elaborate, produce and edit new stories (Creating)

Module 1: Introduction to Communication (20 Lectures)
Definition of Communication, nature and process of human communication, functions of communication, Forms of Communication, Levels of Communication, Mass Communication and its Process, Normative Theories of the Press, Media and the Public Sphere.

Module 2: Understanding News (20 Lectures)
Meaning, definition, nature of News, News process: from the event to the reader, Hard and Soft news, basic components of a news story, Attribution, embargo, verification, balance and fairness, brevity, dateline, credit line, by-line.

Module 3: Understanding the structure, construction of news and writing formats (20 Lectures)
Module 4: Role of Media in a Democracy (15 Lectures)
Responsibility to Society, Press and Democracy, Contemporary debates and issues relating to media, media ethics.

Suggested Readings
1. An Introduction to Journalism, Carole Flemming and Emma Hemingway, 2006, Vistaar Publications
8. Writing Tools: 50 Essential Strategies for every writer, Peter Roy Clark, 2006, Little Brown

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MCBP0139 BASICS OF PHOTOGRAPHY (4-0-0)

COURSE OUTCOMES
1. Demonstrate an understanding of composition and image design process (Understanding)
2. Show working knowledge of digital SLR cameras (Applying)
3. Analyse and critique one’s own artistic output (Analysing)
4. Determine safe and responsible work practices (Evaluating)
5. Plan ways to promote one’s work on the internet (Creating)

Module 1: Digital Camera Basics (15 lectures)

Module 2: Photographic Lens (10 lectures)
Basic components of camera lens – lens barrel; lens elements; bayonet; zoom ring; focus ring; aperture blades, Types of lenses, Focal length, Angle of view, Depth of field, Lens filters, Lens accessories.

Module 3: Photographic Composition (15 lectures)
Elements of composition – lines; shape; texture; pattern, arranging visual elements – foreground; background; middle- ground; rule of thirds; space, Understanding Perspective.

Module 4: Photographic Lighting (10 lectures)
Characteristics of light, Basic optics – wavelength and colour; shadows; reflection and refraction, Light sources, Relationship between light source and subject, Three-point lighting, White Balance, Basic lighting equipment.

Module 5: Digital Image Formats, Storage and Presentation (10 lectures)
Image capturing formats – RAW; JPEG; TIFF, Storage devices – SD card; CF card etc. Camera kits and accessories, getting one’s work noticed – world wide web; building own website; getting connected; stock photography.

Suggested Readings:

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MCPY0140 PHOTOGRAPHY (0-0-2)

Description
Students will acquire introductory skills and knowledge about the art of digital photography. Students will learn to comfortably handle DSLR cameras, understand the concepts of exposure triangle; and apply composition techniques from finding effective backgrounds to rule of the thirds. At the end of the course, students will prepare a photo portfolio which will be submitted as a requirement for the completion of the course.

Suggested Assignments
Street photography, Landscape photography, Studio portrait, Food photography, Product photography, Photo story. Students will maintain documentation for all the photo assignments during the semester.

Suggested Readings:

MCIB0141 INTRODUCTION TO BROADCAST MEDIA (4-0-0)

COURSE OUTCOMES
1. Define the meaning and concept of broadcast media (Remembering)
2. Understand the principles and techniques of broadcast media (Understanding)
3. Demonstrate competency in shooting and editing video (Applying)
4. Critique the issues and debates in news broadcasting and production (Analysing)
5. Produce content for broadcast media (Creating)

Module 1: Basics of Visual Images (10 Lectures)
What is an image, electronic image, television image - Digital image, Edited Image (politics of an image) What is a visual? (Still to moving) - Visual Culture - Changing ecology of images today - Characteristics of Television as a medium.

Module 2: Basics of Sound (15 Lectures)
Concepts of sound-scape, sound culture - Types of sound-Sync, Non-Sync, Natural sound, Ambience Sound -Sound Design- Its Meaning with examples from different forms - Sound recording techniques - Introduction to microphones - Characteristics of Radio as a medium – Introduction to Audio Production.

Module 3: Writing and Editing Radio News (10 Lectures)

Module 4: Writing and Editing Television News (15 Lectures)

Module 5: Broadcast News (10 Lectures)

Suggested Readings:
7. Television Production and Broadcast Journalism, Philip L. Harris, 2011
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MCNM0143: INTRODUCTION TO NEW MEDIA (5-1-0)

COURSE OUTCOMES
1. Define new media (Remembering)
2. Understanding the concept and meaning of new media (Understanding)
3. Analyse the emerging trends in the new media (Analysing)
4. Apply the principles and techniques of new media for content creation (Applying)

Module 1: Key Concepts and Theory (20 lectures)

Module 2: Understanding Virtual Cultures and Digital Journalism (20 lectures)
Internet and its Beginnings, Remediation and New Media technologies, Online Communities, User Generated Content and Web 2.0, Networked Journalism, Alternative Journalism; social media in Context, Activism and New Media, new media and virtual identity.

Module 3: Digitization of Journalism (15 lectures)

Module 4: Overview of Web Writing and Content Design (20 lectures)
Linear and Non-linear writing, Contextualized Journalism, Writing Techniques, Linking, Multimedia, Storytelling structures, Open-Source Overview of Web Writing, Website planning and visual design, Content strategy and Audience Analysis, Brief history of Blogging, Creating and Promoting a Blog Online Communities, New Media and Ethics: Piracy, Copyright.

Suggested Readings:
5. Understanding New Media, Siapera, Eugenia, 2011, Sage Publications

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MCSC0144: MEDIA, CULTURE AND SOCIETY (5-1-0)

COURSE OUTCOMES
1. Define the key terms related to media, culture and society (Remembering)
2. Understand the linkage between media, culture and society (Understanding)
3. Analyse the ways in which media, culture and society influence each other (Analysing)
4. Critique the ideological structures in society and their propagation by the media (Evaluating)

**Module 1: Understanding Culture (15 lectures)**
Concept of Culture, Mass Culture, Popular Culture, Folk Culture, Media and Culture, Culture and Mediation, Culture & Power, Hybridization.

**Module 2: Critical Theories (15 lectures)**
Frankfurt School, Media as Cultural Industries, Imperialism, Political Economy, Ideology and Hegemony, Culture & Consumption.

**Module 3: Representation (5 lectures)**
Media as Texts, Signs and Codes in Media, Discourse Analysis, Representation of nation, class, caste and gender issues in Media, Media Representation, Media & Identity, Media & Environment.

**Module 4: Audiences (15 lectures)**
Audiences, Audience as market, Media Audience, Uses and Gratification Approach, Reception Studies, Active Audiences, Women as Audiences Sub Cultures; Music and the popular, Fandom.

**Module 5: Media and Technologies (15 lectures)**
Folk Media as a form of Mass Culture, live performance; Audience in live Performance, Media technologies; Medium is the Message; Technological Determinism; New Media and Cultural forms.

**Suggested Readings**
1. Media Studies: An Essential Introduction Edited by Philip Rayner, Peter Wall and Stephen Kruger, Routledge (Covers Module II, III, IV and V)
8. Traditional Folk Media in India, Parmar S, 1975, Geka Books

**Mapping of COs to Syllabus**

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**MCIC0145: INTRODUCTION TO COMPUTER APPLICATIONS (0-0-2)**

**COURSE OUTCOMES**
1. Demonstrate an understanding on Computer operating system and different software (Understanding)
2. Use Computer applications and Internet efficiently (Applying)
3. Excel in creating and editing on word documents, spreadsheets and point presentation (Creating)

**Module 1: Word Processing Software (8 lectures)**
Getting Started with Microsoft Office, creating, editing, saving and printing text documents, Fonts and paragraph formatting, simple character formatting, inserting tables, smart art, page breaks, using lists and styles, working with images, using spelling and Grammar check, understanding document properties.

**Module 2: Spreadsheet (8 lectures)**
Spreadsheet basics, creating, editing, saving and printing spreadsheets, working with functions & formulas, modifying worksheets with colour & auto formats, graphically representing data: Charts & Graphs, speeding data entry: using data forms, analysing data: data Menu, subtotal, filtering data, formatting worksheets, securing & Protecting spreadsheets.

**Module 3: Presentation software (8 lectures)**
Opening, viewing, creating, and printing slides, applying auto layouts, adding custom animation, using slide transitions, graphically representing data: Charts and Graphs, creating professional slides for presentation.

**Module 4: Internet and the World Wide Web (8 lectures)**
Understanding search engines, types of websites, understanding E-mails, VPN, Bookmarking and going to a specific website, Search
engine extensions, adding hypertext in word file and emails, understanding user-generated content, understanding social media platforms.

Suggested Readings:
1. Excel Formulas and Functions for Dummies, Ken Bluttman and Peter G. Aitken, 2010, John Wiley & Sons publications
5. Office 2019 All-in-One for Dummies, Peter Weverka, 2018,
6. PowerPoint 2019 For Dummies, Doug Lowe, 30 November 2018, For Dummies publications

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MCPR0146 ADVERTISING AND PUBLIC RELATIONS (5-1-0)

COURSE OUTCOMES
1. Trace the evolution of advertisement and public relations (Remembering)
2. Discuss the concept and tools of advertising and public relations (Understanding)
3. Apply the concepts, principles and tools of advertising and public relations (Applying)
4. Analyse the role and importance of advertising in society (Analysing)
5. Critique the different aspects of brand building and its importance for an organisation (Evaluating)
6. Develop and demonstrate strategic plans and planning methods in advertising and public relations (Creating)

Module 1: Introduction to Advertising (15 lectures)
Meaning and history Advertising, Functions, Role of Advertising in Marketing mix, PR), Advertising Theories and Models- AIDA model, DAGMAR Model, Maslow’s Hierarchy Model, communication theories applied to advertising, Types of advertising and new trends, Economic, Cultural, Psychological and Social aspects of advertising, Ethical & Regulatory Aspects of Advertising-Apex Bodies in Advertising-AAAI, ASCI and their codes.

Module 2: Advertising through Print, electronic and online media (15 lectures)

Module 3: Public Relations-Concepts and practices (15 lectures)
Introduction to Public Relations, Growth and development of PR, Importance, Role and Functions of PR, Principles and Tools of Public relations, Organisation of Public relations: In house department vs consultancy, PR in govt. and Private Sectors, Govt’s Print, Electronic, Publicity, Film and Related Media Organizations.

Module 4: PR-Publics and campaigns (15 lectures)
Research for PR, Managing promotions and functions, PR Campaign-planning, execution, evaluation, Role of PR in Crisis management, Ethical issues in PR-Apex bodies in PR- IPRA code - PRSI, PSPF and their codes.

Module 5: Social Media Marketing (15 lectures)
Social Media Technologies and Management, Integrated Marketing Communication, Developing Social Networks, Social Media Strategies, Tactics and Ethics, Social Media Tools, Measurement Strategies and ROI.

Suggested Readings
8. Ogilvy on Advertising in the Digital Age, Miles Young, 2018, Carlton Books
MCDC0147 DEVELOPMENT COMMUNICATION (5-1-0)

**Course Outcomes**

1. Identify the linkages between development, media, and communication (Remembering)
2. Understand the concepts and theories of development and social change (Remembering)
3. Analyse the role of the media in socio-economic development and social change (Analyse)
4. Assess communication channels for development (Evaluating)
5. Create media programmes for development interventions (Creating)

**Module 1: Development: Concept, Concerns, Paradigms (20 Lectures)**

Concept of development Measurement of development, Development versus growth Human development, Models of development, Basic Needs Model, Nehruvian model, Gandhian Model, Panchayati Raj, Developing countries, UN Millennium Development Goals.

**Module 2: Development Communication (20 Lectures)**

Concept and approaches, Paradigms of development, Dominant paradigm: dependency, alternative paradigm, Dev communication approaches – diffusion of innovation, empathy, magic multiplier, Alternative Dev communication approaches: Sustainable Development Participatory Development Inclusive Development, Gender and development, Development support communication – definition, genesis, area, woods triangle, Social and Behaviour Change Communication (SBCC).

**Module 3: Role of Media in Development (20 Lectures)**

Mass Media as a tool for development, Role, performance record of each medium- print, radio, tv, video, traditional media, Role of development agencies and NGOs in development communication, Critical appraisal of dev communication programmes and govt. schemes: SITE, Krishi Darshan, Kheda, Jhabua, MNREGA; Cyber media and development: E- governance, e-chaupal, national knowledge network, ICT for dev narrowcasting, Development support communication in India in the areas of: agriculture, health & family welfare, population, women empowerment, poverty, unemployment, energy and environment, literacy, consumer awareness, Right to Information (RTI).

**Module 4: Practising Development Communication (15 Lectures)**

Strategies for designing messages for print, Community radio, Television programmes for rural India, New media technologies for development, Development Journalism and rural reporting in India, Information needs in rural areas; Use of traditional media for development in rural areas; Rural newspapers; Critical appraisal of mainstream media’s reportage on rural problems and issues.

**Suggested Readings:**


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MCLE0148 MEDIA LAWS AND ETHICS (5-1-0)

733| ADBU | Regulations and Syllabus | 2022-23 |
COURSE OUTCOMES
1. Discuss media laws and ethics in India and global context (Remembering)
2. List the salient features of the Indian Constitution in relation to the media (Understanding)
3. Demonstrate an understanding of the nature of ethics and morality in journalism (Applying)
4. Critique the ethical issues of the media (Analysing)

Module 1: Introduction to Indian Constitution (15 Lectures)
Preamble-Salient Features, Fundamental Rights and Duties, Features of Article 19 (1A) and 19 (2), Directive Principles of State Policy, Indian Judiciary and Parliamentary System, Press as fourth estate of democracy.

Module 2: Media Laws (15 Lectures)

Module 3: Digital Laws (15 Lectures)

Module 4: Media and Ethical Principles (15 Lectures)

Module 5: Media Organisations (15 Lectures)
International Bodies: International Press Institute, Role of UNESCO, SAFMA, Press Council, TRAI, BRAI, IBF, CBFC, INS, Editors Guild, IFWJ, IJA, NUJ, IJU, NBA, BEA, Trade Union Rights in Media.

Suggested Readings:
5. Indian Journalism: Keeping It Clean, Alok Mehta, 2007, Rupa

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MCFM0149: FOLK MEDIA (0-0-2)

COURSE OUTCOMES
1. Identify the major forms of folk media in India (Remembering)
2. Explain the role of folk media as an alternative media (Understanding)
3. Discover the skills required for performing street play and puppetry (Applying)
4. Critique the role of folk media in fostering social change (Evaluating)
5. Plan and organise folk media performance for varied audiences (Creating)
Module 1: Meaning and Nature of Folk Media (12 lectures)
Definition; nature and types of folk media, Strengths and Advantages, Challenges faced by folk media, Major forms of folk media in India, Difference Between folk media and electronic media, Status of folk media in India today, Participatory communication and folk media, Folk media and its role in social change; Uses in different fields – DFP, Song and Drama Division, NGOs, Social Action Groups.

Module 2: Folk Media of Northeast India (8 lectures)
Types of folk media in northeast India, Various folk forms of Assam and its significance – Bihu songs, Lokageet, Bhaona, Lullabies, Ojapali, Ainaam, Sattriya, Borgeet.

Module 3: Street Play and Puppetry (10 hours)
Influence of folk theatre on street theatre, Role of street theatre in the Indian freedom struggle, Street theatre as agitational propaganda and social education, Origin of puppets, Traditional and contemporary forms of puppets, Window on the world puppets, Use of puppets – entertainment; education; social education.

Suggested Assignments:
Traditional media in practice: Students will be trained in various techniques of folk media. At the end of the course, students are expected to perform a street play and/or a puppet performance on specific social issues.

Suggested Readings:
2. Folk Culture of Assam: A Brief History of Ancient Assam, Julfikar Hussain, 2019, Notion Press.
3. Folk and Folklore of Assam, Julfikar Hussain, 2020, Notion Press.
5. Examining the Role of Traditional Folk Media in Rural Development, Coleman Essien, 2017, LAP LAMBERT Academic Publishing
7. Role of Traditional Folk Arts as Media of Mass Communication, Sathish Kumar, 2013, Lambert Academic Publishing.
8. Traditional Folk Media in India, Shyam Parmar, 1975, Gekha Books.

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MCIR0150: INTRODUCTION TO RESEARCH (5-1-0)

COURSE OUTCOMES
1. Define the meaning of communication research (Remembering)
2. Understand the methods of communication research (Understanding)
3. Apply the methods of media research (Applying)
4. Assess the needs for communication in various fields (Assessing)
5. Assess and appraise relevant literature (Evaluating)
6. Design and conduct communication research projects (Creating)

Module 1: Introduction to Research (15 Lectures)
Meaning, Definition, Function, Types of Research, Research Approaches, Role of theory in research, Research design, Research question, Hypothesis, Review of Literature.

Module 2: Media and Communication Research (20 Lectures)
Understanding media and communication research, Qualitative-Quantitative Technique, Content Analysis, Survey Method, Observation Methods, Experimental Studies, Case Studies, Historical Research, Ethnography, Netnography.

Module 3: Sampling Techniques (20 Lectures)
Sampling Methods, Sampling Error, Tools of data collection: Primary and Secondary Data-Questionnaire, Focus Groups, Telephone, Surveys, Online Polls, Published work.

Module 4: Data Analysis and Report Writing (20 Lectures)
Data Analysis Techniques; Coding and Tabulation, Non-Statistical Methods (Descriptive and Historical) Working with Archives; Library Research; Working with Internet as a source; Writing Citations, Bibliography Writing the research report, Readership and Audience Surveys, Various scaling techniques, textual analysis, discourse analysis, Ethical perspectives of mass media research.
Suggested Readings:
2. Media Research Methods; Audiences, institutions, Texts, Bertrand, Ina and Hughes, Peter, 2005, Palgrave

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MCAB0151 ADVANCED BROADCAST MEDIA (5-1-0)

COURSE OUTCOMES
1. Demonstrate an understanding on different broadcast formats (Understanding)
2. Apply the techniques of programme production for broadcast media (Applying)
3. Analyse the emerging trends in broadcast media (Analysing)
4. Create television programmes by mixing genres (Creating)

Module 1: Broadcast Genres (15 lectures)
Why am I the ‘Idiot Box’? – Debates; issues and concerns of the television genre; Various evolving contemporary television genres – Drama; soap opera; comedy; reality television; children’s television, animation; prime time and day time.

Module 2: Public Service Broadcasting (20 lectures)
Public service model in India - policy and laws, Global overview of public service broadcasting, Community radio, Community video, Participatory communication, Campus radio.

Module 3: Private Broadcasting (20 lectures)
Private broadcasting model in India - policy and laws, Structure; functions and working of a broadcast channel, Public and Private partnership in television and radio programming (India and Britain case studies).

Module 4: Advanced Broadcast Production (20 lectures)
Writing and producing for radio, Public Service Advertisements, Jingles, Radio Magazine shows, mixing genres in television production – Music Video for social comment/as documentary, Mixing ENG and EFP, Reconstruction in News based programming.

Suggestive Projects:
- Script writing
- Presentation of experimental genre in Radio/TV
- Presentation about PSBT and such organizations.
- Script on Music Presentation
- Presentation of Commercial Channel functions.
- Presentation on global broadcasting models & Indian Broadcasting Models

Suggested Readings:
1. Advanced Broadcast Media Technologies Market Developments and Impacts in the 90's and beyond, Marcia L. De Sonne, 1992, Lawrence Erlbaum Assoc Inc.

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MCME0152 MEDIA MANAGEMENT AND ENTREPRENEURSHIP (5-1-0)

COURSE OBJECTIVES:
1. Identify the various principles of media management (Remembering)
2. Understand the concept of media management and entrepreneurship (Understanding)
3. Apply the knowledge and principles of media management (Applying)
4. Evaluate the scenario of media entrepreneurship (Analysing)

Module 1: Media Management: Concept and Perspective (20 Lectures)
Fundamentals of management, Management School of Thought, Concept, origin and growth of Media Management, Media as an industry and a profession, Media Ownership, Ownership patterns of mass media in India: sole proprietorship, partnership, private limited companies, public limited companies, trusts, co-operatives, religious institutions (societies) and franchisees (chains), Media policies.

Module 2: Media Industry: Issues & Challenges (15 Lectures)
Media industry as manufacturers- Manufacturing Consent, news and content management. Market Forces, performance evaluation (TAM, TRP, BARC and HITS) and Market shifts.

Module 3: Entrepreneurship Development (20 Lectures)
Entrepreneurship – concept; definition, need and significance, Entrepreneurship growth process, Barriers, Entrepreneurship education model, Entrepreneur – characteristics; types and role demand, Entrepreneurial Motivation and challenges, Types of enterprises - based on capital; product; location; ownership pattern and process.

Module 4: Media Entrepreneurship (20 Lectures)
Concept of Media Entrepreneurship, Characteristics of Media Entrepreneurs, Case Studies, Government Initiatives, Schemes for Entrepreneurship, Media Entrepreneurial Scenario in Northeast India, Scope; opportunities; problems and issues.

Suggested Readings:
1. Indian Media Business, Vinita Kohli Khandekar, 2008, Sage
7. Political Economy of Communications in India, Pradip Ninan Thomas, 2010, Sage

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MCPH0153: ART AND PRACTICE OF DIGITAL PHOTOGRAPHY (4-0-0)

COURSE OUTCOMES
1. Show working knowledge of digital SLR cameras (Remembering)
2. Demonstrate an understanding of composition and image design process (Understand)
3. Analyse and critique one’s own artistic output (Analysing)
4. Determine safe and responsible work practices (Evaluating)
5. Develop photography portfolio and projects (Creating)

Module 1: History of Photography (10 lectures)

Module 2: Digital Camera and Photography Lens (15 lectures)
Human eye and camera, Essential components of digital camera, Digital camera sensors, Digital image capture and file formats, Exposure triangle, Exposure meter, Camera kits and accessories, Components of camera lens, Types of lenses, Lens aberration, Focal length, Angle of view, Depth of field, Lens filters, Lens accessories.
Module 3: Photographic Lighting (15 lectures)
Lighting basics – nature of light; properties of light (direction, intensity, colour); wavelength and colour; reflection and refraction, Outdoor lighting, Studio lighting, Three-point lighting, Lighting ratio, soft light, hard light, Portrait lighting – split lighting; rembrandt lighting, butterfly lighting, loop lighting, Lighting accessories.

Module 4: Photographic Composition (10 lectures)
Elements of photographic design – lines; shape and form; texture; pattern, arranging visual elements in a frame – foreground; background and middle ground; rule of thirds; space, understanding perspective, Framing and formatting, Balance and sense of scale, Rhythm and repetition.

Module 5: Digital Image: Post-production and Presentation (10 Lectures)
Overview, organising photographs, saving digital files, basic image editing, getting one’s work noticed, Pictures on the world wide web, personal website, getting connected, stock photography.

Suggested Readings:
2. Langford’s Basic Photography, Michael Langford, Anna Fox and Richard Smith Sawdon, 2015, Focal Press

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MCDM0154 COMMUNICATION AND DISASTER MANAGEMENT (5-1-0)

COURSE OBJECTIVES
1. Understand approaches of disaster management (Understanding)
2. Analyse media’s role in disaster management (Analysing)
3. Design disaster communication (Applying)
4. Produce media contents on disasters and disaster prevention (Creating)

Module 1: Introduction to Disaster Management (25 Lectures)
Meaning, concepts and types of disaster, Economy of Disaster, Politics of Disaster, Disaster Preparedness Plan, Risk Analysis, Crisis and Disaster Management, Response: Rescue, Relief and Rehabilitation, Post Disaster effects and Remedial Measures, National Disaster Management Authority (NDMA).

Module 2: ICT for Disaster Communication (25 Lectures)
Use of ICTs in disaster management/communication, Emergency Response, HAM radio and community radio, Internet, email, mobile, social media, blogging; computer, television, radio, applications like distress communication and deploying bio surveillance, Geo-Informatics Technology, GIS, GPS, Weather forecasting.

Module 3: Natural Disaster and Role of Media (25 Lectures)
Case study on man-made and major natural disasters and role of media, crisis communication, preparing for a crisis, Communication, Participation, and Activation of Emergency Preparedness Plan, Designing crisis communication plans, Audience-specific strategic message development.

Suggested Readings:
1. An Introduction to Disaster Management, Natural Disaster and Man-made hazard, S Vaidyanathan, 2020, CBS Publishers and Distributors Pvt. Ltd.
3. Crisis and Disaster Management Turbulence and Aftermath, Asim Kumar Mukhopadhyaya, Kumar, 2015, Generic
6. ICTs in Disaster, Aruna Sarangi, 2010, Neha Publishers and Distributors
7. Understanding Disaster Management in Practice with reference to Nepal, Practical Action, Achyut Luite, 2010
8. Understanding the Economic and Financial Impacts of Natural Disasters, Charlotte Benson and Edward Clay, 2004, World...
Bank Publications
9. Voices from Chernobyl: The Oral History of a Nuclear Disaster, Svetlana Alexievich and Gessen Keith, 1997, Picador

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MCVF0155 INTRODUCTION TO ANIMATION AND VFX (4-0-0)

COURSE OUTCOMES
1. Identify the tools and techniques for animation and VFX (Remembering)
2. Understand and apply various techniques of animation and VFX (Understanding)
3. Demonstrate progress in basic animation and VFX skills (Evaluating)
4. Design and develop animation and VFX art-work (Creating)

Module 1: Introduction to a 2D Animation Software (20 hours)
Getting started, Exploring the software, Exploring the Drawing and Painting Tools, Manipulating Objects, Creating an Animation, Basics of Action Script, creating a New Document, Understanding Objects, creating a Table, Understanding Links, Understanding Text Formatting Options.

Module 2: Introduction to a VFX Software (25 hours)
Getting Started, Adobe After Effects Workflow, creating a basic animation using effects and presets, animating text, working with shape layers, animating layers, working with masks, Puppet tools, Roto brush tool, performing colour correction, Rendering and outputting.

Suggested Readings:
3. Basics Animation 03: Drawing for Animation, Paul Wells, Bloomsbury Publishing India Pvt. Ltd.
4. How to Make Animated Films, Tony White, Focal Press

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NCGM0156: GLOBAL MEDIA AND POLITICS (5-1-0)

COURSE OUTCOMES
1. Identify the inter-relation between local, global, international and intercultural issues and trends (Remembering)
2. Understand the relationship between media and political actors (Understanding)
3. Demonstrate understanding of the role and the position of media institutions in the wider context of socio-political relations and conflict (Applying)
4. Critically evaluate media-related issues to contemporary debates in global politics (Analysing)
5. Produce critical media content on contemporary socio-political issues (Creating)

Module 1: Media and International Communication (15 Lectures)
The advent of popular media, Radio and International Communication, Media propaganda in the inter-war years - World War I and World War II.

Module 2: Media and Super Power Rivalry (15 Lectures)
Media during the Cold War; Vietnam War; Disintegration of USSR; Radio free Europe; Radio Liberty; Voice of America, Communication debates: NWICO; McBride Commission and UNESCO, Unequal development and Third World concerns: North-South; Rich-Poor.

Module 3: Global Conflict and Global Media (15 Lectures)

Module 4: Media and Cultural Globalization (15 Lectures)
Cultural Imperialism, Cultural politics, Media hegemony and Global cultures, Homogenization, the English language Local/Global, Local/Hybrid.

Module 5: Media and the Global Market (15 Lectures)
Discourses of Globalisation: barrier–free economy; multinationals; technological developments; digital divide, Media conglomerates and monopolies: Ted Turner/Rupert Murdoch, Global and regional integrations: Zee TV as a pan-Indian channel, Bollywood Entertainment: Local adaptations of global programmes KBC; Big Boss; Indian Idol etc.

Suggested Readings:
7. Reporting war: Journalism in wartime, Stuart Allan and Barbie Zelizer, 2004, Routledge Publication

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MCIF0157: INTRODUCTION TO FILM STUDIES (4-0-0)

COURSE OUTCOMES
1. Identify the historical background of moving images (Remembering)
2. Discuss the major film movements (Understanding)
3. Interpret the role of cinema in popular culture (Applying)
4. Critique cinema from around the world (Analysing)

Module 1: Indian Cinema (15 lectures)
Early Cinema and the studio era, 1950s – Cinema and the nation (Guru Dutt, Raj Kapoor and Mehboob), 1970s – The rise of the angry young man, Indian New Wave, Globalisation and India cinema, regional cinema, Cinema in North East India.

Module 2: Film Language (15 lectures)
Visual language – shot; scene; mise-en-scene; deep focus; continuity editing; montage, Sound and colour – diegetic and non-diegetic sound; off-screen sound; sync sound; use of colour as a stylistic element, Early cinema, Genre and the development of classical Hollywood cinema.

Module 3: Film Form and Style (15 lectures)
German Expressionism and Film Noir, Italian Neorealism, French New Wave, Third Cinema and Non-Fiction Cinema.

Module 4: Film and Popular Culture (15 lectures)
Melodrama, Stardom, Film Authorship with a special focus on Satyajit Ray/Akira Kurosawa, Introduction to feminist film theory.

Suggested Readings:
1. A Dialectic Approach to Film Form in Film Form: Essays in Film Theory (Edited and Translated by Jay Leyda), Sergei Eisenstein, 1977, Harvest/Harcourt Brace Jovanovich, Publishers
3. Discourses of Nationalism in Guru Dutt’s Pyaasa, Alison Griffiths, 1996, Deep Focus
12. The Actor as Parallel Text in Bombay Cinema in Quarterly Review of Film & Video Vijay Mishra, Peter Jeffery and Brian Shoesmith

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MCNE0158: MEDIA IN NORTHEAST INDIA (5-1-0)

COURSE OBJECTIVES
1. Describe the important socio-political and development realities of Northeast India (Remembering)
2. Trace the growth of media organisations in Northeast India (Understanding)
3. Analyse the emerging trends of the news media industry in the Northeast (Analysing)

Module 1: Introduction to Northeast India (25 Lectures)

Module 2: History of Media in Northeast (25 Lectures)

Module 3: Current Status of Media in Northeast (25 Lectures)
Current media landscape in North-eastern Region, Ownership Pattern and Status of Journalists, Problems and Challenges of the Press in Northeast, New Media in Northeast, Future Scopes and Prospects of Media Industry in the Region, Film Industry in NE, Production House.

Suggested Readings
5. Press in Assam—Origin and Development, S.P Baruach, Lawyer’s Book Stall, Guwahati
7. The American Missionaries and North-East India (1836-1900 AD), H.K. Barpujari,1986, Spectrum Publications

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MCHR0159: HUMAN RIGHTS AND CONFLICT REPORTING (5-1-0)

COURSE OUTCOMES
1. Examine the theoretical, methodical and critical analysis of the relationship between media and conflicts (Remembering)

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2. Develop skills and attitudes to empower people with principles of human rights (Understanding)
3. Analyse the role of media, communication and information in the discipline of human rights (Analysing)
4. Create awareness on issues of human rights violations (Creating)

Module 1: Introduction to Human Rights (20 Lectures)

Meaning, nature and development of human rights, right to life, equality, civil rights, political rights, cultural rights & economic rights, UN charter and UDHR, specific Articles of the Universal Declaration of Human Rights, Organisations working on Human Rights issues – national and global, Red Cross, Amnesty, Human rights watch.

Module 2: Issues and Challenges of Human Rights (15 Lectures)

Rights of women and children, Developmental rights and rights of indigenous people, social and political movement, Ethnic conflict, Armed conflicts and human Rights violation in North-eastern region, case studies.

Module 3: Approaches to Understanding Conflict and Conflict Management (20 Lectures)

The context of defining conflict, Nature and types of conflicts, Conflict situation, Root causes of conflict, Conflict theories, Conflict management, Conflict transformation, Third party Mediation, Gandhian approach to conflict resolution, Case studies

Module 4: Human Rights and Conflict Reporting (20 Lectures)

Understanding conflict reporting, media in conflict situation, Journalist’s survival guide, physical safety, Legal safeguards, reporting on victims of conflict: women, children, Trauma reporting, Reporting Human Rights violations, genocide and crimes against humanity, Understanding the nuances: ignoring, silencing or misrepresented human rights issues around the world, Conflict Reporting in North-eastern India, ethical issues in conflict reporting, case studies.

Suggested Readings
1. Conflict Theory and the Conflict in Northern Ireland, Cunningham Jr William G.
4. Peace-Building: Theoretical and Concrete perspectives, Gawerc Michelle I, 2006, Peace & Change Wiley online library
6. Press in Assam - Origin and Development, Sunil Pawan Baruah, 1999, Published by Shri K.N Dutta Baruah
8. The mediation process practical strategies for resolving Conflict, Moore Christopher (1998-2005), Research Consortium Book Summary

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MCMC0160: MOBILE COMMUNICATION (5-1-0)

COURSE OUTCOMES
1. Define mobile communication (Remembering)
2. Trace the evolution of wireless and mobile communication technology (Understanding)
3. Apply the key technologies used in development and distributing content for the mobile platform (Applying)
4. Create media contents for social media (Creating)

Module 1: Introduction to Mobile Communication (25 Lectures)

Wireless Communication Technology, Evolution of mobile communication, basic components of mobile communication system, mobile phones as a tool for development communication.

Module 2: Mobile Communication and Convergence (25 Lectures)

Interactive content development, mobile convergence: visual, text, images and video, blogging, podcasting and livestreaming, Television, Radio and Internet content creation through mobile phones.

Module 3: Mobile Journalism (25 Lectures)

Concept and meaning, advantages of mobile journalism, Mastering mobile journalism, Skills and workflow, Technology and equipment – MOJO Apps, hardware, Mobile Camera Techniques, Case study.

Suggested Exercise
Create visuals, sound and text messages for mobile media, produce audio-video PSAs, Mobile News Report for different beats, Editing on Mobile Apps.
Suggested Readings
1. Mobile Journalism. Al Jazeera Media Training and Development Centre, Maccise, Diana Larrea and Mara, Monstaser, E-book
2. Multimedia sound and video, Lozano, Jose, Pearson
5. Practising Convergence Journalism. An Introduction to Cross-media storytelling, Kolody, Janet, Routledge

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MCTP6102: TELEVISION PRODUCTION (0-0-2)

Description
Students will acquire introductory skills and knowledge about the art of television production. They will learn to comfortably handle digital video cameras as well as apply the techniques of camera movements and camera angles. They will also learn pre-production, production and post-production techniques. Besides learning the techniques of television production, students will also learn to be proficient in the use of a video editing software. At the end of the course, students will prepare a short television production which will be submitted as a requirement for the completion of the course.

Suggested Assignments:
Public Service Advertisement (PSA), Commercial Advertisement, Talk shows, News Bytes, Music Video, Television Interviews, Short films and documentaries.

MCGD6103: GRAPHIC DESIGN (0-0-2)

COURSE OBJECTIVES
1. Gain skills in the development of print and on-line publications (Remembering)
2. Demonstrate competency in image editing (Understanding)
3. Engage with the conceptual and technical aspects of design such as logo, banner, brochure, poster-making (Creating)

Module 1: Image Editing Tool (15 Lectures)
Introduction to image editing tool, Getting started with image editing software, Menu Bar, Using the Help, using icons below menu bar, saving documents, Page Setup, Printing of documents, Toolbox, Layers and importance of layers, Filters, Layer Styles, Adjustment Layers, Retouch and Healing Tools, Type Tool, Free Transform Tool, Master Selection Tools, Installing and Managing Brushes and Other Presets, Image editing actions and common effects, Colour correction tools, Print setting

Module 2: Page Layout Tool (15 Lectures)
Introduction to page layout tool, Getting started with Page Layout software, Menu Bar, Using the Help, Using icons below menu bar, Saving documents, Page Setup, Printing of documents, Create; Edit; and Format text and paragraphs, Working with multiple images in a document, Drawing tools, Work with multiple pages; margins and columns, Working with master page, Customizing page layout software, Selecting page size, Working with text, Working with objects and layers, Applying and managing colour, Applying Fills; Strokes; and Effects, Publish work as PDF, Proof-reading, Print setting

Suggested Readings:

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MCRP6104 RADIO PRODUCTION (0-0-2)

COURSE OUTCOMES
1. Understand the skills and techniques of radio production (Understanding)
2. Identify the radio technologies for audio recording and broadcasting (Applying)
3. Discover the skills required for developing content for radio (Analysing)
4. Produce radio programmes for varied audiences (Creating)

Module 1: Stages of Radio Production (10 hours)
Pre-production - idea; research; radio script, Production- creative use of sound; understanding sound recording; sound recording equipment; single and multitrack recording, post-production - understanding audio editing; introduction to basic audio editing skills using a software program.

Module 2: Radio Broadcast Formats (10 hours)
Radio broadcast formats – Public service advertisements (PSAs); jingles; radio magazine; interview, talk show; discussion; feature; documentary.

Module 3: Radio Production Technology (10 hours)
Basics of sound, Microphone - types and selection of microphones, Audio cables and connectors, Hardware for audio recording, Audio recorders, Headphones, Recording audio in the field, Portable audio mixers, Sound cards, Digital Audio Workstations (DAW).

Suggested Exercise
Produce radio programme format mentioned in module II.

Suggested Readings:

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MCNA6105: NEWS READING AND ANCHORING (0-0-2)

COURSE OUTCOMES
1. Identify the various skills necessary to be a professional news anchor (Remembering)
2. Understand the roles and responsibilities of a news presenter (Understanding)
3. Apply news reading and anchoring skills to develop programmes for cross-media platforms (Applying)
4. Articulate the art of anchoring, news reading and reporting (Analysing)
5. Produce news content for multimedia platforms (Creating)

Module 1: News Reading, Anchoring & Presentation (15 hours)
Duties and responsibilities a news reader, 7Ps in News Presentation: Posture, Projection, Pace, Pitch, Pause, Pronunciation and Personality, Learning Interviewing skills, Anchor’s role in debates and panel discussions inside Studio and outside, On location anchoring/ Reporting facilitator, Relevance of research and keeping updated with current affairs, Knowing personalities and their background, Understanding ground realities and issues, Art of listening, Analysis of news capsule from camera perspective particularly when it is outdoor reporting, Reporting for various beats: Politics, sports, business, crime, legal/court etc.

Module 2: Voice Over, Narration and Commentary (15 hours)
Basics of Voice: pitch/tone/intonation/inflation, Voice Over: Rhythm of speech, Breathing, Resonance, Studio autocue reading, Voice recording. Understanding of Voice Modulation, command over language, Skills of on-air presence: Connect with audience; Express appropriate emotion; Confidence; Conversational skills; Fluency; Ability to improvise; Solid knowledge base, Detailed analysis of styles used by prominent TV anchors and radio presenters.

Suggested Exercise
TV/Radio News presentation, News documentaries, Programme Anchoring, Talks shows, News Interview, Online LiveStreaming, Field reporting.

**Suggested Readings**
4. Public Speaking, Pebley O’neal Katherine and Stephanie O’shaughnessy, 2005, Prufrock
6. The ABC of News Anchoring, Richa Karla Karla, 2012, Pearson Education India

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**MCPH6106: PHOTOGRAPHY (0-0-2)**

**Description**
Students will acquire skills and knowledge about the art of digital photography. Using a combination of lecture, demonstration, and hands-on exercises, this course will explore the basic photographic techniques and artistic concerns involved in making photographs. These include camera handling, composition, effective use of light, file management, digital image manipulation and developing a photographic vision. At the end of the course, students will create a portfolio of unique photographs which will be submitted as a requirement for the completion of the course.

**Suggested Assignments:**
Nature Photography, Street Photography, Portrait Photography, Fashion Photography, Food photography, Photo story production in groups of three, Maintain individual photography portfolio.

**Suggested Readings:**
6. Understanding Exposure, Bryan Peterson, 2016, Amphoto Books

**MCFV6107: ANIMATION AND VFX (0-0-2)**

**Description**
As a part of the final project, students will submit any of the following projects. Students are expected to apply the concept, knowledge and skills gained during the course of the study while undertaking this paper. Each student will have to submit at least one of the following projects to complete the course.

- Design and create a short 2D Animation with sound
- Design and create a short 3D Animation with sound using After Effects

**Project Evaluation Criteria**
- Evaluation of the final project: 70%
- Viva-voce: 30%

**Last date of project submission**
- To be notified by the department
- Portfolio Submission and Presentation: To be notified by the department

**MCIN6108: INTERNSHIP**
(Non-credited Compulsory Course)

Students will undertake 4-weeks internships in media and communication organizations during the vacation between fourth and
fifth semester. They will discuss the choice of media and communication organization with their respective mentors and obtain the consent of the head of the department. Before going for the internship, an Internship Agreement Contact form from the concerned organization will be submitted by the student to their respective mentors. At the end of the internship students will submit a copy of the Internship Completion Certificate to their mentors from the designated authority of the concerned media and communication organization. Students will submit a report of their internship which will include the following documents:

- **Employer Evaluation**: At the end of the internship the supervising employer will be asked to submit a written evaluation of the student’s performance.
- **Journal**: Each student will keep a daily journal with an entry for each day spent doing work for the internship. This journal should be e-mailed to the mentor at the beginning of each work week. In this journal the student should summarize the activities and assignments on which the student worked. The student should also keep track of the number of hours for each week.
- **Internship Completion Certificate**
- **Work Samples**: Examples of work during the Internship.

The department will issue the following documents to the students for the internship:

- **Internship Application Form**: to be submitted to the mentor prior to internship.
- **Internship Agreement Contract**: to be submitted to the mentor prior to internship.
- **Employer Evaluation of Intern**: to be included in the portfolio

**Last date of Internship**

- To be notified by the department
- Internship Report Submission and Presentation: To be notified by the department

**MCDP6109: DOCUMENTARY PRODUCTION (0-0-2)**

**COURSE OUTCOMES**

1. Discuss the types of documentaries and production techniques (Remembering)
2. Understand ethical issues related to documentary production (Understanding)
3. Reflect upon and analyse the documentary form (Analysing)
4. Critically evaluate documentary forms and production techniques (Evaluating)
5. Produce, direct, film and edit documentary productions (Creating)

**Module 1: Documentary Theory (20 lectures)**

Understanding the Documentary, Observational and Verite documentary, Introduction to Realism Debate, the performative/fictive in Documentary: Using re-enactment/reconstruction, Ethics and Representation.

**Module 2: Pre-Production (20 lectures)**

Researching the Documentary, Modes of Research: Library, Archives, location, life stories - Ethnography, writing a concept: telling a story, Script Writing, Treatment, writing a proposal and budgeting, Structure and scripting the documentary.

**Module 3: People and Techniques (10 lectures)**

The Documentary Crew, Equipment, Scripting, Sound for Documentary.

**Module 4: Video Documentary Production (10 Hours)**

The Documentary Camera, shooting styles, Production details and logistics, Introduction to Editing styles.

**Practicum**: Shooting a short film (5-6 minutes) and editing the same.

**Suggested Screenings**

Michael Moore: Roger and Me, Nanook of the North by Robert J Flaherty, Nightmail by Basil Wright, Bombay Our City by Anand Patwardhan, Black Audio Collective, City of Photos by Nishtha Jain, Films by PSBT

**Suggested Readings:**

1. A New History of Documentary Film, Jack EC Ellis, 2005, Continuum Intl Pub Group,
4. How to Write a Documentary Double Take by PSBT, Trisha Das
5. Indian Film, Erik Barnow and Krishnaswamy, 1980, Oxford University Press
6. The Open Frame Reader: Unreeling the documentary Film Ed. by PSBT, Rajiv Mehrotra, 2006, Rupa Publications
8. The Techniques of Documentary Film Production, W. Hugh Badley, 1969, Focal Press,

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**MCMP6110: MEDIA PROJECT (0-0-6)**

**Project Description**

Students will create a video production project which will be an application of the skills gained by them during the duration of their study. As part of the project work students will apply their theoretical knowledge and understanding in the practical realm and work together in a group. The video production project can be in a fictional format, documentary format or animated format. The subject, topic, content of the project will be of 20 minutes duration. After approval of the idea from the teacher in-charge and the script selection committee, students will execute the project within the given time frame. Students should have sponsors for their project which shall cover some percentage of their approved budget. The video production project will be publicly screened in the university followed by discussion with the groups.

The final evaluation will be on the basis of the following criteria:

a. Video Production Project – 50%
b. Screening and Discussion – 20%
c. Viva-Voce – 20%
d. Pre-screening Publicity and Marketing – 10%  

**Project Submission Date:** To be notified by the department  
**Screening Date:** To be notified by the department

**Viva-voce:** To be notified by the department

**MCDI6111: DISSERTATION (0-0-6)**

**Dissertation Description**

As part of the course students will undertake a research study in the field of media and communication. Students will complete data collection, analysis, preparation of research reports and submit the final dissertation. The dissertation has to be systematically structured following proper methodology of communication research. Students will have to ensure that the dissertation is prepared keeping in view Intellectual Property Rights, maintenance of research ethics and avoidance of plagiarism. Students are required to make a presentation of the dissertation submitted to the department on the date set by the department.

**Suggested Readings**

MA MASS COMMUNICATION

MCRC0026: RURAL COMMUNICATION (3-0-0)

COURSE OBJECTIVES
CO1 Define the meaning and concept of community and rurality (Remembering) CO2 Explain the role of communication in rural development (Understanding)
CO3 Apply communication channels for rural development (Applying)
CO4 Analyse the social, economic, political and cultural framework of rural communication (Analysing)
CO5 Evaluate the need for media and communication for rural development (Evaluating)
CO6 Design communication programme for rural development (Creating)

Module 1: Rural Communication and Participation (9 Lectures)
Community and Rurality: Concept and Definition, Meaning of Rural Communication, Communication Structure in Rural Settings- Folk and Traditional Media, Radio in Rural Communication, Community Media for Participatory Communication, Media and Communication Habits among Rural Communities, Media Penetration and Changing Rurality, Rural Communication Channels - Village Meetings; Village Market; Village fair, ICT and Rural Governance.

Module 2: Documenting Development in Rural Settings (9 Lectures)
Role of Communication in Rural Development, Documenting and Analysing Rural Development, Communication Agenda, Rural Health and Communication, Crisis and Natural Disaster Communication, Communicating Education and Agriculture, Communication and Extension Activities in Rural Settings.

Module 3: Evaluating Communication Needs in Rural Areas (9 Lectures)

Module 4: Channelizing Development in a Rural Context (9 Lectures)

Module 5: Practicum (9 hours)
As part of this module, students are required to conduct community outreach programmes in rural areas on issues of rural development or design communication programmes for rural development.

Suggested Readings
7. Strategic Communication for Rural Development. World Bank, F. M. Santucci, 2005

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MCML0027: MEDIA LITERACY (3-0-0)

COURSE OBJECTIVES
1. Define the concept, meaning and characteristics of the media industry (Remembering)
2. Explain the functions of communication (Understanding)
3. Choose appropriate media channels for effective communication (Applying)
4. Distinguish different types of media (Analysing)
5. Assess the emerging trends in the communication industry (Evaluating)

Module 1: Introduction to Media Literacy (12 Lectures)
Understanding media landscape, Meaning and definition, Importance of Media literacy, Media audience, media literacy approach, Types and Role of Media, Ownership Pattern and Control of Mass Media, Communication and Information Industry, Information Society, New Media Culture.

Module 2: Digital Media (7 Lectures)
Information and Communication Technology (ICT), Digital file types: documents, picture, video and audio, Editing Software: Print, Audio and video, creating digital media content with mobile phone.

Module 3: Computer Mediated Communication (8 Lectures)
Internet, Websites, online social media, User Generated Content in social media, SEO, Blogging, Live Streaming, E-Governance, Digital Marketing.

Module 4: Convergence Media (7 Lectures)

Module 5: Confronting Issues (10 Lectures)

Suggested Readings

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MCHD0028: HISTORY AND DEVELOPMENT OF COMMUNICATION MEDIA (3-0-0)

COURSE OBJECTIVES
1. Demonstrate an understanding of the history of media and the evolution of the mediated environment (Understanding)
2. Organize a historical survey of media and diachronic analysis of a variety of mediated forms especially in the context of India (Applying)
3. Identify the rich folk heritage of India and its role in grassroots communication (Applying)
4. Evaluate the relationship between media and development in Indian culture, politics and society (Evaluating)

Module 1: Early history of Communication and the Printing Era (15 Lectures)

Module 2: Development of Electronic Media (15 Lectures)
Development of Radio as a medium of mass communication, History of radio in India, Evolution of AIR Programming, Penetration of radio in rural India, Commercial Broadcasting, FM Radio, Overview of community radio, Development of Television as a medium of mass communication, History of Television in India, Television and the State’s Development Agenda; Prasar Bharati, Doordarshan, Cable and Satellite Television in India; Commercialization of Programming, The Coming of Transnational Television.

Module 3: Development of Visual Media and Folk Media (15 Lectures)
The early years of Photography, Development of film as a medium of communication, History of Films in India, Issues and Problems of Indian Cinema Types of folk media, use of folk media, Advantages of folk media, Folk Media and communication, Role of folk media in promoting – health, education, Women’s issues and Community development, Folk vs electronic media.
Suggested Readings
3. The Handbook of New Media, L. A Lievrouw and Sonia Livingstone, 2005, Sage Publications

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MCPC0029: PHILOSOPHY OF COMMUNICATION (3-0-0)

COURSE OBJECTIVES
CO1 Define the concept of communication (Remembering)
CO2 Infer analytical reasoning on communication (Understanding)
CO3 Identify the philosophical and sociological bases of communication (Applying)
CO4 Analyse critically the purpose of human communication (Analysing)
CO5 Interpret and decode media contents wisely (Evaluating)
CO6 Discuss the idea of knowledge and psychological understanding of media text (Creating)

Module 1: Concept of Communication (10 Lectures)

Module 2: Philosophy and Knowledge (20 Lectures)
Epistemology, Ontology, Dialectic – Hegelian and universal, Buddhist philosophy of communication, Positivist and Post-positivist, Locke’s account of knowledge, Phenomenology, Hyper-realism, Hegemony, Political economy and Frankfurt School, Marxist Media Theory, Propaganda model.

Module 3: Psychoanalysis of Communication (15 Lectures)
Philosophy of the unconscious, Oedipus concept, Id, Ego, Superego, Sexuality, Idea of myth.

Suggested Readings
2. Capital, Karl Marx, 2016, Fingerprint Publishing
5. The Unconscious, Antony Easthope, 2003, Routledge Publication
6. The Ego and the Id, Sigmund Freud, 1962, Martino Fine Books

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MCTC0030: THEORETICAL PERSPECTIVES OF COMMUNICATION (4-0-0)

COURSE OBJECTIVES
1. Define the concept of semiotic theory and practice (Remembering)
2. Explain the intersection between communication, in its many forms, and society and culture (Understanding)
3. Apply communication theories and models in communication programmes and research (Applying)
4. Analyse the link between major theoretical understandings of communication and the socio-cultural setting they have developed in (Analysing)
5. Test the various models and theories of communication in real-world situations (Creating).

**Module 1: Theories and Models of Communication (15 Lectures)**
Normative Theories, Democratic Participation Theory, Shannon-Weaver’s Mathematical Model, Aristotle’s definition of Rhetoric, Berlo’s SMCR Model, Westely and MacLean’s Conceptual Model, Newcomb’s Model of Communication, George Gebner’s Model, Schramm’s Interactive Model, Harold D. Laswell, De Fleur Model.

**Module 2: Media Effects Theory, Psychological & Sociological Theory (15 Lectures)**

**Module 3: Powerful Effects of Media (15 Lectures)**
Dominant Paradigm, Spiral of Silence, Diffusion of Innovation, Agenda Setting, Marshall McLuhan’s Medium Theory.

**Module 4: Semiology and Postmodern Theories (15 Lectures)**
Semiotic theory and practice - historical context and doctrinal perspectives in semiotics, Models of the Sign and types of Codes, Structuralism; Formalism; Post-Structuralism.

**Suggested Readings**

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**MCPJ0031: PRINCIPLES AND PRACTICES OF JOURNALISM (4-0-0)**

**COURSE OBJECTIVES**
1. Define the concept, meaning and function of journalism (Remembering)
2. Explain the role and responsibilities of a journalist. (Understanding)
3. Apply the concepts and techniques of journalism in news reporting (Applying)
4. Analyse the role of news media in society (Analysing)
5. Write, report and edit news stories (Creating)

**Module 1: News & News Writing Principles (15 Lectures)**
Concept of News, Types of News, News Values, Ethics, Concept of Reporting, Types of Reporting, Qualities of a Reporter, Roles and responsibilities of media journalists, Sources of news, Cultivation of sources, Emerging trends in journalism.

**Module 2: News and Features format (12 Lectures)**
News format vs. Features Format, Lead writing, Types of lead, Editorial, Feature, Column, Middle, Interviews, Reviews and Special Articles, Letter to Editors, Writing Headlines, Types of Headlines.

**Module 3: Organisational Structure and Regulating Bodies (9 Lectures)**

**Module 4: Editing and Layout (9 Lectures)**
Meaning, Purpose, Tools & Techniques, Media language, Editing Symbols, Style Sheets, copy testing, Proofreading, Page Layout – modular; horizontal; vertical; photo placements; photo-caption; use of artwork; breaking the layout, Agency Copy Editing, Page design – innovations in the edit page.

**Module 5: Practicum (15 hours)**
Basic of design, Introduction to page layout software, Field reporting and publication
Suggested Readings

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MCID0032: INVESTIGATIVE AND DATA DRIVEN JOURNALISM (3-0-0)

COURSE OUTCOMES
1. Define the meaning and concept of investigative and data journalism (Remembering)
2. Demonstrate how to conduct news investigation (Understanding)
3. Plan and execute investigative news reporting methodically and ethically (Applying)
4. Analyse different sets of data and information (Analysing)
5. Assess the risk involved in investigative reporting (Evaluating)

Module 1: Basics of Investigative Journalism (10 Lectures)
Concept, meaning and definition of Investigative Journalism, types and history, Sources, Research, Fact checking and editing, Role of investigative reporting in a democratic society, Trends in Investigative Reporting, Investigative techniques, Case studies, Associations of Investigative Journalists, The soul of the investigative reporter, ethics of investigativereporting.

Module 2: Digital Investigation (8 Lectures)
Understanding Digital Investigation, Computer Assisted Reporting, Web research and data collection, Data Literacy, DataMining Tools, Open-Source Intelligence Tools (OSINT), Social Media Auditing, Online Fact Checking and Verification.

Module 3: Data Journalism (8 Lectures)
Concept, meaning, definition of Data Journalism, Data-driven Storytelling, Data Acquisition, Data Analytics, Reporting with Data, Public, Private and Open-Source Database, Overcoming Information Overload.

Module 4: Tools and Techniques of Data Driven Journalism (8 Lectures)

Module 5: Practicum (11 hours)
Develop an investigative pitch/plan for a major investigative story, Data Visualisation, Online Fact Checking, and Social Auditing.

Suggested Readings
3. Data Smart: Using Data Science to Transform Information into Insight, John Foreman, 2013 Wiley
5. Data-Driven Storytelling, Nathalie H. Riche, Nicholas Diakopoulos, Christophe Hunter and Seelagh Carpendale, 2018, AK Peters/CRC Press

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MCTS0033: THEORIES OF DEVELOPMENT COMMUNICATION AND SOCIAL CHANGE (4-0-0)

COURSE OBJECTIVES
1. Define the basic terms related to development & development communication (Remembering)
2. Explain different models and approaches of development (Understanding)
3. Develop communication strategy for development (Applying)
4. Examine role of media in socio-economic development and social change (Analysing)
5. Assess situation for communication intervention (Evaluating)
6. Create advocacy and initiate behaviour change through communication channels (Creating)

Module 1: Introduction to Development (15 Lectures)
Meaning, definition and process of Development, Growth and Development, Characteristics of Developing and Underdeveloped countries, Regional Development, Development Challenges, Emerging Issues in Development.

Module 2: Theories, Models and Approaches of Development (15 Lectures)

Module 3: Concepts, Theories and Models of Development Communication (15 Lectures)

Module 4: Social and Behaviour Change Communication (15 Lectures)
Concepts of SBCC, Managing information for social change; individual level behavioural change, Models of Change: persuasion model; health belief model; stages of trans-theoretical model; socio-ecological model, Communication planning models: ACADA Model; P-Process; COMBI Model and Integrated Communication, Case studies.

Suggested Readings
2. Communication for Development in the Third World, Srinivas Melkore & Steeve, 2001, Sage India
9. Media in Development Arena, RK Ravindran, 2000, Indian Publishers Distributors
10. Other Voices: The Struggle for Community Radio in India, Paravala V and Malik K V., 2007, Sage India

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MCRM0034: MEDIA AND COMMUNICATION RESEARCH METHODOLOGY (4-0-0)

COURSE OBJECTIVES
1. Define meaning, scope, objectives and significance of media research (Remembering)
2. Demonstrate appropriate methods for collecting and analysing research data (Understanding)
3. Apply research methods related to the disciplinary areas of communication and media (Applying)
4. Assess and appraise relevant literature (Evaluating)
5. Conduct research, write research reports and projects (Creating)
Module 1: Meaning and Objectives of Research (15 hours)
Media Research – Meaning; Scope; Objectives and Significance, Research Process, Formulation of Research Problem, Literature Survey, Research Design, Collection of Data, developing a Questionnaire, Aids for Writing Research Reports – Bibliography; Footnote and Reference; Synopsis and Abstracts, Writing of Report; Summary; Executive Summary; Conclusion and Recommendation.

Module 2: Research Methods and Applications (20 hours)
Techniques of Data Collection – Observation; Questionnaire and Interview; Content Analysis, Qualitative Methods - Field Experiments; Ethnography; Focus Groups; Case Studies, Quantitative Research Methods - Experimental Research; Survey Research; Content Analysis, Audience Research in Print and Electronic Media.

Module 3: Statistical Applications in Communication Research (25 hours)
Statistics – Definitions; Uses and Limitations, Classification and Tabulation of Data, Univariate and Bivariate, Diagrammatic and Graphical Presentations, Sampling - Types of Sampling; Guiding Principles of Sampling, Test of Hypothesis – Basics; Probability distribution; normal distribution; t-test; Chi- square test; Measures of Central Tendencies, Measure of Variability, Correlation - Computation of Product Moment; Correlation Coefficient; Spearman’s Rank; Coefficient Correlation, Scaling Techniques – Arbitrary; Thurstone; Likert-Scale.

Suggested Readings

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MCDM0035: DIGITAL MEDIA (3-0-0)

COURSE OBJECTIVES
1. Define new media and information society (Remembering)
2. List the characteristics of new media (Remembering)
3. Show their ability to engage in contemporary debates on the implications of digital culture (Understanding)
4. Demonstrate the ability to deal critically with social analysis of popular media (Understanding)
5. Analyse key issues emerging from recent development into digital culture (Analysing)

Module 1: Digital Communication (12 Lectures)
New Media and Information Society, The Characteristics of New Media, Hyper-textuality and Hyper- Mediacy, New Media and Visual Culture, Interactivity, Mobile journalism (MOJO).

Module 2: The Internet and the Public Sphere (10 Lectures)
Online News; Digital Economics, Access and the Digital Divide, Economics and Networked Media Culture, The social form of New Media, Globalisation; neo-liberalism and the Internet.

Module 3: Media, Culture, Technology and Society (13 Lectures)
Relationship between Space and Identity, Ideological Connotation of the new Cyber and Participatory Culture, Intensity of Change; Intensifying Process of Globalization, Cyber-Culture, Fragmentation and Convergence.

Module 4: Online Media Praxis (10 Lectures)

Suggested Readings
2. Critique, social media and the Information Society, Christian Fuchs and Marisol Sandoval (Eds.), 2006, Routledge

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3. Digital Cultures: Understanding New Media, Glen Creeber, and Royston Martin (Eds.), 2009, Open University Press
8. New Media: A Critical Introduction, Martin Lister, Jon D., Seth Giddings, Iain Grant, Kieran K, 2009, Routledge,
10. The New Media Book, Dan Harries Dan, 2002, Palgrave MacMillan

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MCMLO037: MEDIA LAWS, ETHICS AND SOCIAL RESPONSIBILITY (3-0-0)

COURSE OUTCOMES
1. Define the salient features of media laws and ethics (Remembering)
2. Explain the essential features of the Indian Constitution in the context of press freedom (Understanding)
3. Examine the purpose and role of media professionals in society (Applying)
4. Analyse the legal issues pertaining to the media (Analysing)
5. Evaluate the relative merits and demerits of the ethical questions pertaining to the media (Evaluating)

Module 1: Legal System in India (10 Lectures)
Introduction to the Legal System: Jurisprudence, Sources of law: custom; precedent; statute, Types of law: criminal; civil; tort, History of media laws in India.
Rights, Rules and Laws: Justice and law; laws and society
Judicial Systems in Relation to Media: Basic features of the Indian Constitution, Structure of Judicial System in India – Supreme Court, High Court, Lower courts.

Module 2: Media Laws (15 Lectures)
Public Interest Litigation and Defamation: Civil and Criminal law of defamation, Libel and Slander, Public Interest Litigation.

Module 3: Media Ethics (10 Lectures)
Ethics and Journalistic Professionals: Introduction to Ethics, Press Council’s Norms of Journalistic Conduct, AIR News Policy for Broadcast Media; Broadcasting Code
Media and Social Responsibility: Media and pressure groups, Prasar Bharati Act 1990, The Broadcast Code Governing AIR
Rights and Duties of Media Professionals: Politics and Elections, Investigative Reporting, Court Reporting

Module 4: Issues in Reporting (10 Lectures)
Media and Conflict Reporting: Conflict Scenario in North-East India, Ethical Issues in Conflict Reporting, International Humanitarian law
Cyber Laws: Information Technology Act 2000, Cyber Crimes, Cyber Crimes relating to Women and Children

Suggested Readings:
2. Ethics, Frankena K. William, 2002, Prentice Hall India

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MCAM0038: ADVERTISING, CORPORATE COMMUNICATION & PUBLIC RELATIONS (3-0-0)

COURSE OBJECTIVES
1. Define the key terms related to advertising, public relations and corporate communication (Remembering)
2. Explain the different models and approaches of advertising, public relations and corporate communication (Understanding)
3. Develop public relations and corporate communication strategies for public & private enterprises (Applying)
4. Plan and execute ethically sound and socially responsible advertising strategies and public relations campaigns (Evaluating)
5. Produce multimedia ads for varied audiences (Create)

Module 1: Advertising (15 Lectures)
Need and Impact of Advertising: National and global scenario, Integrated marketing communication, Persuasion, retention and recall, Process of Advertisement Creation: media planning, visualization, copywriting, Brand Management: Concept and evolution, components of brands, image and personality.

Module 2: Corporate Communication (15 Lectures)
Defining corporate communication strategies, corporate communication in public sector, private sector and multi-national, strategic corporate communication and management, proactive and reactive media relations, media selection, symmetrical and asymmetrical models in handling crisis, Role of corporate communication in crisis and disaster management, use of media in crisis management.

Module 3: Public Relations (15 Lectures)
Definition and concept: Public relations, External and internal, Vertical and horizontal, Promotion of products and services, Image building, social marketing, Campaigns, Press Conferences and press releases, Conferences and conducted tours, staging of special events, Use of Various Media: Print, electronic, media and web, Outdoor media and exhibitions, Newsletters/brochures/video and audio material, Traditional media.

Suggested Readings:

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MCAV0039: AUDIO-VIDEO EDITING (3-0-0)

COURSE OUTCOMES
1. Identify the importance of Sound and Sound SFX (Remembering)
2. Understand the techniques of audio recording and editing (Understanding)
3. Execute video and audio tracks with effects (Applying)
4. Differentiate between the different techniques of Video Editing (Evaluate)
5. Plan, design and create digital video projects incorporating audio and video elements (Creating)
Module 1: Audio Editing (20 Hours)
Configuration of a PC for sound recording, Motherboards, Processor, Sound Card, Graphic card, Monitors, Recorders: Analog, Digital, Tape Based & Tapeless, Digital Audio Workstations (DAW’s), Set up an audio editing software, The user interface, Waveform editing, Effects, Audio Restoration, Mastering, Sound design, Creating and recording files, Multitrack sessions, Multitrack session editing, Automation, Video soundtracks, The essential sound panel, The multitrack mixer, Creating music with sound libraries, Recording and output in the multitrack editor.

Module 2: Video Editing (25 Hours)
Installing video editing software, Optimizing performance of system and software, Performing non-linear editing, Understanding the user interface of the software, Setting up a project, Importing media, organizing media, Mastering the essentials of video editing—using the source monitor; viewing video on a second monitor; using a numerical keyboard; editing from the project panel; navigating the timeline panel; using essential editing commands; setting the duration for still images, Working with clips and markers, Adding transitions, Advanced editing techniques—performing four-point editing; changing playback speed; replacing clips and footage; nesting sequences; multi-camera editing. Putting clips in motion, Editing and mixing audio, Adding video effects, Colour correction and colour grading, Compositing techniques, Creating graphics, Exporting the timeline.

Suggested Readings:
4. Film Editing: Great Cuts Every Filmmaker Should Know, Gail Chandler, 2009 Michael Wiese Productions
6. In the Blink of an Eye: A Perspective on Film Editing, Walter Murch, August 1st 2001, Silman-James Press

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MCTV0040: TELEVISION AND VIDEO PRODUCTION (3-0-1)

**Course Outcomes**
1. Identify different genres of television production (Remember)
2. Understand the intricacies and nuances of screenwriting (Understanding)
3. Distinguish various equipment and tools required for television and video production (Analyse)
4. Assess the importance of cinematography in television and video production (Evaluate)
5. Produce television programmes for various audiences (Creating)

Module 1: Writing for Television: (10 Lectures)
Preparing to Think Visually: Diving Into the Screenwriter’s Mind, Approaching Screenwriting as a Craft - Mise-en-Scene; Breaking Down the Elements of a Story, Structure of Story & Screenplay: Beginning, Middle, End; Dynamics of Characterization: Character Building, Constructing Dynamic Dialogues, Finalizing the Script: Maintaining an Audience’s Trust, Turning Your Story into a Script, Rewriting Your Script, Adaptation and Collaboration: Two Alternate Ways to Work; Intro to Storyboarding/Visual Storytelling & Storyboards; Storyboarding Techniques: Drawing the components of the storyboard, Indicating motion in the storyboard.

Module 2: Genres and Audience (15 Lectures)
Nature of drama in television: Various shows, formats and genres, telecast patterns, audience viewership performance, Building the story, herd culture, Creating niche television programming: Importance of niche content, niche content channels, Differentiation of infotainment, edutainment, entertainment, lifestyle genres, Differentiation of genres, Specialty of different genres, popularity of genres, content on demand.

Module 3 Television and Video Formats (10 Lectures)

Module 4: Lighting Equipment and Techniques (15 Lectures)
Understanding of colour, use of colour, Capturing the emotion; Role of light, Lighting techniques - Concept of lighting various planes; Understanding Various types of lights; Lighting accessories, grey card, Metering, Colour temperature meter, Camera filters, Types of lighting - Studio lighting for three cameras set up, Outdoor lighting, Lighting for documentary, Mood Lighting & Colour Lighting
Theory and Practice.

Module 5: Lenses, Camera Movements and Techniques (10 Lectures)
Lenses: Type of Lenses, Power of Lenses, Understanding the shot requirement and usage of a lens, Lens and perspective: Depth of Field, Depth of focus, Focus pulling; Camera Movements, Camera angles, Usage and need of Track and trolley, Crane, Jimmy Jib, Poll Cam, Managing Movements, Single camera Setup, Multi camera setup and Continuity Exercise.

Suggested Readings
2. Breaking into Film by Kenna McHugh, 1998, Peterson Nelnet Co
5. How not to write a screenplay: 101 common mistakes most screenwriters make by Denny Martin Flinn, 1999, Lone Eagle

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MCSM0041: SOUND FOR MEDIA (3-0-1)

COURSE OUTCOMES:
1. Define the key terms related to sound (Remembering)
2. Explain the basic principles of sound production (Understanding)
3. Develop sound recording skills for visual media (Applying)
4. Distinguish between analogue sound and digital sound (Analysing)
5. Assess the acoustic quality of a room for sound production (Evaluating)
6. Produce audio programmes (Creating)

Module 1: Introduction to Sound (15 Lectures)
Understanding sound, Human hearing process, Air pressure, Characteristics of sound: wavelength; amplitude; frequency; phase, Components of sound: pitch; volume; timbre; harmonics; rhythm; tempo; attack; sustain and decay, Propagation of sound waves, Mono and stereo sound, Hi-fi vs low-fi sound, Sound perspective, Sound texture, Natural sound: Ambience; speech; dialogue etc., Sound creation: studio sound; inventing sounds and sound creation in software.

Module 2: Analogue and Digital Sound (17 Lectures)
Meaning of analogue and digital, Analogue sound, Characteristics of analogue sound: phase; frequency response; signal- to-noise ratio, Digital sound, Characteristics of digital sound: sampling; quantization; bit rate; dither; jitter, Compression and audio codec: audio file types/formats; open and proprietary formats, file compression.

Module 3: Sound Recording (15 Lectures)
Microphones: construction and polar pattern, recording practices: location recording; studio recording; equipment for location recording; equipment for studio recording, Music and Sound effects, Creating soundscape, Off-screen; on-screen and non-diegetic sound, Sound for video: news stories; documentaries; internet videos, Audio cable and connectors.

Module 4: Studio Acoustics (13 Lectures)
Meaning and definition of acoustics, Studio acoustics, Noise sources, Sound isolation, Sound absorption, Noise control: acoustic treatment; technical requirement for construction of studio.

Suggested Readings:
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MCPC0042: POLITICAL COMMUNICATION (3-0-0)

COURSE OBJECTIVES:
1. Define the key terms in political communication (Remembering)
2. Understand the different techniques of political communication (Understanding)
3. Critically analyse the relationship between media and politics (Analysing)
4. Develop a critical understanding of the role of communication in politics (Evaluating)

Module 1: Introduction to Political Communications (15 Lectures)
Political Communication: Concept, Theoretical Approaches, Theories and Political communication paradigm, Channels of Political Communication, communication and civic engagement.

Module 2: Media and Politics (15 Lectures)
Media Coverage of Politics, Framing, Opinion Polls, Election Coverage, Political Advocacy, The transmission of political information (Print/TV/SM), Media Bias, Campaign Advertising & Political Participation, Case Studies.

Module 3: Media, Power and Ideology (15 Lectures)
Constructing Ideology: Consensus as ideology; manufacturing consent; Ideology & hegemony, Identity formation and political mobilization, State and Information, Political process and Governance in India, Gauging Public Opinion, Public Opinion and Public Policy, Political Polarization.

Suggested Readings:

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MCNR043: NEWS REPORTING AND EDITING (3-0-1)

COURSE OUTCOMES
1. Define the meaning and concept of news reporting and editing (Remembering)
2. Understand the organisational structure of a newsroom (Understanding)
3. Develop editing skills for the print media (Applying)
4. Differentiate between news reporting and editing (Analysing)
5. Assess the quality of an editor in publishing a newspaper (Evaluating)
6. Design print media publications (Creating)

Module 1: News Gathering Process (15 lectures)
Principle of News Reporting, Elements of Reporting, Types of Reporting, Role and Importance of Sources, Cultivating, Verifying and Dealing with Sources of News, Attribution, Qualities of a good Reporter, Ethical aspects of Sourcing news & Reporting, Risk in reporting.

Module 2: Different Formats of News Report (15 lectures)

Module 3: The Editing Process (15 lectures)
Structure of a Newsroom, Editorial desk, Functions of Editorial Desk, Nature and need for editing, Principles of Editing, Role, 759|ADBU| Regulations and Syllabus|2022-23 |
objectives and tools of editing; process of editing; Editing symbols; language in editing; Objectives of copy editing; editing agency copies; handling wire and correspondents’ copy; Ensuring News value and other criteria; Checking facts, language, style, clarity & simplicity; Editing/revising press releases and handouts; Relevant graphics for copy, Style sheets and house styles; Photo Editing; Newsroom terminology in electronic editing; Magazine editing, Headline Writing: Principles, types and techniques.

Module 4: Practicum (15 hrs)
News editing: Hard news, soft news, Opinion and Analytical Pieces), News selection and placement; Preparing dummies; Graphics; Use of editing software; Photo editing and caption writing; Production of Lab Journal.

Suggested Readings:

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MCHE0044: HEALTH AND ENVIRONMENT COMMUNICATION (3-0-1)

COURSE OUTCOMES
1. Define the key terms in health and environment communication (Remembering)
2. Explain different models and approaches of health and environment communication (Understanding)
3. Develop communication strategy for public health and environment protection (Applying)
4. Examine the role of media in social change (Analysing)
5. Assess the situation for communication intervention (Evaluating)
6. Report news on health and environmental issues (Create)

Module 1: Health Communication (15 Lectures)

Module 2: Theories and Approaches to Health Communication (15 Lectures)
Health communication theories, Health Communication approaches and action areas: Persuasive approaches, Cultural perspectives, Emotional perspectives, public relations and public advocacy, Community mobilization, Planning, implementation and evaluation of public health communication campaign - Health communication planning process, Situation analysis and audience profile, Identifying programme objectives and strategies.

Module 3: Environment Communication (15 Lectures)
Environment journalism: emergence, rise of environment activism, role of the state, developments in India, relevant laws, UN initiatives, environment protection and the role of Media, Environmental journalism today, Skills for environmental journalism.

Module 4: Environmental Communication and Challenges (15 Lectures)
Media theory basics for the environmental journalist: Objectivity, Framing-News values, Agenda setting, Advocacy journalism, the media as environmental watchdog, Challenges for investigative environmental journalism. Writing an environment feature, environment research.

Suggested Readings:
3. Environment Journalism, H Bodker and I Neverla (Eds), 2013, Routledge
7. Journal of Health Communication, Tailor & Francis

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MCPM0045: PROGRAMME MANAGEMENT (3-0-0)

COURSE OUTCOMES
1. Understand the meaning and concept of project proposal writing (Understand)
2. Identify the principles and approaches of programme management (Analyse)
3. Undertake critical review of C4D projects (Evaluate)
4. Prepare development project management plans and programmes (Creating)

Module 1: Project Formulation and Appraisal (15 Lectures)
Overview of project management, Feasibility and technical analysis, Market and demand analysis, Economic and financial analysis, Formulation of Detailed Project Report (DPR).

Module 2: Project Planning, Writing and Scheduling (15 Lectures)
Meaning and concept of project planning, Need assessment and project feasibility, Rationale, Project components: Executive summary, Statement of need, Project goals, Project description, Budgeting, Organizational information, Materials and equipment, Human resources, Project costing and financing, organisation structures in project.

Module 3: Project Implementation, Budget and Results (15 Lectures)
Project team and competencies, Coordination and communication, Review Mechanism, Tracking project milestones, Report writing, production and supervision of key inputs, capacity strengthening activities/training, team building activities, Advance and contingency planning, Fund management, project-life-cycle, Results-based Management - outputs, outcomes and higher-level goals or impact, Cost-Benefit Analysis (CBA), Sensitivity Analysis, Project management information system, material and equipment,, financial aspects, project Sustainability, Closing a project, Reviewing a project.

Suggested Exercise
Literature Review, Case Study, Field Survey, Project Writing, Project Reviews, PRA

Suggested Readings:
1. Gower Handbook of People in Project Management (Project and Programme Management Practitioner Handbooks), Lindsay Scott and Dennis Lock, 2013, Routledge
2. How to change the world: Social Entrepreneurs and the Power of New ideas, 2004, David Bornstein, OUP USA

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MCSCA0046: SITUATION ANALYSIS FOR COMMUNICATION STRATEGY (3-0-1)
COURSE OUTCOMES
1. List the basic models and steps of communication strategy planning (Remembering)
2. Understand the techniques of development communication planning (Understanding)
3. Assess the situation for development communication and intervention (Evaluating)
4. Examine the role of media in socio-economic development and social change (Analysing)
5. Prepare develop communication strategy and plans (Creating)

Module 1: Socio-Ecological Framework and Situation Analysis

Module 2: Literature Review and Formative Research
Research on current knowledge, attitudes, experiences, practices and beliefs among the participants groups, Understanding Local knowledge, Formative Research, Participatory Research, Participatory Rural/Urban Appraisal (PRA), Participatory Learning and Action (PLA), Most Significant Change (MSC), Appreciative Inquiry, Case study on C4D.

Module 3: Synthesising, Analysing and Reporting Data
Data synthesis, reporting, identifying long-term goals, determining preconditions needed to achieve the goals, linking interventions to results, identifying indicators of results and producing a narrative to summarize changes, issues and challenges.

Suggested Readings:
2. Information and Communication Technology: Reinventing Theory and Action (2Volumes), Kiran Prasad, 2009, BRPC
7. Participatory Video: Images that Transform and Empower, A Shirley White, 2003, Sage India

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MCCA0047: PLANNING MODELS AND COMMUNICATION APPROACHES (3-0-1)

COURSE OUTCOMES
1. Identify the steps in communication strategy development (Remembering)
2. Explain the basic principles and development planning models (Understanding)
3. Analyse the relevance of theoretical frameworks of communication for development (Analyse)
4. Critically analyse the key components of communication strategies (Evaluate)
5. Design and implement C4D programmes (Creating)

Module 1: C4D Planning Models (20 Lectures)

Module 2: Communication Approaches (20 Lectures)

Module 3: Communication Intervention and Strategy (20 Lectures)
Identifying key stakeholders, Preparation of Partnership Plan, Management Plan, Operation Guidelines, Levels of Intervention: Macro, Mezzo and Micro levels, Establishing objectives at multiple levels, Key steps leading to change, Logical Frame, Communication strategy: Advocacy: Effective advocacy, Media Advocacy, Celebrity Advocacy, Legal Advocacy & Executive/Legislative and Regulatory Advocacy), Social Marketing, Entertainment Education, Peer Education, Capacity and Capability Strengthening, Project Implementation, Feedback and Review.
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**MCMC0048: MEDIA AND CULTURAL STUDIES (4-0-0)**

**COURSE OBJECTIVES**

1. Describe the key concepts of cultural and media studies (Remembering)
2. Understand the cultural dynamics of society with the help of contemporary theory (Understanding)
3. Examine the role of media in mediation of social identity (Analysing)
4. Assess the diverse media and cultural practices (Evaluating)

**Module 1: Media and Culture (15 Lectures)**

Concept of Culture - meaning; dimensions, Basic theoretical framework - Critical Cultural Theory; Frankfurt School; Chicago School, Mass media and postmodern culture, Culture industries, Popular and mass culture, Multiculturalism and subcultures, Mediated culture, cultural hybridity.

**Module 2: Media and Society (15 Lectures)**

Media Manufacturing of Culture, Pluralism and Counter-Culture, Mediated Culture, Media & Margins, Media influence on culture, Gender; culture and space, Media and gender.

**Module 3: Media, Culture and Identity (15 Lectures)**

Identity and Culture, Mediated Identity, Gender, Body and the Culture of Modernity, Contesting Cultures, Techno-Culture, Cyberculture, Media Representations, Under-Representation, Gendered Representation, Visual Pleasure, Internet as a Cultural Platform.

**Suggested Readings:**

3. Media and Culture: An Introduction, Campbell, Richard, Martin, Christopher R, and Fabos Bettina, 2011
7. Sociology of Indian Culture, D.P. Mukerji, 1979, Rawat Publishers
8. What is Cultural Studies? A Reader., John Storey (Ed), John Storey, 2009, Hodder Education

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MCFA0049: FILM APPRECIATION (3-0-1)

COURSE OUTCOMES
1. Trace the origin and growth of cinema (Remembering)
2. Explain film structure and film language (Understanding)
3. Differentiate story, plot and subplot (Understanding)
4. Analyse cinema critically (Analysing)
5. Critique various film theories (Evaluating)
6. Develop skills to write film reviews and criticism (Creating)

Module 1: Growth and Development of Cinema (15 Lectures)
*History of Indian cinema - Beginning of cinema in India, Hindi cinema, regional cinema, Parallel film movements, Crossover cinema.
*History of cinema in Northeast - Status of cinema in different states of Northeast, Cinema in Assam, Cinema in Manipur.

Module 2: Film Language, Structure and Narrative (15 Lectures)
*Film Structure – Form and content of film, Structure: camera movement, lighting, editing, acting, sound, Computer Generated Imagery (CGI), Special effects.
*Film Language - Semiotic theory of cinema, signs, symbols, codes, iconography, Mise-en-scene, Montage, Connotative and Denotative meanings.
*Film Narrative - Fictional and non-fictional narrative, Significance and structural elements of narrative, Story and plot, Sub-plots, Deviant plot structure, Principles of plot construction.

Module 3: Film Movements, Theories and Genre (15 Lectures)
*Film Movements – Soviet formalism, Avant garde, German expressionism, Italian neorealism, French new wave, Indian newwave.
*Film Theories – Auteur theory, Psychoanalytic model, Feminist model, Cognitive model, Ideological model
*Film Genre – Meaning and functions, Film genre and their characteristics, Classical Hollywood genre, Indian formula films.

Module 4: Technology and Film Criticism (15 Lectures)
*Film and technology – Digital technology and cinema, YouTube
*Film Criticism – Aesthetics of film, Writing film review and criticism, Film as art, Film Analysis, Textual and contextual analysis of films.

Suggested Readings:

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MCBJ0050: BUSINESS JOURNALISM (3-0-0)

COURSE OBJECTIVES
1. Describe the key terms related to business and finance (Remembering)
2. Understand different forms of business journalism (Understanding)
3. Write business news articles (Creating)

Module 1: Introduction to Business and Financial System (15 Lectures)
Basic knowledge of financial system and institutions, Gathering, distribution and allocation of revenue vis-à-vis Central Government and State Governments; finance commission/department, Central and State budgets: budget-making exercise, how to read a budget, concept of zero deficit budget, importance of Public Accounts Committee, Introduction to Tax Laws, Essential Commodities

**Module 2: Basics of Business Journalism (15 Lectures)**
Business journalism: Global and Indian context, types of business journalism, media and new trends in business journalism, international money market and new information technology, commercial database, ethics in business reporting – business journalism, servant or watchdog.

**Module 3: Writing Business News (15 Lectures)**
Sources of news on business, finance and industry – governments, chambers of commerce and industries, corporate, trading and industrial executives, share markets, commodities markets, money markets etc. Government policy decision, company reports, RBI reports; analysis of decisions, reports and statements, Data visualisation tools and presentation, ethics in business journalism.

**Suggested Readings**

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**MCPM0051: PROJECT MONITORING AND EVALUATION (3-0-1)**

**COURSE OUTCOMES**
1. Identify the data-gathering techniques of communication projects (Remembering)
2. Describe the project monitoring and evaluation processes (Understand)
3. Undertake critical analysis of evaluation data (Analyse)
4. Prepare monitoring and evaluation plans, write reports and communicate findings (Create)

**Module 1: Programme Monitoring, Evaluation and Promotion (20 Lectures)**
Concept of project Monitoring and Evaluation (M&E), Project cycle, Distinction between M&E, evaluation and impact evaluation, Role of logic models, M&E Plan, Different types of evaluations, Monitoring Outcomes and Assumptions, Measurement of progress, Indicators of change, Impact assessment, Stakeholder Analysis Networks Analysis, Social Support & Recognition, Positionality and ethics, Outcome mapping, Strengths and weaknesses, Promotion of changed/adapted behaviour/results, Testimonial Reminders, Repetition.

**Module 2: Data-gathering and Analysis (20 Lectures)**
Quantitative and qualitative approaches, survey, community dialogues, interviews, data analysis, use of statistical tools, Baseline Data, Information Management, interpretation, data visualisation, assessing validity and reliability and determining generalisability of the data, Learning and accountability.

**Module 3: Reporting and Documentation of M&E Data (20 Lectures)**
Interpretation of M&E data, understand its uses, data preparation, documentation, Types of Records: Process, Narrative and Summary, Problem-oriented Recording, formulating recommendation, Reporting Project Progress and Findings, practicum, Reflective practice - Learning Lessons, Adapting the Plan, Continuous Improvement Communicating the Results.

**Suggested Readings:**
3. Outcome Mapping: Building Learning and Reflection into Development Programs, Earl, S., Carden, F. and Stymulo, T., 2001, IDRC
7. The use and abuse of the logical framework approach, O. Bakewell and A Garbutt, 2005, Sida
8. The ‘Most Significant Change’ (MSC) Technique: A Guide to Its Use, R. Davies and J Dart, 2005

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MCTP6015: TECHNIQUES OF PHOTOGRAPHY AND IMAGE EDITING (0-0-2)

COURSE OUTCOMES
1. Show working knowledge of digital SLR cameras (Remembering)
2. Demonstrate an understanding of composition and image design process (Understanding)
3. Apply image editing and output techniques (Applying)
4. Analyse and critique one’s own artistic output (Analysing)
5. Determine safe and responsible work practices (Evaluating)
6. Create photographic work of acceptable standard (Creating)

Description:
To equip the learners with skills and knowledge about the art of digital photography, to enable the learners to professionally handle DSLR cameras, understand technical concepts from the different shooting modes to aperture and shutter speed; and apply composition techniques from finding effective backgrounds to rule of the thirds. To provide hands-on training on outdoor photography as well as studio photography.

Recommended Assignments:
Street photography, Landscape photography, Action Photo story, Cityscapes, Studio portrait, Building a Photography portfolio.

Suggested Readings
2. Fundamentals of Photo Composition, Paul R. Comon, Sterling Publications.
4. Langford’s Basic Photography, Michael Langford, Anna Fox and Sawdon Rechard Smith, Focal Press.

MCJG6016: JOURNALING (0-0-1)

COURSE OUTCOMES
1. Demonstrate the ability to explore different options for handling daily experiences (Understanding)
2. Develop self-awareness, self-learning and communication skills (Applying)
3. Apply contextual and experiential learning in their everyday lives (Applying)
4. Improve creativity and imagination (Creating)

Description:
During these 30 hours of the Course, students are required to maintain a daily reflective journal, using the Visible Thinking Routine as a critical structure for guiding their journal writing. Students are required to do journaling once a week and submit the journal to the assigned faculty member every Friday for analysis. Grades will be awarded for this course on the basis of the journal entries and a presentation at the end of the semester.

Suggested Readings
3. Journaling During Research, Kay Debra Logan, 2005, Library Media Connection; Vol. 23 Issue 6, p12

MCDI6017: DISSERTATION PHASE – I (0-0-2)

Description:
Through this practicum students will be taught the different methods for conducting academic research. It will also teach students to conduct review of literature, prepare synopsis outline, format or structure of report. They will also learn how to add Appendices, such as references to sources of data, instruments of data collection; give Bibliography and footnotes.
DEPARTMENT OF MASS COMMUNICATION

The Exercise:
During this 60-hours course, students will have to choose a research topic of their choice, conduct a literature review with bibliography, and develop a research proposal which will be submitted in partial fulfilment for the requirement of Master’s degree in Mass Communication. Students will also write and present a research paper.

Recommended Readings
5. Research Methodology Methods and Techniques, C.R. Kothari

MCAV6018: AUDIO-VIDEO PRODUCTION (0-0-2)

COURSE OBJECTIVES
1. Show awareness of safe and responsible work practices (Remembering)
2. Demonstrate an understanding of the audio-video production process (Understanding)
3. Experiment with different types of audio and video production tools (Applying)
4. Develop competency in editing and output techniques (Creating)
5. Create different formats of audio and video programmes (Creating)

The Exercise:
Basics of audio editing, Basics of video editing, Principles of scripting, Audio recording techniques and equipment, Radio Talk show, Radio Commercials, Studio recording, Outdoor recording, Hands-on training on Camera techniques and accessories, Framing and Shot sizes, Lighting techniques for video, Commercials, Video Interview, Live recording techniques.

Suggested Readings
2. Techniques of Radio Production, Robert Mcleish, 2015, Focal Press
5. Writing for Radio and Television in India, Krishnan K. Kedia, Cyber Tech Publications.

MCDP6019 DISSERTATION PHASE – II (0-0-2)

Project Description
During this practicum course students will complete data collection, analysis, preparation of research report and submit the final dissertation. The dissertation has to be systematically structured following proper methodology of communication research. Phase - I of the course is carried out in the 2nd Semester where students work upon research proposals, literature review and research methodology. Students will have to ensure that the dissertation is prepared keeping in view Intellectual Property Rights, maintenance of research ethics and avoidance of plagiarism. Students are required to make a presentation of the dissertation submitted to the department on the date set by the department.

Suggested Readings:

MCIP6020 INTERNSHIP (5 Credits – 90 hours)

Description
Students will undertake 4-weeks internships in media and communication organizations during the winter vacation between third semester and fourth semester. They will discuss the choice of media and communication organization with their respective mentors and obtain the consent of the head of the department. Before going for the internship, an Internship Agreement Contact form from the concerned organization will be submitted by the student to their respective mentors. After completion each student
will submit a copy of the Internship Completion Certificate to their mentors from the designated authority of the concerned media and communication organization.

The final evaluation will be on the basis of the following criteria:

a. Journal – 30%

b. Portfolio and Presentation – 50%

c. Written evaluation by the employer – 20%

Journal: Each student will keep a daily journal with an entry for each day spent doing work for the internship. This journal should be e-mailed to the mentor at the beginning of each work week. In this journal the students should summarize the activities and assignments on which the student worked. The student should also keep track of the number of hours for each week.

Portfolio: At the end of the internship, each student is required to prepare a professional portfolio that contains examples of the students’ work during the internship. The portfolio will additionally contain a written evaluation of the media organization, employer evaluation of the student, a copy of the internship completion certificate, a one-page summary of the internship.

Employer Evaluation: At the end of the internship the supervising employer will be asked to submit a written evaluation of the student’s performance.

Student Evaluation: At the end of the internship the student will be asked to submit a written evaluation of the employer. The department will issue the following to the students:

a. Internship Application Form – to be submitted to the mentor prior to internship.

b. Internship Agreement Contract – to be submitted to the mentor prior to internship.

c. Student Evaluation of the Internship – to be included in the portfolio

d. Employer Evaluation of Intern – to be included in the portfolio

Last date of Internship: To be notified by the department

Portfolio Submission and Presentation: To be notified by the department

MCFP6021 FINAL PROJECT (5 Credits – 90 hours)

Project Description:
Each student is required to submit a project based on her/his area of specialization or any other relevant areas of Journalism and Mass Communication/Advertising/Public Relations etc. They are required to choose the topic of their Final Project in consultation and supervision of the teacher/Mentor of the department and duly approved by the Head of the Department. The Final Project has to be submitted (two printed in bound form and a soft copy) as per the schedule duly notified by the department.

Suggested Project:
Designing and publication of newspapers/magazines/publicity posters/brochure

Project Evaluation Criteria

- Project activity assessment: 20%
- Evaluation of final project: 60%
- Viva-Voce: 20%

Last date of project submission: To be notified by the department

Portfolio Submission and Presentation: To be notified by the department
VALUE ADDED COURSES

MCCS6122 COMMUNICATION SKILLS (1-0-1)

COURSE OBJECTIVES
1. Identify the different styles of communication (Remembering)
2. Understand how to develop effective speaking skills (Understanding)
3. Evaluate various communication needs (Evaluating)
4. Develop professional oral & written communication skills (Applying)

Module 1: Basics of Communication (5 Lectures)

Module 2: Oral Communication (13 Lectures)
Language in Communication, Phonetics, Spelling, Pronunciation, and Accent, Speech Drills, Oral Communication Skills: Seeking and giving information/suggestions/advice, Offering and responding to offers, Requesting and responding to requests, Congratulating people, Expressing condolences, Asking questions and responding politely, Apologizing and forgiving, Giving instructions, Seeking and giving permission, Expressing opinions, Group discussion, Seeking explanations, Expressing sympathy, Reading Skills: Skimming and Scanning, Levels of Reading, Reading Comprehension, Academic Reading Tips, Listening and speaking skills, Contextualised speaking.

Module 3: Written Communication (12 Lectures)
Writing Skills, Elements of Writing: Sentence, Phrases and Clauses, Forms of Written Communication, Formal & Informal Writing, Letter Writing, Notices, Summary, Note-making, Job application, Preparing a CV/Resume and Effective Profiling, Preparation of Cover letters, preparing for and Facing a Job Interview, Preparing a Presentation, Preparing Agenda and Minutes for Meetings, Writing Notices and Memos, Drafting an E-mail, Correspondence with Government Authorities/institutions, Office Orders, Enquiries and Replies, audience analysis.

Suggested Readings:

Mapping of COs to Syllabus

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MCCW6123 CREATIVE WRITING (1-0-1)

COURSE OUTCOMES
1. Demonstrate understanding on various forms of creative writing (Understanding)
2. Apply the techniques of creative writing for storytelling (Applying)
3. Write contents for various purposes (Creating).

Module 1: Introduction to Creative Writing (10 lectures)
Writing as an Art, Types of writing, Principles of writing, Characteristics of Good Writing, Elements of Writing: Form, Content, Audience, Style & Structure, Meaning of creative writing, Creative process and abilities for writing, Challenges in Creative Writing.

Module 2: Process and Techniques of Creative Writing (10 lectures)
Finding the ideas, sketching the plot, characterization, conflict, climax, resolution, Action Description, Point of View, Dialogue, setting atmosphere, Using technology in process of writing.

Module 3: Writing Exercises (10 Hours)
Content Writing, Reviews writings, Blogging, Feature and Opinion Pieces, Creative Writing, Short Story, Poetry, Fiction, Essay, Adventure Story, Reflective Writing, Persuasive Writing – Commercials, Figurative Writing, Travel Writing.
Suggested Readings:
2. Creative Writing Course Book, Paul Mills, 2006, Routledge
7. Word Power: A guide to creative writing, Julian Birkett, 2016, Bloomsbury Academic India
8. Writing on Both Sides of the Brain: Breakthrough Techniques for People Who Write, Henriette A Klauser, 1987, HarperOne

Mapping of COs to Syllabus

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MCEM6124 EVENT MANAGEMENT (1-0-1)

COURSE OUTCOMES
1. Understand the relevance of event management as a professional skill and career option (Understanding)
2. Demonstrate an in-depth understanding of the intricacies of managing an event (Applying)
3. Examine individual and team orientation in event planning and management (Analysing)
4. Plan and organise an event (Creating)

Module 1: Introduction to Event Management (6 lectures)
Concepts and types of events, Understanding and Introduction to the events landscape, Idea generation, Conceptualisation: Techniques/Methods.

Module 2: Event Planning and Administration (8 lectures)
Developing event vision/mission, objectives and goals, Event proposal, Strategic planning techniques: Action Plans; Event Group Sustainability methodologies, Logistics and operations: Use of work plan structures; time-plans; worksheets; Gantt Charts, Legal frameworks: Licenses and Permissions, Event administration strategies, Resource Mobilisation and techniques, financial management.

Module 3: Event Marketing (8 lectures)
Target Group Segmentations: Concepts and Strategies, Strategic and Integrated Marketing Communications for events, Event Branding, Digital marketing and audience building for events, Marketing plan creation; strategies and implementation, Skills for event managers and planners: negotiation and networking skills; image management; leadership.

Module 4: Post Event Documentation and Evaluation (8 lectures)
Documentation: aims: methods and techniques, Event evaluation methodologies, Audience feedback and review mechanisms, developing event follow-up strategies and action plans, Developing the Event Planners Journal.

Suggested Readings:

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SERVICE LEARNING

MCLS0100: COMMUNITY MEDIA (2-0-0)

COURSE OUTCOMES
1. Define and explain service learning and participatory approach to social development (Remembering)
2. Classify the different types of community media (Understand)
3. Utilise community media for social change and development (Applying)
4. Analyse storytelling formats and content about development issues (Analyzing)
5. Identify opportunities for discussing development issues using community media (Evaluating)
6. Produce content for community media (Creating)

Module 1: Introduction to Service-Learning (5 Lectures)
Concept of Service Learning—definition, principles, models of different Higher Education Institution Service Learning; Service Learning as a medium of social change.

Module 2: Understanding Community and Community Participation (5 Lectures)
Understanding Community, Participatory approach to social development; Principles of community participation; Participatory Rural Appraisal.

Module 3: Community Media and Community Engagement (5 Lectures)
Understanding Community Media, Types, Purpose, Relevance and Significance, Skills, tools and Techniques of community media, Practices of Community Media, Participatory communication, socio-cultural media, Communication for Social and Behaviour Change, ethical issues.

Module 4: Community Practicum and Learning Activities (15 Lectures)
Internship, Community Mobilisation, Awareness/Advocacy campaign, folk performances, community meetings, rural reporting, community radio programmes, community video, case studies.

Suggested Readings:
1. A to Z in Projects Cycle Management: A Results Based Approach, P. J. Lukose, 2015, Media House Publications, New Delhi
5. Media, Communication and Development: Three Approaches, Linje Manyozo, 2012, Sage India

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VISION
To be a centre of excellence in teaching, learning, research and in the practice of psychological counselling, thereby promoting community mental health and psychosocial competence in order to foster cohesion in the society.

MISSION
1. Department of psychology and counselling Assam Don Bosco University seeks to:
2. Achieve excellence in teaching, learning, research, practice and extension activities.
3. To nurture and develop the counselling skills of the students.
4. To prepare competent counsellors who are socially committed and culturally sensitive and are bound by the ethics of the profession.
5. To create an environment committed to promoting the application of science of psychological counselling to real world situation.

PROGRAM OUTCOMES – BA PROGRAMME
PO 1: Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO 2: Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO 3: Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO 4: Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO 5: Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO 6: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO 7: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PROGRAM SPECIFIC OUTCOMES – BA PSYCHOLOGY
PSO 1: Knowledge of Basic Concepts of Psychology: To impart knowledge and understanding of the basic concepts, systems, theories of psychology and psychopathology.

PSO 2: Practical Application Skills: An ability to apply the theoretical principles of Psychology demonstrating an understanding of behavior, thoughts, and feelings of the individual and the individual in group settings

PSO 3: Assessment Skills: Basic professional skills pertaining to psychological testing, assessment and counselling.

PSO 4: Multicultural Competence: To recognize, understand, and respect the complexity of multiculturalism in the practice and application of counseling and psychotherapy.

MAPPING OF COURSES WITH POS/PSOS

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### PROGRAM OUTCOMES – MSC PROGRAMME

**PO 1:** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

**PO 2:** Effective Communication: To build on effective inter and intra personal communications skills including empathy. Open mindedness, mutual respect, Confidence, effective listening, non-verbal communication, clarity and concision.

**PO 3:** Scientific Temper: To build essential skills of different ways of life including questioning observing, physical reality, testing, hypothesizing, analyzing and communicating

**PO 4:** Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

**PO 5:** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

**PO 6:** Environment and Sustainability: Building a contemporary state of art model using the theories of social sciences for sustainable development of the campus/environment.

**PO 7:** Gender Sensitization and Social Commitment: To bring about a change in behavior and attitude and to instill empathy in the students to raise awareness about the gender equality concerns and to imbibe the sense of social responsibility for self and community to envisage ethical framework, obligation to work and cooperate with other individuals and organizations for the benefit of the society at large

**PO 8:** Self-Directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

### PROGRAM SPECIFIC OUTCOMES – MSC PSYCHOLOGY

**PSO 1:** Knowledge and Attitude: To develop budding counselling psychologists who will be able to understand and demonstrate behavior, have attitudes in the basic areas of professional counseling.

**PSO 2:** Research and Analytical Skills: Will be able to demonstrate competence in analysis and critically analyse scholarly work in areas of research, consultancy and counseling practice.

**PSO 3:** Application: To equip students with knowledge in the fundamentals of psychology and counseling so that they understand the application of the field relating to different issues in psychology.

**PSO 4:** Core Competency Skills: To enhance the core counseling skills, such as active listening, empathy, unconditional positive regard, congruence and so on and empowering the process of human development.

**PSO 5:** Ethics: To demonstrate the technical skills and ethical decisions appropriate for the holistic professional development in the field.

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BACHELOR OF ARTS – HONOURS IN PSYCHOLOGY

PCIP0122: INTRODUCTION TO PSYCHOLOGY (4-0-0)
(Credits: Theory-04) Theory: 60 Lectures

Course Outcomes
1. Define psychology and define the various concepts. (Remembering)
2. Explain the nature and characteristics of psychological research and perspectives. (Understanding)
3. Analyse the basic principles and theories of intelligence, learning and memory and motivation. (Analysis) CO4
   Distinguish between various psychological researches (Understanding and analysis)
4. Explain the causes of forgetting and stages of memory (Remembering) CO6
   Apply research designs and approaches appropriately. (Application)
5. Evaluate modern and Indian perspectives of psychology (Evaluation)
6. Developing familiarity with individual level phenomenon such as intelligence, personality, learning, memory and motivation. (Evaluation)
7. Design research studies for psychological phenomena. (Creating)

Module I: Introduction (16 hours)
Nature of Psychology: Definition, Fields of psychology, Schools of modern psychology, Psychology in India: History and current status, Methods of psychology (with special emphasis on Experimentation), Biological basis of human behavior (with emphasis on brain).

Module II: Learning, Memory and perception (16 hours)
Learning: Classical conditioning, instrumental learning, observational learning (socio-cognitive learning);
Memory: Models of memory: Information processing model (Sensory register, STM, LTM and concept of working memory), Levels of processing, Parallel Distributed Processing model, Reconstructive nature of memory; Forgetting, Improving memory
Perception: Top down and Bottom Up processes, Size Constancy, Depth Perception

Module III: Motivation & Emotion (12 hours)
Approaches to understanding motivation and Types of Motives
Elements of Emotions (components), Emotional Intelligence and Gender, Culture & emotions

Module IV: Individual differences: Personality and Intelligence (16 hours)
Personality: Nature and Theories
Intelligence: Nature and Theories

Suggested Readings

Mapping of COs to Syllabus

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PCBP0123 BIOPSYCHOLOGY (5-1-0)
(Credits: Theory-05, Tutorial-01) Theory: 75 lectures Tutorial: 15 hours

Course Outcomes
1. Define the basic terms related to the field of Bio-psychology. Name different biological systems involved in psychological disorders. (Remembering)
2. Learn the biological basis of psychological disorders. (Understanding)
3. Make use of bio-psychological theories, and principles to enhance bio-psychological approaches for health promotion and illness
Module I: Introduction to Bio-psychology (20 Hours)
Concept of biopsychology; Major theoretical perspectives: Rene Descarte, Phineas Gage, Charles Darwin; reductionism; Nature versus Nurture controversy; ethical issues.
Neurons, Synapses, Neurotransmitters.
The nervous system: Basic subdivisions- Peripheral and Central.
Hemisphere function: Sperry and the split—brain; Left handedness; Emotion and the right hemispheres.

Module II: Learning and Memory (20 Hours)
Anterograde and retrograde Amnesia.
Korsakoff’s Psychosis.

Module III: Sleep, Arousal and Biological Rhythms (15 Hours)
Concept of arousal; Physiological measures of arousal Reticular Formation and Central arousal.
Biological rhythms. Functions of sleep.

Module IV: Emotion and Motivation (20 Hours)
Anxiety; stress and arousal; Endocrine system: Structure and Functions, Major endocrine glands, Hormones: Types and Functions, Influence of hormones on human behavior.
Emotion – Central and Peripheral mechanisms. Physiology of Hunger and Thirst.
Homeostasis; Obesity and Anorexia.

Tutorial (15 Hours)
1. Use of bio-feedback to understand brainwaves and other physiological functioning.
2. To demonstrate the assessment, scoring and assessment of some neuro-cognitive batteries
3. Visit to brain research centres for familiarity with techniques of brain mapping
4. Developing intervention techniques for behaviors such as eating and sleeping based on knowledge of the underlying social and biological mechanisms.

Suggested Readings

Mapping of COs to Syllabus

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PCPI0124: PSYCHOLOGY OF INDIVIDUAL DIFFERENCES (5-1-0)
(Credits: Theory-05, Tutorial-01) Theory: 60 lectures

Course Outcomes
At the end of this course students will be able to:
1. Define the key concepts of individual differences. (Remembering)
2. Recall dimensions of categorizing individuals contextually. (Remembering)
3. Interpret self enhancement. (Understanding)
4. Apply concepts of motivation and creative thinking (Applying)
5. Examine psychometric approaches to individual differences. (Analysing)
6. Determine cultural factors behind individual differences. (Evaluating)
7. Interpret potentialities of people beyond IQ. (Evaluating)
8. Compose new ideas to integrate existing space to enhance tolerance of differences. (Creating)
9. Create new techniques to enhance cognitive abilities ranging from adaptation to enhancement. (Creating)

**Module I: Personality (15 hours)**

Personality: Nature of personality; Biological foundations of personality; Culture, gender and personality; Perspectives on personality: Psychodynamic, Phenomenological-humanistic and social cognitive.

**Module II: Intelligence (15 hours)**

Intelligence: Concept of intelligence: Psychometric and cognitive approaches to intelligence; Gardner’s multiple intelligences; Emotional Intelligence, Heredity, environment and intelligence; Group differences in intelligence; Extremes of intelligence.

**Module III: Understanding Self (10 hours)**

Indian approach: Self and identity in Indian thought.

**Module IV: Self Enhancement (20 hours)**

Enhancing individual’s potential: Self-determination theory; Enhancing cognitive potential, Self-regulation and self enhancement; Fostering creativity.

**Suggested Readings**


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**PCSR0125: STATISTICAL METHODS FOR PSYCHOLOGICAL RESEARCH-I (5-1-0)**

(Credits: Theory-05, Tutorial-01) Theory: 75 lectures Tutorial: 15 hours

**Course Outcomes**

1. Define the basic concepts of research, identify major research designs and recognize the philosophical foundations of research. (Remembering)
2. To understand the importance of inferential statistics and scales of measurements. (Understanding)
3. To analyse the scope and uses of graphical representation of the quantitative data. (Analysing)
4. To use measures of Central Tendency and Measures of Variability in research. (Applicability)
5. To evaluate different research designs and their appropriate applicability. (Evaluation)
6. To create a research proposal using appropriate research design, graphical representation of data and statistical computation. (Creating)

**Module I (15 Hours)**

Introduction to Research, The Goals of Psychological Research, Paradigms of Research Overview of major research designs
Introduction to Statistics
Descriptive and Inferential Statistics; Variables and Constants; Measurement Scales.

**Module II (15 hours)**

Organizing Qualitative Data
Constructing a grouped frequency distribution, a relative frequency distribution and a cumulative frequency distribution; Computation of Percentiles and Percentile Ranks.
Graphic Representation of Data
The Histogram; Frequency Polygon; Bar Diagram; Pie Chart, Cumulative Frequency Graph; Factors Affecting the Shape of Graphs.

**Module III (20 hours)**

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Measures of Central Tendency

The Mode, Median and Mean; Properties and Relative Advantages and Disadvantages of the Mode, Median and Mean; Central Tendency Measures in Normal and Skewed Distributions; The Effects of Linear Transformation on Central Tendency Measures.

Measures of Variability and Standard (z) Scores

The Range; The Interquartile and the Semi-Interquartile Range; The Average Deviation; The Variance; The Standard Deviation; Calculation of Standard Deviation from Raw Scores and Grouped Scores; Properties and Comparison of Measures of Variability; The Effect of Linear Transformation on Variability Measures; Standard Scores (z-score); Properties of z-scores.

The Normal Distribution

The Nature and Properties of the Normal Probability Distribution; Standard Scores and the Normal Curve; The Normal Curve as a Model for Sampling Distributions; Divergence from Normality (Skewness and Kurtosis)

Module IV (20 hours)

Correlation

Meaning of Correlation, Positive and Negative correlation, calculation of Correlation Coefficient, Calculating Pearson’s Correlation Coefficient from Deviation Scores; Calculating Pearson’s Correlation Coefficient from Raw Scores; Spearman’s Rank-Order Correlation Coefficient

Random Sampling and Sampling Distributions Random Sampling:
Using a Table of Random Numbers; The Random Sampling Distribution of the Mean: An Introduction; Characteristics of the Random Sampling Distribution of the Mean; Using the Sampling Distribution of Sample Means to Determine the Probability for Different Ranges of Values of Sample Mean; Random Sampling With and Without Replacement.

Module V: Tutorial (15 hours)

1. Doubt Clarifying sessions and discussions
2. Reviewing research papers for ethical and moral considerations during research.
3. Activity on Scientific Writing: How to write research paper based on quantitative studies, APA style of writing and referencing, Plagiarism checks and other ethical considerations
4. Use of computers and familiarity with soft-ware for behavioural research: Creating spreadsheets, organizing and computing data, use of graphs, Introduction to statistical software like SPSS/PSPP

Suggested Readings


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PCGP0126: GENERAL PSYCHOLOGY (5-1-0)
(Credits: Theory-05, Tutorial-01) Theory: 75 lectures Tutorial: 15 hours

Course Outcomes

1. Define Psychology, name the different fields of Psychology, state the different theories of personality and intelligence, list the different developmental processes, name the different assessment tools of intelligence and personality, state the application of Psychology in different fields such as work, legal issues and health, state the theory of moral development. (Remembering)
2. Understand the meaning of Psychology, explain learning, explain the models of memory, classify the different types of motives, explain developmental processes through different theories/perspectives such as Piagetian, Freudian, classify different stages of moral development, explain emotional intelligence and its different components. (Understanding)
3. Apply the different theories of emotion to everyday life, determine the applicability of Psychology in different areas such as work, law and health, apply principles of learning to understand from real life examples, apply strategies for memory retrieval, apply approaches of motivation into practice. (Applying)
4. Identify different aspects of problem solving, analyze the strengths and weaknesses of different theories of intelligence, identify a good personality assessment tool, analyze the applicability of classical and operant conditioning, analyze the principles of reinforcement, identify positive and negative emotions. (Understanding)
5. Summarize the different theories of motivation and emotion, deduce the strengths and weaknesses of different psychological assessment tools, organize the developmental processes according to different theories, conclude the effectiveness of psychological knowledge in different fields. (Understanding)
6. Determine the nature of Psychology, assess the strengths and limitations of different theories of learning, evaluate the importance of positive and negative emotions, determine the causes of memory failure, evaluate the different stages of development, evaluate the different interventions related to health. (Understanding)

Module I: Orientation to Psychology (26 hours)
- Nature, fields and applications of psychology;
- Cognitive Processes: Learning, memory and problem solving;
- Conative Processes: Motivation, types of motives (Sociogenic/Psychogenic motives);
- Affective Processes: Emotion, Theories of Emotion, Positive and negative emotion

Module II: Psychology of Individual Differences (25 hours)
- Theories of personality: Freudian psychoanalysis, type and trait; humanistic;
- Theories of intelligence: Spearman ‘g’ theory, Sternberg and Gardner;
- Emotional intelligence;
- Assessment of intelligence and personality

Module III: Understanding Developmental Processes (15 hours)
- Cognitive Development: Piaget;
- Moral Development: Kohlberg;
- Psycho-social Development: Erikson, Psychosexual Development: Freud.

Module IV: Applications of Psychology (9 hours)
- Work
- Health
- Law

Tutorial (15 hours)
Objective:
To better understand the concepts of Psychology and determine their applicability to real life situations.

Module I Orientation to Psychology (5 hours)
Doubt clearing sessions, Reflection papers, application of principles of learning, use of YouTube videos for memory retrieval strategies, identification of positive and negative emotions through different tools.

Module II Psychology of Individual Differences (5 hours)
Doubt clearing sessions, Reflection papers, introduction to different tools to measure intelligence, personality and emotional intelligence.

Module III Understanding Developmental Processes (3 hours)
Doubt clearing sessions, Reflection papers, conduction of conservation tasks (Piaget’s theory of Cognitive Development), use of YouTube videos for moral dilemmas.

Module IV Applications of Psychology (2 hours)
Doubt clearing sessions, Reflection papers, review of research articles on application of Psychology.

Suggested Readings

Mapping of COs to Syllabus

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PCHW0127 Psychology for Health and Wellbeing (5-1-0)
(Credits: Theory-05, Tutorial-01) Theory: 75 lectures Tutorial: 15 hours

Course Outcomes
1. Define the basic terms related to the area of health and wellbeing. (Remembering)
2. Identifying stressors in one’s life and how to manage them. (Remembering)
3. Interpreting variety of health enhancing, health protective, and health compromising behavior and their application in illness
management. (Understanding)
4. Learn the importance of inner strength and human values which could help in maintenance of holistic health and gain insights into positive aspects of work. (Understanding)
5. Make use of psychological principles to enhance health management not only in their own lives but in community as well. (Applying)
6. Examine the stress response and its impact on the etiology and course of many health-related problems. (Analyzing)
7. Estimate the approximate health hazards and recommend the health enhancing behaviors. (Evaluating)
8. Develop awareness about the various health hazards and suitable ways of dealing with such risks effectively at the community level. (Creating)
9. Create an environment where individuals are able to find the balance between the inner strengths and the outside world. (Creating)

Module I: Illness, Health and Wellbeing (17 hours)
Continuum and Models of health and illness- Bio-Medical, Biopsychosocial, holistic health; health and wellbeing

Module II: Stress and Coping (20 hours)
Nature and sources of stress; Effects of stress on physical and mental health; Coping and stress management

Module III: Health Management (17 hours)
Health-enhancing behaviours; Health compromising behaviours; Health Protective behaviours; Illness Management

Module IV: Promoting Human strengths and life enhancement (21 hours)
Classification of human strengths and virtues; cultivating inner strengths: Hope and optimism; Gainful Employment and Me/We Balance.

Module V: Tutorials (15 Hours)
Objective: The aim is to understand the applicability of principles learnt and solidify the understanding so as to develop the ability to design ways of better health management for the community.

Module I Illness, Health and Wellbeing (3 hours)
Doubt clearing sessions/Assignments/tests with application-based questions

Module II Stress and Coping (4 hours)
Doubt clearing sessions/group activities/workshops/Assignments

Module III Health Management (4 hours)
Doubt clearing session/Case study/Group discussion/Assignments

Module IV Promoting Human strengths and life enhancement (4 hours)
Doubt clearing sessions/reflections/Journal writing/Assignments

Suggested Readings

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PCPR0128 PSYCHOLOGICAL RESEARCH (4-0-0)
Theory (4 credits – 60 hours)

Course/Learning Outcomes
1. Define the basic concepts of psychological research. (Remembering)
2. Understand the various approaches and research traditions in psychological research. (Understanding)
3. Application of different techniques and tools in psychological research. (Applying)
4. Analyse the effectiveness of various tools used in different types of research designs in psychological research. (Analysing)
5. Evaluate the significance of research in psychology and the advantages and disadvantages of the different orientations and research traditions. (Evaluating)
6. Design research problems, formulate hypothesis, and the steps involved in conducting psychological research. (Creating)

Module I: Introduction (20 hours)
Basics of Research in Psychology: What is Psychological Research? The Goals of Psychological Research; Principles of Good Research; Ethics in Psychological Research.
Research Traditions: Quantitative and Qualitative Orientations towards research and their steps; Comparing qualitative and quantitative research traditions.
Formulating a problem and developing a Testable Research Question and Research Hypothesis.

Module II: Experimental Method (16 hours)

Module III: Non-Experimental Methods – I (12 hours)
Case Study, Sociometry, Observation, Surveys, Focus Group Discussion, Interviews.

Module IV: Non-Experimental Methods - II (12 hours)
Psychological Testing: Standardization; Reliability, Validity and Norms of a Psychological Test; applications

Suggested Readings:

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PCDT0129 DEVELOPMENT OF PSYCHOLOGICAL THOUGHT (5-1-0)
(6 Credits- 90 Hours)

COURSE OUTCOME:
1. Find and define key concepts of Psychology schools of thoughts (Remembering)
2. Comparison and Contrast between schools of thought & demonstrate fundamental knowledge and comprehension of the major concepts, theoretical perspectives, historical trends, and empirical findings (Understanding)
3. Apply psychology-specific content and effective self-reflection (Applying)
4. Contrast key concepts, principles and overarching themes (Analysing)
5. Critically evaluate sources of information in the field of psychology and major psychological school of thoughts (Evaluating)
6. Adapt and discuss the psychological principles and developing a working knowledge of the different content or program areas in psychology apply to behavioural phenomena (Creating)

Module 1: Understanding Psyche: Debates and Issues (15 hours)
Free will and determinism. Empiricism and rationality. Issues of Consciousness and Mind Body Relationship

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(*Each of these debates and issues to be dealt with from the point of view of an East-West Comparison; Eastern perspective will include Yoga & Vedantic view)

Module-II: Schools of Psychology (25 Hours)
Early Schools of Psychology: Associationism, Structualism and Functionalism (Brief Introduction). Positivist Orientation: From behaviorism to cognition- Key contributions of Watson, Tolman, Hull, and Skinner; Cognitive revolution, Information Processing Model.

Module-III: Psychoanalytic and Humanistic-Existential Orientation (25 hours)
Freudian Psychoanalysis, The turn towards ‘social’ – Adler, Jung, Fromm, Erik Erikson, Object relations; Cultural psychoanalysis (Sudhir Kakar), contributions of Phenomenologically oriented humanistic and existential thinkers.

Module –IV: Contemporary Developments (10 hours)
Feminism and social constructionism.

Suggested Readings:

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PCSY0130 SOCIAL PSYCHOLOGY (5-1-0)
(6 Credits- 90 Hours)

COURSE OUTCOMES
1. Define social Psychology, historical perspectives. (Remembering)
2. Illustrate the interpersonal processes (Understanding)
3. Apply the keys aspects of individual processes in the social world (Applying)
4. Examine the individual processes in the social world (Analysing)
5. Explain the concept group, cooperation and conflict. (Evaluating)
6. Creatively give an idea of the implications of the individual processes in the social world (Creating)

Module I: Introduction (15 hours)
History of social psychology, Scope of social psychology, and to understand the individual in the social world

Module II: Individual Processes (15 hours)
Person perception, Attention-theories, biases and errors; Attitude: Formation, change and resistance to change

Module III: Interpersonal processes (10 hours)
Interpersonal attraction, prosocial behavior, aggression

Module IV: Group dynamics (20 hours)
Key aspects of groups, cooperation and conflict, group decision making

Suggested readings:

Mapping of COs to Syllabus

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**Module 6: Understanding**

**COURSE (6 PCPM0132 PSYCHOLOGY AND MEDIA (5 credits – 90 hours)**

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**Module I: Stress and health (8 hours)**


**Module II: Stress and health (8 hours)**

Effects of stress on health, eustress

**Module III: Managing stress-I (6 hours)**

Methods: yoga, meditation, relaxation techniques.

**Module IV: Managing stress-II (6 hours)**

Problem focused and emotion focused approaches.

**Suggested Readings:**


**Mapping of COs to Syllabus**

**PCPM0132 PSYCHOLOGY AND MEDIA (5-1-0)**

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**Module I: Media and User (20 hours)**

Understanding mass media; Issues in Media psychology: Construction of reality, media and culture, Media and ethics, regulation.

**Module II: Media and advertising (15 hours)**

Developing an effective advertising programme/media promotions/campaigns for social marketing. Case studies in the Indian context.

**Module III: Audio-Visual media (TV and movies) and Print media (25 hours)**

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Module IV: Interactive and emerging technologies (15 hours)
Virtual social media, interactive media, gaming, issues of internet addiction. Case studies in the Indian context.

Suggested Readings:

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PCSM0133 STATISTICAL METHODS FOR PSYCHOLOGICAL RESEARCH-II (5-1-0)
(6 Credits-90 Hours)

Course Outcome
1. Define the basic concepts of inferential statistics, hypothesis testing, non-parametric data. (Remembering)
2. To understand the importance of inferential statistics and hypothesis testing. (Understanding)
3. To analyse the scope and uses of inferential statistics and hypothesis testing in quantitative data. (Analysing)
4. To use the measures of inferential statistics and significance level in research. (Applicability)
5. To evaluate different types of inferential statistics, non-parametric statistics and hypothesis and their appropriate applicability. (Evaluation)
6. To develop an understanding of statistical computation using inferential statistics, usages of statistical software. (Creating)

Module I: Introduction to Inferential Statistics and Hypothesis Testing about Single Means (25 hours)
a. The meaning of Statistical Inference and Hypothesis Testing; Hypothesis Testing about Single Means (z and t); Assumptions in Testing a Hypothesis about a Single Mean; The Null and the Alternative Hypotheses; Choice of HA: One-Tailed and Two-Tailed Tests; Steps for Hypothesis Testing; Hypothesis Testing about a Single Mean – Calculation; The Statistical Decision regarding Retention and Rejection of Null Hypothesis; Estimating the Standard Error of the Mean when σ is Unknown; The t Distribution; Characteristics of Student’s Distribution of t; Computing t Using Definitional Formula Only; Levels of Significance versus p-Values.
b. Interpreting the Results of Hypothesis Testing: A Statistically Significant Difference versus a Practically Important Difference; Errors in Hypothesis Testing; Power of a Test.

Module II: Hypothesis Testing About the Difference Between Two Independent Means (25 hours)
a. The Null and Alternative Hypotheses; The Random Sampling Distribution of the Difference between Two Sample Means; Properties of the Sampling Distribution of the Difference between Means; Determining a Formula for t; Testing the Hypothesis of No Difference between Two Independent Means; Use of a One-Tailed Test; Assumptions Associated with Inference about the Difference between Two Independent Means
b. Hypothesis Testing About the Difference Between Two Dependent (Correlated) Means: The Null and Alternative Hypotheses; Determining a Formula for t; Degrees of Freedom for Tests of No Difference between Dependent Means; Testing a Hypothesis about Two Dependent Means using the formula involving standard errors and correlation only; Assumptions When Testing a Hypothesis about the Difference between Two Dependent Means.

Module III: Hypothesis Testing for Differences among Three or More Groups: One-Way Analysis of Variance (ANOVA) (25 hours)
a. The Null and Alternative Hypotheses; The Basis of One-Way Analysis of Variance: Assumptions Associated with ANOVA; Variation within and between Groups; Partition of the Sums of Squares; Degrees of Freedom; Variance Estimates and the F Ratio; The ANOVA Summary Table; Raw-Score Formulas for Analysis of Variance only; Comparison of t and F.
b. Hypothesis Testing for Categorical Variables and Inference about Frequencies: The Chi-Square as a Measure of Discrepancy between Expected and Observed Frequencies; Logic of the Chi-Square Test; Assumptions of Chi-Square; Calculation of the Chi-Square Goodness-of-Fit-Test- One Way Classification; Chi Square for Two Classification Variables-Contingency Table Analysis;
Interpretation of the Outcome of a Chi-Square Test.

Module IV: Nonparametric Approaches to Data (15 hours)

a. Introduction to Distribution-free Nonparametric Tests; Comparison with Parametric Tests; Uses and Applications of
c. Introduction to SPSS: Getting Started with SPSS; Uses of SPSS in Statistics and Research.

Suggested Reading:

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PCDP0134: DEVELOPMENTAL PSYCHOLOGY (5-1-0)
(6 Credits-90 Hours)

COURSE OUTCOMES:
1. Define the concept of and process of human development across the life span. (Remembering)
2. Explain the various domains of human development (Understanding)
3. Utilize the knowledge of different theoretical perspectives, developmental tasks, adjustment process and hazards across the
   lifespan (Applying)
4. Analyse the sensitivity to socio-cultural context of human development. (Analysing)
5. Evaluate the lifespan perspective (Evaluating)
6. Adapt to the new principles of human development (Creating)

Module I: Introduction (15 hours)
Define the concept of Human Development. Theories, themes and research designs related to the study of human development

Module II: Periods of Life Span Development (25 hours)
Prenatal development, Birth and Infancy, Childhood, Adolescence, Adulthood

Module III: Domains of Human Development (25 hours)
Cognitive development: perspectives of Piaget and Vygotsky; Language development; Physical development; Emotional development;
Moral development; Personality development

Module IV: Socio-Cultural Contexts for Human Development (10 hours)
Family, Peers, Media & Schooling, Human Development in the Indian context

Suggested Readings:
   Publications.

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PCPA0135: APPLIED SOCIAL PSYCHOLOGY-THEORY (4-0-0)
4 credits (60 Hours)

Course Outcomes:
1. Define concepts in applied social psychology. (Remembering)
2. Recall theoretical background for applied approach of social psychology. (Understanding)
3. Identify diversity is population dynamics. (Analyzing)
4. Apply concepts of intervention based on case studies of social psychology (Applying)
5. Examine relevance of social psychology aspects in health and legal system. (Evaluation)
6. Determine effective intervention programme to various need based contexts. (Creating)

Module 1: Introduction (12 hours)
Nature of applied Social Psychology, Social influences on behavior, Levels of analysis, Methodological approaches – Participatory Action and Learning research techniques.

Module 2: Applying Social Psychology- I (18 hours)
Diversity: Ideological perspectives on diversity; Perspectives of Non dominant cultural groups, Reducing Prejudice.

Module 3: Applying Social Psychology- II (18 hours)
Work: Workplace behavior - motivation, job performance, and job satisfaction; Workplace stress; Balancing home and worklife; Consumer behavior.
Health: Symptom perception, compliance, health enhancing behavior, wellbeing. Legal system: Investigation interviews, events in the court room, prison setting.

Module 4: Intervention and Evaluation (12 hours)
Impact analysis; Process of intervention; need for evaluation for effective programme. Case studies in Indian context.

Suggested Readings

Mapping of COs to Syllabus

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PCEM0136: EMOTIONAL INTELLIGENCE (2-0-0)
(2 credits – 30 hours)

Course Outcomes:
1. Define the basic concepts of emotional intelligence in different contexts. (Remembering)
2. Explain different concepts of emotional intelligence. (Understanding)
3. Apply the theoretical concepts of emotional intelligence into real life settings. (Applying)
4. Analyse the managing emotions. (Analyzing)
5. Evaluate Relationships, Conflict Management, And Effective Leadership. (Evaluating)
6. Discuss applications of emotional intelligence. (Creating)

Module I: Introduction (10 hours)
Emotional Intelligence, Models of Emotional Intelligence. EQ competencies: self-awareness, self-regulation, motivation, empathy, and interpersonal skills. Importance of Emotional Intelligence
Module II: Knowing One’s and Others’ Emotions (8 hours)
Levels of emotional awareness. Recognizing emotions in oneself. The universality of emotional expression. Perceiving emotions accurately in others

Module III: Managing Emotions (6 hours)
The relationship between emotions, thought and behaviour. Techniques to manage emotions

Module IV: Applications (6 hours)

Suggested Readings:

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PCPW0137: PSYCHOLOGY AT WORK (5-1-0)
(6 Credits- 90 Hours)

Course Outcomes
1. Define and recognize the significance of values in an individual and applying them in their life and profession (Remembering)
2. Differentiating between ethical and unethical practices and working out strategy to actualize a harmonious environment wherever they work (Understanding)
3. Applying professional ethics and implementing it in professional set up (Applying)
4. Analyse and examine the development of beliefs, attitudes and habits displaying morality using simulated situations (Analysing)
5. Determine the harmonious relationships based on trust and respect for themselves, for others and for their profession (Evaluating)
6. Developing a deeper understanding of conceptual and theoretical bases of job satisfaction, motivation and employees’ work attitudes and their relationship with performance and organizational outcomes (Creating)

Module- I: Introduction to I/O Psychology (10 hours)
Definition, Brief History, Contemporary Trends and Challenges, I/O Psychology in India.

Module –II: Job Satisfaction and Work Motivation (20 hours)
Concept of Job satisfaction and work motivation, causes of Job Satisfaction, outcomes of Job Satisfaction, Theories of Work Motivation and Applications

Module -III: Communication in Organizations (20 hours)
Communication process, purpose of communication in organizations, communication networks, barriers to effective communication, managing communication

Module- IV: Leadership (25 hours)
The meaning of leadership, early approaches to leadership, contemporary approaches to Leadership- Transformational & Transactional Leadership; Leadership in a Globalized World, Indian perspective on leadership.

Suggested Readings:

788 | ADBU | Regulations and Syllabus | 2022-23

### Mapping of COs to Syllabus:

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### PCUD0138: UNDERSTANDING PSYCHOLOGICAL DISORDERS (5-1-0)
(Credits: Theory-05, Tutorial-01) Theory: 75 lectures Tutorial: 15 hours

#### Course Outcomes
1. Define mental illnesses. (Remembering)
2. Classify and categorize psychological disorders. (Understanding)
3. Apply diagnostic criteria to categorize Anxiety disorders, Conversion disorders, Dissociative disorders, Developmental disorders, Substance related disorders and eating disorders. (Applying)
4. Analyse the distinction between normality and abnormality. (Analysing)
5. Explain the causal factors of mental health and illnesses. (Evaluating)
6. Develop an understanding to distinguish clinical features of different mental illnesses. (Creating)

#### Module I – Understanding abnormality
Definition and criteria of abnormality, classification (latest edition of DSM & ICD), Clinical Assessment, Diathesis Stress Models

#### Module II- Clinical States
- a. Anxiety disorders – Phobias, Obsessive Compulsive Disorder, Generalized Anxiety Disorder (Clinical Picture and Dynamics of anxiety disorders)
- b. Conversion Disorder (Clinical Picture and Dynamics)
- c. Dissociative Identity Disorder (Clinical Picture and Dynamics)

#### Module III: Developmental Disorders (Clinical Picture and Dynamics)
Mental Retardation, Autism, ADHD, and Learning Disabilities

#### Module IV: Substance related disorders and eating disorders
- a. Substance-Related Disorder: Alcohol abuse and Drug abuse (clinical picture and causes)
- b. Eating disorder: Anorexia Nervosa and Bulimia Nervosa

### Suggested Readings:

### Mapping of COs to Syllabus

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### PCOB0139: Organizational Behaviour (4-0-0)
(Credits: Theory-04) Theory: 60 lectures

#### COURSE OUTCOMES
1. Define the key concepts of Organisational Behavior. (Remembering)
2. Explain various organizational contexts in the globalised world. (Understanding)
3. Apply knowledge of psychological constructs in modifying the organisational environment. (Applying)
4. List current areas in need of upgrading in the Indian context. (Analyzing)
5. Examine modern day challenges to success in organization. (Evaluating)
6. Plan novel strategies for organizational change. (Creating)

Module I: Introduction (10 hours)
Historical antecedents of Organizational Behaviour, Contemporary Trends and Challenges, Organizational Behavior: Challenges in the Indian Setting

Module II: Individual level processes (20 hours)
Employee attitudes: Job satisfaction, Organizational Commitment, Organizational Citizenship Behaviour Work Motivation: Early theories- Maslow, McClelland, Two factor; Contemporary theories- Goal setting, Equity, Expectancy ; Applications: Job Characteristics Model, Job redesign

Module III: Dynamics of Organizational Behavior (16 hours)
Organizational Culture, Power and Politics: sexual harassment, organizational politics; Positive Organizational Behavior

Module IV: Leadership (14 hours)
Basic approaches: Trait theories, Behavioral theories, Contingency theories; Contemporary Issues: Approaches to leadership, Contemporary leadership roles, Challenges to the leadership construct; Creating Effective Leaders.

Suggested Readings

PCPP0140: Positive Psychology (4-0-0) 
(Credits: Theory-04) Theory: 60 lectures

Course Outcomes
1. Define Positive Psychology (Remembering)
2. Examine emotional states and processes. (Analyzing)
3. Illustrate on the nature of Happiness and well being. (Understanding)
4. Explain the concept of self-efficacy, optimism and hope. (Evaluating)
5. Apply any one method in Positive Psychology (Applying)
6. Create an idea about the importance of Positive Psychology into practice. (Creating)

Module I (10 hours)

Module II (15 hours)
Positive Emotional States and Processes: Happiness and Wellbeing, Positive Affect and Positive Emotions, Emotional Intelligence, Resilience

Module III (10 hours)

Module-IV (10 hours)
Applications: Work, education, ageing, health
Practicum: Any one practicum can be designed from the syllabus so as to enhance the understanding of the concepts and applications of positive psychology.

Suggested Readings:

790|ABDU| Regulations and Syllabus|2022-23

Course Outcome

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PCHR0141: HEALTH PSYCHOLOGY (4-0-0)
(Credits: Theory-04) Theory: 60 lectures

COURSE /LEARNING OUTCOMES
1. Define the basic terms related to the field of health psychology (Remembering)
2. Learn the need to study health psychology and the approaches to change in health behavior (Understanding)
3. To understand the relationship between psychological factors and physical health and learn how to enhance well-being (Applying)
4. Examine the stressors and its impact on the etiology and course of many health related problems (Analyzing)
5. Devise policies of health care delivery system beneficial to the public (Creating)
6. Estimate the management of various health related disorders (Evaluating)

Module I: Introduction: Introduction to Health Psychology; components of health: social, emotional, cognitive and physical aspects; mind-body relationship; goals of health psychology, Bio-psychosocial model of health. (20 hours)

Module II: Behavior and health: Characteristics of health behaviour; Barriers to health behaviour; Theories of health behaviour and their implications. (10 hours)

Module III: Stress: Nature, Sources, Effects of stress on physical and mental health; Coping and stress management. (10 hours)

Module IV: Health Management: Health-enhancing behaviors: Exercise, Nutrition, safety, managing and controlling pain. Health Protective behaviours, Illness Management. (20 hours)

Suggested Readings:

Mapping of COs to Syllabus

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PCHR0142: HUMAN RESOURCE MANAGEMENT (4-0-0)
(Credits: Theory-04) Theory: 60 lectures

Course Outcomes:
1. To understand human resource management as a profession, its concepts and meaning (Remembering)
2. Understand the role of human resource management, various practices and evaluation process (Understanding)
3. Equip learners with knowledge, skills, attitude, professional competencies and social sensitivities essential for a successful career in Human resource management (Applying)
4. Analyse skills learned and modifications of failures during training or practical applications (Analysing)
5. Integrate the knowledge obtained from theory with the practice (Evaluating)
6. Plan new and innovative strategies for organizational development (Creating)

Module I: Introduction to Human Resource Management (HRM) (10 hours)
Personnel management, HRM and HRD, Context and issues in HRM

Module II: Human Resource Practices (10 hours)
Job analysis; Recruitment and selection; Training; Performance evaluation

Module III: International human resource management (IHRM) (13 hours)
The context of Globalization, Dimensions of Cultural difference (Hofstede), Policies and practices in the multinational enterprise, Selection of international assignees; Expatriate failure, Cross-cultural training.

Module IV: Organizational change and development (12 hours)
Organizational change: concepts, models (one model), techniques (one for individual and one for group), organizational development: concepts, models (one model), techniques (one for individual and one for group).

Suggested Readings:

Mapping of COs to Syllabus

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PCPP6108: Positive Psychology – Practicum (0-0-2)
(Credits: Practicum-02, 60 lectures)

Course Outcomes
1. Define Positive Psychology (Remembering)
2. Examine emotional states and processes. (Analyzing)
3. Illustrate on the nature of Happiness and well-being (Understanding)
4. Explain the concept of Happiness and well-being (Evaluating)
5. Apply any one method in Positive Psychology (Applying)
6. Create an idea about the importance of Positive Psychology into practice

Module I Introduction to Happiness (10 hours)
Introduction to Happiness, basic concepts, theoretical foundations

Module II Administration (15 hours)
Introduction to Happiness, Basic concepts, mock conduction, interpretation of results and discussions.

Module III Introduction to Well-being (10 hours)
Introduction to well being, basic concepts, theoretical foundations

Module IV Administration (10 hours)
Basic concepts, Mock conduction, scoring, interpretation of results and discussion.
Practicum: Any one practicum can be designed from the syllabus so as to enhance the understanding of the concepts and applications of positive psychology.

Suggested Readings

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PCHP6109: HEALTH PSYCHOLOGY PRACTICUM (0-0-2)
(Credits: Practicum-02, 60 lectures)

Course Outcomes
1. Discuss the basic terms related to health psychology, the need of the study of health psychology (Remembering)
2. Classify the various types of psychological tests on the basis of their use (Understanding)
3. Make interpretations and draw conclusions based on the norms given in the manual (Applying)
4. Examine the detail of the test, the aim, applications, procedure of administration and results (Analysing)
5. Estimate the purpose and importance of the tests (Evaluating)
6. Test the administrator’s decision-making process to select a particular test for assessment of a given psychological condition (Creating)

Module I (10 hours):
Introduction to the different tests that looks for health and quality of life: 15- Dimensional Health-Related Quality of Life, WHO Quality of Life- BREF, Perceived stress scale, Psychological wellbeing scale, understanding the need for assessing physical and mental health status.

Module II (15 hours):
History, Definition, Purpose, Relevance of the tests.

Module III (15 hours):
Administration: Basic concepts; conduction, scoring, interpretation of results and discussion.

Module IV (20 hours):
Conduction of any one of the test: 15-Dimensional Health-Related Quality of Life, WHO Quality of Life-BREF, Perceived stress scale, Psychological wellbeing scale.

Suggested Readings:
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PCHR6110: HUMAN RESOURCE MANAGEMENT- PRACTICUM (0-0-2)
(Credits: Practicum-02, 60 lectures)

Course Outcomes:
At the end of this practical students will be able to:
1. Define the key concepts related to Human Resource Management (Remembering)
2. Recall theoretical perspectives, diversities, adversities and techniques of human resource management (Understanding)
3. Applying the theoretical perspectives in practical setting (Applying)
4. Listing out areas of management, failures and up-gradation of people in organizations (Analysing)
5. Assess human resource practices and their outcome in organizational performance and employee wellbeing (Evaluating)
6. Plan strategies for organizational change ensuring effective implementation (Creating)

Module I: Introduction (30 hours)
Concept and definition of human resource management, nature, objectives, scope, role, importance, function, role of human resource manager and challenges of human resource management in Indian Economy

Module II: Application (30 hours)
Practicum: Students would be required to complete 1 practicum from any of the topics discussed in DSE-PSY-02.

Suggested Readings:

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PCOB6111: Organization Behaviours-Practicum (0-0-2)
(Credits: Practicum-02, 60 lectures)

Course Outcomes
1. To define & assessing emotional intelligence, motivation and aptitude in the discipline OB (Remembering)
2. To understand the conceptual framework of Emotional Intelligence, motivation aptitude in connection of the discipline and its practical applications in the organizational set up (Understanding).
3. To apply, accept and embrace EI, Motivation and necessity of aptitude in working with different cultural and diverse background in the workplace (Applying)
4. Analyse various theories and models of EI, Intrinsic and extrinsic motivation and its aptitude in the field of Organization behaviour (Analysing)
5. To critically evaluate and contributes in the overall understanding of the discipline related Emotional intelligence, aptitude and motivation (Evaluating)
6. To develop creative and innovative ideas that could positively shape the organizations. (Creating)

Module I Emotional Intelligence:

Module II Intrinsic Extrinsic Motivation:
Define Intrinsic and Extrinsic Motivation, self-determination theory, Self-Report Measures of Intrinsic Motivation, Intrinsic Motivation Inventory (IMI) by Ryan, et all (Online available).

Module III Aptitude Test
Define, an aptitude test & what are the different types of aptitude test? Sales Aptitude Test (Duncan’s Sales Aptitude Test, DSAT) by Sanjay Vohra

Suggested Readings:

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PCPD0143: UNDERSTANDING AND DEALING WITH PSYCHOLOGICAL DISORDERS (5-1-0)
(Credits: Theory-05, Tutorial-01) Theory: 75 lectures Tutorial: 15 hours

Course outcomes
1. Define mental health and illnesses and categories of mental illness as specified in DSM-V and ICD-10 (Remembering)
2. Classify and categorise Schizophrenia, mood disorders, personality and Paraphilia and related disorders, (Understanding)
3. Apply diagnostic criteria of Schizophrenia, mood disorders, personality disorders and paraphilia and its different types to diagnose and select the appropriate psychological intervention for different adult mental health related issues (Apply)
4. Analyse the distinction between normality and abnormality. Distinguish clinical features of different mental illnesses various types. (Analysing)
5. Evaluate Bio Psycho Social modes and other modes of treatments for Psychological Disorders. (Evaluate)
6. Create a management plan and strategies for patients on the basis of clinical pictures, diagnosis criteria for subtypes, causal factors, available treatment modes and their competence. (Creating)

Module I:
Schizophrenia: Clinical Picture, Subtypes and causal factors

Module II:
Mood Disorders: Clinical Picture, subtypes, causal factors and suicide

Module III:
a) Personality Disorders (Clinical Picture and Dynamics): Antisocial Personality Disorder and Borderline Personality Disorder
b) Sexual Disorders (Clinical Picture): Gender Identity Disorder, Paraphilia - Paedophilia, Voyeurism, Exhibitionism, Sexual Masochism, Sexual Sadism

Module IV: Treatment of disorders:
a) Biological treatment: Pharmacotherapy and Electroconvulsive therapy
b) Psychological treatment: Psychoanalytic therapy, Behaviour therapy and Cognitive & Behaviour therapy
Suggested Readings:

Mapping of COs to Syllabus

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PCCP0144: COUNSELING PSYCHOLOGY (4-0-0)
(Credits: Theory-04) Theory: 60 lectures

COURSE OUTCOMES
1. Define counselling and state the goals of counselling. (Remembering)
2. Explain the process of establishing client-counselor relationship. (Understanding)
3. Identify counselling techniques as per the current trends (Applying)
4. Analyse the basic principles and techniques of counseling approaches. (Analysis)
5. Evaluate effectiveness of different theoretical approaches in dealing with mental health issues of diverse populations. (Evaluation)
6. Design counselling sessions setting the goals and determining the techniques to be used in each stage depending on the psychological concerns of the client. (Creating)

Module I: Introduction (12 hours)
Definition and goals of Counselling, Counselling as a profession: training, skills and ethics, The effective counsellor: personality and background of the counselor, Counselling relationship

Module II: Techniques of Counselling (20 hours)
Psychoanalytic approach, Humanistic approaches, Behavioral approach, Cognitive approach

Module III: Counselling Applications (20 hours)
Child Counselling, Family Counselling, Career Counselling, Crisis intervention: suicide and grief

Module IV: Contemporary Trends (8 hours)
Indian approaches: yoga and meditation, Counselling and technology, Expressive techniques: art, music, dance.

Suggested Readings:

Mapping of COs to Syllabus

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**Course Outcomes**

1. Identify defining features of a community and types of communities. (Remembering)
2. Associate community models in the current context of public health and community development programmes. (Understanding)
3. Examine the effectiveness of current community interventions. (Applying)
4. Map diversity in community psychology intervention in the present scenario. (Analysing)
5. Reflect on barriers to community development. (Evaluating)
6. Develop suggestions to health promotion strategies. (Creating)

**Module I: Introduction (10)**

Definition of community psychology; types of communities; models.

**Module II: Core values (20 hours)**

Individual and family wellness; sense of community; respect for human diversity; social justice; empowerment and citizen participation; collaboration and community strengths.

**Module III: Health promotion (20 hours)**

Process of community organization for health promotion, importance. Community program for: child and maternal health, physical challenged and old age in the Indian context.

**Module IV: Interventions (10 hours)**

Community development and empowerment; case studies in Indian context.

**Suggested Readings:**


**Mapping of Cos to syllabus**

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Module I: Cultural Processes (10 hours)
Cultures; Psychic Unity and Cultural Relativity; Beyond Descriptions of Cultural Differences, methods of studying cultural psychology.

Module II: Culture, Self and Others (20 hours)
Who am I and Who are They? Culture and architecture; Representation: Person, Other People, Self and of Groups, The Making and Remaking of Cultures: A Developmental Perspective: Family and children, models of the family, self-construal and developmental pathways.

Module III: Intercultural Contacts (16 hours)
Nature, psychological benefits and costs of cultural competence; Migration, globalization and cultural diversity; Management of multicultural identities.

Module IV: Indigenous Psychology (14 hours)
Indian Psychology – Implications and applications; Indian perspective on emotions; self and identity; indigenization of psychology in India.

Suggested Readings:

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PCCY6113: COMMUNITY PSYCHOLOGY- PRACTICUM
(Credits: Practicum-02, 60 lectures)

COURSE OUTCOMES
1. Identify defining features of the community of interest. (Remembering)
2. Associate community models in the current context of public health promotion. (Understanding)
3. Examine the gaps in existing community interventions. (Applying)
4. Map resources in the community of interest for intervention. (Analysing)
5. Reflect on intervention used for community development. (Evaluating)
6. Develop suggestions for future health promotion strategies. (Creating)

Module I: Introduction (5 hours)
Community Organisation and Community Building

Module II: Framing an Operational Model for health promotion (3 hours)
Identifying an issue, formulating a hypothetical work-plan based on a theoretical model, identifying community resources or required tools and apparatus, group formation.

Module III: Health promotion (52 hours)
Community Mobilisation, Creating Awareness and Conducting Assessment if necessary, Preparation of Project Report.

Suggested Readings:

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**PCIP6114: Cultural and Indigenous Psychology-Practicum (0-0-2)**
(Credits: Practicum-02, 60 lectures)

**Course Outcomes**

1. To define the basic concepts of Cultural Processes/Culture, Self & Others/Intercultural Contacts/Indigenous Psychology. (Remembering)
2. To understand the use of measurement tools to assess dimensions related to cultural processes/culture, self and others/intercultural contacts/indigenous psychology. (Understanding)
3. Application of measurement tools to assess dimensions related to cultural processes/culture, self and others/intercultural contacts/indigenous psychology. (Applying)
4. Analyse the effectiveness of various tools used to assess the various dimensions of cultural and indigenous psychology. (Analysing)
5. To evaluate the advantages and disadvantages of the different types of tools and techniques used for cultural psychology research. (Evaluating)
6. Construct conclusions from the results of assessment conducted. (Creating)

Students to do any 1 practicum based on the concepts discussed in PCIP0146 (Cultural Processes/Culture, Self & Others/Intercultural Contacts/Indigenous Psychology)

**Module I: Introduction (20 hours)**
Theoretical Foundation, History, Objective; Technique, Administration, Scoring and Interpretation of Results.

**Module II: Administration (40 hours)**
Mock conduction: scoring, interpretation of results and discussion; Final Conduction: scoring, interpretation of results and discussion.

**Suggested Readings:**


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PCCP6115: COUNSELLING PSYCHOLOGY-PRACTICUM (0-0-2)
(Credits: Practicum-02, 60 lectures)

COURSE OUTCOMES
At the end of this course students will be able to:
1. Define the concepts of Case History, Mental Status Examination and Depression. (Remembering)
2. Interpret the significance of individual processes in individual wellbeing. (Understanding)
3. Apply the understanding of psychological constructs to the behavior of individuals in specific contexts. (Applying)
4. Examine psychometric properties of a test and its significance. (Analysing)
5. Determine scoring of the tests and interpretation of test scores. (Evaluating)
6. Construct conclusions from the results of assessment conducted. (Creating)

Module I: Introduction to Counselling Skills (10 hrs)
Introduction to Case History taking and Mental Status Examination

Module II: Administration (20 hrs)
Documentation of case history and mental status examination of clinical cases (case example or observed)

Module III: Introduction to Depression (10 hrs)
Introduction to Depression; Selected test: Theoretical Foundation, History, Objective; Psychometric Properties, Administration, Scoring and Results.

Module IV: Administration (20 hrs)
Basic Concepts; Mock: conduction, scoring, interpretation of results and discussion; Final: Conduction, scoring, interpretation of results and discussion.

Suggested Readings:

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PCIP6104 INTRODUCTION TO PSYCHOLOGY – PRACTICUM (0-0-2)

PCIP6105: PSYCHOLOGY OF INDIVIDUAL DIFFERENCES- PRACTICUM (0-0-2)
(Credits: Practicum-02) Practicum: 60 lectures

Course Outcomes
1. Define the basic concepts of personality and intelligence. (Remembering)
2. Recall theoretical and psychometric categories of personality and intelligence. (Remembering)
3. Interpret application of individual difference principles to personality and intelligence. (Understanding)
4. Apply concepts of intelligence and personality in social interactions. (Applying)
5. Examine psychometric properties of a test and its significance. (Analysing)
6. Determine scoring of the tests. (Evaluating)
7. Interpret results in consideration to group differences and social-environmental factors. (Evaluating)
8. Create an imitation of a testing environment for proper conduction of psychological tests. (Creating)
Module I: Introduction to Personality Test (10 hours)
General Introduction to personality tests; Selected test: Theoretical Foundation, History, Objective; Psychometric Properties, Administration, Scoring and Results.

Module II: Administration (20 hours)
Basic Concepts; Mock: conduction, scoring, interpretation of results and discussion; Final: Conduction, scoring, interpretation of results and discussion.

Module III: Introduction to Intelligence Test (10 hours)
General Introduction to personality tests; Selected test: Theoretical Foundation, History, Objective; Psychometric Properties, Administration, Scoring and Results.

Module IV: Administration (20 hours)
Basic Concepts; Mock: conduction, scoring, interpretation of results and discussion; Final: Conduction, scoring, interpretation of results and discussion.

Suggested Readings
4. MatthijsCornelissen, GirishwarMisra and SuneetVarma , Foundations of Indian Psychology (Vol. 1), Theories and concepts

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PCPR6106 PSYCHOLOGICAL RESEARCH - PRACTICUM (0-0-2)
(2 credits – 60 hours)

Course/Learning Outcomes
1. Define the basic concepts of psychological research. (Remembering)
2. Understand the various techniques used in psychological research. (Understanding)
3. Application of different techniques and tools in psychological research. (Applying)
4. Analyse the effectiveness of various tools used in different types of research designs in psychological research. (Analysing)
5. Evaluate the significance of research in psychology and the advantages and disadvantages of the different orientations and research traditions. (Evaluating)
6. Build the ability to obtain and analyse data. (Creating)

Module I: Experiment / Psychological testing (40 hours)
One experiment based on group data analysis/One psychological test based on group data analysis

Module II: Qualitative Research Methods (20 hours)
Interview/Observation/Projective / Semi Projective Tests/Case Study

Suggested Readings:
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PCAP6107 APPLIED SOCIAL PSYCHOLOGY – PRACTICUM (0-0-2)
(2 Credits– 60 hours)

Course Outcomes:
1. Define the basic concepts of interpersonal relationships and occupational stress. (Remembering)
2. Recall theoretical and psychometric categories of social relationship dynamics and work environment and positive psychology. (Remembering)
3. Interpret application of organizational psychology principles to social relationships at work. (Understanding)
4. Apply concepts of sociometry in social interactions. (Applying)
5. Examine psychometric properties of a test and its significance. (Analysing)
6. Determine scoring of the tests and interpretation of test scores. (Evaluating)

Module I: Introduction to Sociometry (10 hrs)
Introduction to Sociometry; Theoretical Foundation, History, Objective; Technique, Administration, Scoring and Interpretation of Results.

Module II: Administration (20 hrs)
Basic Concepts; Mock: conduction, scoring, interpretation of results and discussion; Final: Conduction, scoring, interpretation of results and discussion.

Module III: Introduction to Occupational Stress (10 hrs)
General Introduction to Occupational Stress; Selected test: Theoretical Foundation, History, Objective; Psychometric Properties, Administration, Scoring and Results.

Module IV: Administration (20 hrs)
Basic Concepts; Mock: conduction, scoring, interpretation of results and discussion; Final: Conduction, scoring, interpretation of results and discussion.

Suggested readings:
2. Monir Rostampoor-Vajari, What is sociometry and how can we apply it in our life?, 2012, AASS, Vol. 2, No. 4, pp. 570-573.
3. Occupational and Environmental Health, Chapter: Occupational Stress, Publisher: Oxford University Press, Landsbergis et al. (2017), Editors: Barry S. Levy

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MSc PSYCHOLOGY –DETAILED SYLLABUS

PCSP0006: INTRODUCTION TO SOCIAL PSYCHOLOGY
(3 Credits – 45 hours)
Course Outcomes
1. Define the basic concepts of social psychology in different contexts. (Remembering)
2. Explain different concepts of social processes, social influence, group dynamics and group influence. (Understanding)
3. Apply the theoretical concepts of social psychology into real life settings. (Applying)
4. Analyze the difference between social perception and social cognition as well as prejudice, stereotype, discrimination. (Analyzing)
5. Compare different types of groups and their functional systems. (Evaluating)
6. Discuss various social problems in light of the theoretical concepts of social psychology. (Creating)

Module I: Introduction (8 hours)

Module II: Social Processes (12 hours)
Social perception or cognition, interpersonal attraction, social motives, social learning, socialisation and social roles, pro-social behaviour, aggression and violence.

Module III: Social Influences (12 hours)
Persuasion, attitude, prejudice, discrimination and stereotypes - nature and differences among them. Factors in the formation of attitudes, measuring attitudes, factors in attitude change.

Module IV: Group Dynamics and Group Influence (13 hours)
Formation of groups, structure and functions, types, group communication, group norms, conformity behaviour, co-operation and competition, social facilitation, leadership, group effectiveness, decision making, problem solving, group conflict and resolution.

Suggested Readings
10. Linda steig, Abraham p. Buunk, applied social psychology: Understanding and managing social problems

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PCEC0013: EASTERN APPROACHES TO PSYCHOLOGY AND COUNSELLING
(3 Credits - 45 Hours)

Course Outcomes
1. Define the basic terms related to the different eastern approaches of psychology. (Remembering)
2. Classify among Indian/Chinese/Japanese approaches to psychology. (Understanding)
3. Make use of the appropriate Indian/Chinese/Japanese approaches to psychology in applied settings. (Applying)
4. Examine ancient and contemporary eastern approaches of psychology. (Analysing)
5. Recommend the suitable approach in applied settings. (Evaluating)
6. Develop a clear understanding of eastern and western approaches to Psychology. (Creating)

Module I: Introduction (7 hours)
Definitions, nature, differentiation of concepts-eastern, indigenous and Indian psychology; relationship between culture and psychology, emergence of non-western and indigenous perspectives to psychology.

Module II: Major Schools of Indian and Eastern Psychology (20 hours)
Indian approaches to Psychology-Upanishads, Sankhya, Dvaitha and Advaitha schools; current areas of research in Indian psychology. Chinese approaches to psychology - Taoism and Confucianism, Japanese approaches to Psychology - Morita and Naikan therapies.
Module III: Self and Consciousness (10 hours)
Viewpoints of Upanishads, Bhagavadgita, Buddhism and Jainism and other Eastern schools of thought.

Module IV: Indian and other Eastern Approaches to Health and Wellbeing (8 hours)
Yoga, Ayurveda, goals of life-concept of purusharthas, personality development-concept of Ashramas

Suggested Readings

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PCTP0020 THEORIES OF PERSONALITY
(4 Credits- 60 hours)

COURSE/LEARNING OUTCOMES
At the end of this course students will be able to:
1. Define personality. (Remembering)
2. Explain the rationale behind the theories of personality. (Understanding)
3. Identify the impact of environment and genetics in development of personality. (Applying)
4. Analyse modifications of self in perceiving environment. (Analysing)
5. Assess the relation between cultural and personality. (Evaluating)
6. Compare and contrast various perspectives of personality. (Creating)

Module I: Introduction to Personality (10 hours)
Definition and Nature of personality; Trait and Type Theories of Personality; Determinants of personality: Biological and socio-cultural- Hans Eysenck, Gray and Cloninger.

Module II: Classical approaches to Personality Development (20 hours)
Pre- Freudian (Structuralism- any two theorists; Functionalism- any two); Psychoanalytic; Post Freudian (Erikson; Eric Fromm);Neo-Freudian (Adler; Horney; Jung); Ego Psychology (Anna Freud; Hartmann; Rapaport)

Module III: Learning, Cognitive and Humanistic-Existential Approaches (20 hours)
Learning Approaches: Bandura
Cognitive Approaches: Rotter, Mischel
Humanistic–Existential Approaches: Frankl, Rollo May, Maslow, Rogers.

Module IV: Assessment of Personality (10 hrs)
Projective Tests- Ink blot test, Thematic Apperception Test, Sentence Completion TestObjective Tests; MMPI-II, 16PF, EPQ

Suggested Readings

Mapping of COs to Syllabus

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**PCMH0021 CONCEPTS OF MENTAL HEALTH AND ILLNESS-I**
(4 Credits - 60 hours)

**COURSE OUTCOMES**
1. Define mental health and illnesses and list categories of mental illness as specified in DSM and ICD (Remembering)
2. Classify and categorise mood disorders, obsessive compulsive and related disorders, anxiety disorders (Understanding)
3. Apply diagnostic criteria of mood disorders, obsessive compulsive and related disorders, anxiety disorders to diagnose individuals with mental illnesses and select the appropriate psychological intervention for different childhood, adolescent and adult mental health related issues (Apply)
4. Analyse the distinction between normality and abnormality. Distinguish clinical features of different mental illnesses (Analysing)
5. Evaluate Bio Psycho Social models and other models of mental health and illness. (Evaluate)
6. Create a management plan for patients on the basis of clinical features, diagnosis criteria and therapist competence (Creating)

**Module I: Introduction (10 hours)**
Definition of mental illness and mental health. Historical review and changes in the concept of mental illness and mental health. Introduction to classification systems (DSM and ICD)

**Module II: Models of Psychopathology (15 hours)**
Biopsychosocial, Psychoanalytic, Behavioralistic, Cognitive- Behavioral, Humanistic, Diathesis-Stress Model

**Module III: Mood Disorders (Symptoms, Etiology and Treatment (15 hours)**
Unipolar Depressive Disorders in different population. Bipolar and Related Disorders in different population.

**Module IV: Anxiety and Related Disorders (Symptoms, Etiology and Treatment) (10 hours)**
Phobias in different population: specific phobia and social phobia. Generalised Anxiety Disorders in different population. Obsessive Compulsive and Related Disorders in different population: Obsessive Compulsive Disorder, Body Dysmorphic Disorder, Hoarding Disorder, Trichotillomania

**Module V: Somatic Symptoms and Dissociative Disorders (Symptoms, Etiology and Treatment) (10 hours)**
Somatic Symptom Disorder, Functional Neurological Disorder, Factitious Disorder, Dissociative Identity Disorder, Depersonalisation Disorder, Derealisation Disorder

**Suggested Readings**
PCRM0022: RESEARCH METHODOLOGY AND STATISTICS IN SOCIAL SCIENCE
(4 Credits- 60 hours)

COURSE/LEARNING OUTCOMES
1. Define the basic concepts of research and recognize the philosophical foundations of research. (Remembering)
2. Understand the steps in conducting research and the major research designs. (Understanding)
3. Analyse the collected data in research using different statistical measures. (Analysing)
4. Apply research design, tools and statistical measures to carry out research in social sciences. (Applying)
5. Compare natural and social sciences as well as the different approaches and research designs most commonly used in social sciences research. (Evaluating)
6. To create a research proposal using indicating appropriate research design method of data collection and statistical computation. (Creating)

Module I: Introduction to Research (10 hours)
Philosophical Foundations of Research. Natural and social science research-characteristics and scientific attitude. Scope of social science research-basic and applied research; Ethical concerns in Counselling research.

Module II: Research designs, approaches and types (12 hours)
Research designs: Descriptive, Exploratory, and Experimental: meaning, scope, characteristics, application in social work setting. Research Approaches: Qualitative and Quantitative Research: meanings, scope, methods, steps, sampling, data collection, analysis, interpretation and reporting. Strengths and weaknesses. Evaluative research: Programme and projects evaluation: concept, types, steps, reports. Participatory research and action research: concepts, scope, application and steps.

Module III: Steps in Research Process (20 hours)
Problem Formulation: Identifying research issue, formulating research topic and problem, review of literature (library work), theoretical framework, formulating objectives, clarifying concepts, variables- conceptual and operational, formulating hypothesis. Population and Sampling: Inclusion and exclusion criteria of population, the logic of sampling size and techniques: probability and non-probability sampling. Tools for data collection: Levels, types of measurements, reliability, and validity of tools. Constructing tools for data collection: questionnaire, interview schedule, scales. Quantification of qualitative data. Sources, collection, and analysis of data: Secondary and primary sources. Data collection, data editing, coding, mastersheet, analysis, report writing, using computer for data analysis: coding, analysis- graphs and results. Professional report writing

Module IV: Introduction to Statistics (18 hours)

Suggested Readings
7. Jacob, K.K., Methods and Fields of Social Work in India, Asia Publishing, Bombay, 1996

### Mapping of COs to Syllabus

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### PCCP0023 COGNITIVE PSYCHOLOGY

(4 Credits-60 Hours)

**Course Outcomes**
1. Define the basic concepts of cognitive psychology, identify major theoretical foundations and recognize the historical background of cognitive psychology. (Remembering)
2. To understand the relationship between mind, brain and behaviour. (Understanding)
3. To analyse the scope and application of cognitive psychology. (Analysing)
4. To use measures of cognitive psychology in research and practice. (Applying)
5. To evaluate different cognitive methods, tools and their appropriate applicability. (Evaluation)

**Module I: Introduction to Cognitive Psychology (10 Hours)**

Definition, history of cognitive psychology and emergence of cognitive science, current trends. The brain and cognition: Basic neuroanatomical principles, modern techniques for exploring cognition (EEG, fMRI, PET), cognitive experiments, Emotional Intelligence, Artificial Intelligence.

**Module II: Memory Processes (15 Hours)**

Sensory Memory, Short Term and Long-Term Memory- types, coding and retrieval; Working Memory: Nature, Theories, Educational Applications.

Semantic and Episodic Memory: Semantic vs Episodic Memory; Level of Processing and Hierarchical Network model. Prospective Memory: Types and Common Failures of Prospective Memory in Everyday life. Forgetting: Incidental and Motivated Forgetting.

**Module III: Attention & Perception (20 Hours)**


**Module IV: Thinking, Problem Solving and Decision Making (15 Hours)**


### Suggested Readings


### Mapping of COs to Syllabus

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PCGP0024: GENERAL PSYCHOLOGY
(3 credits – 45 hours)

Course/Learning Outcomes
1. Define psychology, name the different fields of psychology, list the different areas in which psychology is applicable. (Remembering)
2. Understand how the visual and auditory systems work. (Understanding)
3. Apply the theories of learning to modify behavior and application of different strategies for memory improvement. (Applying)
4. Analyse the strengths and weaknesses of the important theories of psychology. (Analysing)
5. Evaluate the contribution of psychology in different fields. (Evaluating)
6. Create a basic idea of personality and the important theories of personality. (Creating)

Module I: Introduction to Psychology (6 hours)
Introduction - Definition, nature, history, scope, purpose, and sub-fields of psychology. Applications of psychology - stress and stress management, coping, well-being, resilience

Module II: Biological Basis of Behavior (10 hours)

Module III: Cognitive Processes (11 hours)
Memory: Models of memory - Atkinson & Shiffrin, and Craik and Lockhart, Mnemonics, Forgetting - decay and interference
Intelligence: Spearman’s, Sternberg’s, and Gardner’s theories of intelligence

Module IV: Conative and Affective Processes (10 hours)
Emotion: Definition and theories of emotions (James-Lange, Cannon-Bard and Schachter-Singer).
Motivation: Motivational Cycle, types of motives (sociogenic and psychogenic), theories of motivation (Content theories: Maslow, and Herzberg’s 2 factor theory, Process theories: Bandura’s self-efficacy theory, and Vroom’s expectancy theory).

Module V: Theories of Personality (8 hours)
Trait & Type approaches, Psychoanalytic, Neo-Freudian (Jung, Adler), Existential (Frankl), and Humanistic theories (Rogers).

Suggested Readings:

Mapping of COs to Syllabus

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PCCM0025: CONCEPTS OF MENTAL HEALTH AND ILLNESS-II
(4 Credits – 60 Hours)

Course Outcomes
1. Define mental illnesses. (Remembering)
2. Classify and categorise developmental disorders, schizophrenia, personality disorders, substance related disorders, eating disorders and neurocognitive disorders. (Understanding)
3. Apply diagnostic criteria categorise developmental disorders, schizophrenia, personality disorders, substance related disorders, eating disorders and neurocognitive disorders to diagnose individuals with mental illnesses. (Applying)
4. Analyse the distinction between normality and abnormality. Distinguish clinical features of different mental illnesses. (Analysing)
5. Explain the causal factors of mental health and illnesses. (Evaluating)
6. Create a management plan for patients on the basis of clinical features, diagnosis criteria and therapist competence.

**Module I: Introduction (10 hours)**
Causal Factors of abnormal behavior: Causes and Risk Factors for Abnormal Behavior
Clinical Assessments and diagnosis and treatment

**Module II: Developmental Disorders (Symptoms, etiology and treatment) (15 hours)**
Intellectual Disability
Autism Spectrum Disorders
ADHD
Learning Disabilities

**Module III: Major Psychological Disorders (Symptoms, etiology and treatment) (15 hours)**
Schizophrenia Spectrum Disorders
Personality Disorders

**Module IV: Substance related and eating disorders (Symptoms, etiology and treatment) (10 hours)**
Substance Related Disorders
Eating Disorders

**Module V: Neurocognitive and Sexual Disorders (Symptoms, etiology and treatment) (10 hours)**
Delirium
Dementia
Sexual dysfunctions

**Suggested Readings:**

**Mapping of COs to Syllabus**

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**PCBP0026: BIO-PSYCHOLOGY**
(3 Credits- 45 hours)

**COURSE OUTCOMES**
At the end of this course students will be able to:
1. Identifying biological bases of behavior. (Remembering)
2. Associating the role of the nervous system with behavior and emotions. (Understanding)
3. Examining the impact of bio chemicals in behavior and mental health at a conceptual level. (Applying)
4. Mapping the biological markers of individual difference. (Analyzing)
5. Reflecting on genetic and chromosomal bases of psychopathology. (Evaluating)
6. Develop conclusions on biological assessment of behavior. (Creating)

**Module I: Introduction to Bio-psychology (7 hours)**
History and scope; Major theoretical perspectives: Rene Descarte, Phinaes Gage, Charles Darwin. Nature versus Nurture controversy; Sub disciplines and allied fields; Methods in Bio Psychology.

**Module II: Neurons and Genetic bases of behavior (10 hours)**
Structure of neuron; Nerve impulse and Synaptic transmission; Neurotransmitters; Types of neuron. Genetic bases of behavior: Structure of a gene, DNA and Chromosomes, Types and Functions of Genes, Genotype and Phenotype.

**Module III: Nervous System (10 hours)**
Central Nervous System: Brain and Spinal Cord. Peripheral Nervous system: Division; Role of nervous system in controlling behavior.

**Module IV: The Endocrine System and behavior (10 hours)**
Endocrine glands; Hormones; Role of endocrine system on emotions and behavior.

**Module V: Neuropsychological diseases (8 hrs)**

**Suggested Readings:**

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**PCPT0027: PSYCHOLOGICAL TESTING**
(4 Credits - 60 hours)

**Course Outcomes**
1. Define the basic concepts of psychological testing. (Remembering)
2. Classify the group and individual techniques of psychological testing. (Understanding)
3. Make use of different statistical concepts in data analysis. (Applying)
4. Examine the results of the statistical data analysis. (Analysing)
5. Recommend the suitable tool for data collection/interview in applied settings. (Evaluating)
6. Test the psychometric properties of a tool and develop a psychological tool using appropriate norms of tool construction. (Creating)

**Module I: Introduction to Psychological Testing (9 hours)**
History of Psychological Testing; Definition and Purpose and relevance of Psychological testing, Types of tests, Principles, Applications and Issues, Ethical and Social Considerations in Testing

**Module II: Test Construction (15 hours)**

**Module III: Assessment of Cognitive Abilities (13 hours)**
Measurement of Intelligence: Types of intelligence tests, Individual intelligence tests, Other broad range intelligence tests, Group intelligence tests, Psychological issues in intelligence testing Longitudinal studies, Problems in cross cultural testing

**Module IV: Assessment of Personality (13 hours)**
Measurement of Personality: Meaning and Purpose, Tools of Personality Assessment, Measurement of Interests, Values and Attitudes, Projective Techniques: Meaning and Types of Projective Techniques, Classification and Evaluation of Projective Techniques
Module V: Assessment of Aptitude and Achievement (10 hours)
Aptitude and Achievement: Distinction between Aptitude and Achievement Tests, Types of Aptitude tests, Types and selection of standardized Achievement Tests, Achievement test batteries.

Suggested Readings

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PCHT0028: HEALTH PSYCHOLOGY
(3 Credits 45 hours)

COURSE/LEARNING OUTCOMES
At the end of this course students will be able to:
1. Define the basic terms related to the field of health psychology. (Remembering) CO2 Learn the approaches to changes in health behavior (Understanding)
2. Make use of psychological research methods, theories, and principles to enhance biopsychosocial approaches for health promotion and illness prevention. (Applying)
3. Examine the stressors and its impact on the etiology and course of many health related problems. (Analyzing)
4. Estimate the management of various health related disorders. (Evaluating)
5. Devise policies of health care delivery system beneficial to the public. (Creating)
6. Develop awareness about the stressful impact of disabling/life-threatening illness on the patient and their family members as well as the health care providers. (Creating)

Module I: Introduction to Health Psychology (10 Hours)
Definition and emergence of health psychology. Need for health psychology. Research in health psychology: Experiments, Correlational Studies, Prospective and Retrospective Designs, Role of Epidemiology

Module II: Models of Health Behavior (8 Hours)
Health Belief Model, Cognitive Behavioral Approaches, Transtheoretical Model of Behavior Change

Module III: Health conditions and its Psychological Management (15 Hours)
Post Traumatic Stress Disorder, Cancer, COVID-19, Pain

Module IV: Health Care Services (12 Hours)
Health Care Delivery System: Developing vs. Developed nations. Patient-Provider Communication and Patient in Hospital Setting: Adults, children and children with special needs. CAM treatment (Prayer, Meditation, Guided Imagery) and Placebo Effect. Wellbeing of healthcare providers.

Suggested Readings

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#### PCFP0029: FOUNDATIONS OF COUNSELLING PSYCHOLOGY
(4 Credits, 60 Hours)

**Course Outcomes**
1. Define the basic concepts of counselling psychology, identify major theoretical foundations and recognize the historical background of counselling psychology. (Remembering)
2. To understand the professional therapist-client relationship in a therapeutic setting. (Understanding)
3. To analyse the scope and application of counselling psychology. (Analysing)
4. To use the therapeutic skills of counselling psychology in practice. (Applying)
5. To evaluate different counselling models, therapeutic skills and their appropriate applicability. (Evaluating)
6. To develop an understanding of counselling skills, therapies and ethical guidelines of counselling practice. (Creating)

**Module I: Introduction (10 Hours)**
Meaning, Definition & Goals, Historical Background, Mental health development & the guidance movement, Difference between Counselling and other associated helping professions (psychotherapy, psychiatry, social work, guidance), Modern Trends in Counselling.

**Module II: Counselling Process (10 Hours)**
Settings for counselling, Steps in counselling, Therapeutic relationship: The importance of relationship, components of relationship, Facilitative conditions for the counselling relationship.

**Module III: Counselling Approaches & Therapeutic Techniques (25 Hours)**

**Module IV: Counselling Practice (15 Hours)**
Ethical Issues: Professional Codes, Divided loyalties, Areas of ethical difficulty, Legal considerations. Conception of a professional Counsellor, Academic preparation, practical skills. Special Areas in Counselling: Family group consultation – Counselling with families, children as well as parents, Adoption, Marriage & Pre-marital Counselling. Counselling diverse population: Gender, counselling for geriatric clients, the ethnic minorities, and the physically challenged.

**Suggested Readings**

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#### PCCY0030: CHILD AND YOUTH COUNSELLING
(4 Credits- 60 hours)

**Course/Learning Outcomes**
1. Define the basic concepts and goals of child counseling (Remembering)
2. Understand the specific issues faced by children and youth, especially pertaining to education, and career. (Understanding)
3. Apply the skills and techniques of counselling in child and youth-counselor relationship (Applying)
4. Compare and contrast among the major learning styles models and theories in counseling (Analyzing)
5. Appraise the significance of the child-counsellor relationship, and major theories in the counseling process. (Evaluating)
6. Build on the traditional views of learning styles models and improve counselling skills. (Creating)
Module I: Introduction (12 hours)
Definitions and goals of counseling for children and youth; Children and Youth-counsellor relationship, attributes of a counsellor, historical background and contemporary ideas about counselling

Module II: Academic Development (12 hours)
Learning-styles: VAK Model, Kolb’s Experiential Model, MBTI Pattern, Honey and Mumford Model, Hemispheric Dominance Model, Gregorc Model, Gardner’s Multiple Intelligence Model.
Study skills: reading, writing and note-making skills, studying skills and study habits, time management
Cognitive issues: causes and factors affecting attention, concentration, remembering, forgetting, experimental evidences and cognitive training

Module III: Major Theories in Counselling Children (14 hours)
Learning, Behavioural, Cognitive Behavioural Modification, Expressive therapy (play, art and drawing, drama, metaphor, storytelling)

Module IV: Counselling Children with specific problem (12 Hours)
Children and trauma: child abuse (physical, sexual, emotional), HIV/ AIDS, specific issues in educational settingsTechniques of assessment: Cumulative record, Anecdotal Record, Case Study, Sociometry

Module V: Career Counselling (10 hours)
Basic aspects: Nature, scope and importance of career counselling, role of counselor in career preparation, career decision making, career exploration techniques
Career development theories: Holland, Ginzberg, and Super
Career counselling with diverse population: children, adolescents, college students, women and adults.

Suggested Readings

Mapping of COs to Syllabus

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PDR0031: DISABILITY STUDIES AND REHABILITATION PSYCHOLOGY
(4 Credits - 60 hours)

COURSE OUTCOMES
1. Define the concept of rehabilitation and list the methods of assessment and interventions for various disabilities (Remembering)
2. Illustrate the scope of rehabilitation psychology (Understanding)
3. Plan assessments and interventions for various learning, intellectual and physical disabilities and apply the models of rehabilitation in practice (Applying)
4. Analyse the general functions of rehabilitation psychology (Analysing)
5. Compare and conclude on the prevention and early intervention for various disability (Evaluating)
6. Modify the flaws in the successful implementation of various acts related to disability (Creating)

Module I: Introduction (15 hours)
Definition and models of disability. Definition and functions of rehabilitation (general and specific functions). Historical background of Rehabilitation Psychology. Behavioral problems and adaptive behavior

Module II: Cognitive and Academic disability (18 hours)
Intellectual Disability: review of terminology, diagnostic criteria, causes, prevalence, prevention, assessments, intervention and rehabilitation.
Learning disabilities: diagnostic criteria, types, causes, prevalence, prevention, assessments, intervention and rehabilitation.
Autism Spectrum Disorder: diagnostic criteria, types, causes, prevalence, prevention, assessments, intervention and rehabilitation.
Psychotic disorders: diagnostic criteria, types, causes, prevalence, prevention, assessments, intervention and rehabilitation.

**Module III: Physical Disability (15 hours)**

**Module IV: Legal issues (12 hours)**

**Suggested Readings**
1. Tom Meehan Chris Lloyd, Robert King., Handbook of Psychological Rehabilitation, Blackwell Publisher (2007)
3. The professional Practice of rehabilitation counselling, Springer Publication company, 2011
4. Jeanne. B. Patterson, Foundations Of Rehabilitation Counselling with Person who are blind or visually impaired, American foundation for the blind, U.S (1997)
6. Kim Etherington, rehabilitation counselling in physical and mental health, Jessica Kingsley publication
8. T. F. Rigger, Handbook of Rehabilitation Psychology.

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**PCAT0032 ADDICTION AND TRAUMA COUNSELLING**

(3 Credits - 45 hours)

**COURSE OUTCOMES**
1. Define substance related disorders according to the classification of DSM 5/ICD-10. (Remembering)
2. Compare and contrast different psychological interventions for addiction related psychological disorders. (Understanding)
3. Categorize the sources of trauma and trauma intervention. (Analysing)
4. Apply psychological interventions and techniques on trauma victims. (Applying)
5. To evaluate the effectiveness of Psychodynamic approach, CBT, MET, Group intervention in dealing with substance addiction. (Evaluating)
6. Create need based and behavioral management plan for patients with addiction and trauma survivors. (Creating)

**Module I: Addiction Counselling (8 hours)**
Definition, DSM-V diagnostic category – classification of drugs of abuse, stages of addiction

**Module II: Treatment Methodology (15 hours)**
Psychodynamic approaches, cognitive-behavioural therapies, motivational enhancement therapy. Problem-oriented treatment, solution-focused treatment, group therapy, family therapy and community based interventions.

**Module III: Psychological Trauma (12 hours)**
Introduction to Trauma: Definition, types of trauma, historical context of trauma, theoretical contexts of trauma counselling. Ethical perspective on trauma work, trauma and supervision.

**Module IV: Trauma Intervention (10 hours)**
Assessment in psychological trauma: Methods and intervention, models for trauma intervention, strategies and techniques for counselling survivor of trauma.

**Suggested Readings**
4. Trauma counselling - Theories and Interventions, Lopez Levers, Lisa

Mapping of COs to Syllabus

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PCMF0033: MARRIAGE AND FAMILY COUNSELLING

(4 Credits – 60 hours)

Course Outcomes
1. Define the basic concepts of marriage and counselling. (Remembering)
2. Classify different developmental and emotional issues in different family life stages. (Understanding)
3. Identify the classical schools of marriage and family counselling. (Applying)
4. Analyse the Bowen’s intergenerational approach. (Analysing)
5. Explain different therapeutic approaches of marriage and family counselling. (Evaluating)
6. Discuss the processes of counselling couples with special issues/problems. (Creating)

Module I: Introduction (10 lectures)
Historical evolution of Family and Marriage therapy; Goals of Family therapy; current trends in Family therapy; Fundamental concepts in Family therapy (Cybernetics and Systems theory, Social Constructivism) Stages of marriage, Divorce and remarriage, Marriage and Divorce: Role of Family Courts.

Module II: Family Across a Lifespan (16 lectures)
The family life cycle, stages of family life cycle. Key developmental and emotional issues in different stages: Young adulthood. Newly married, Child bearing, Families with preschool children, Families with school age children. Families with teenage children, Launching stage, Middle aged adult, Retirement

Module III: Classical Schools (12 lectures)
Bowen’s Intergenerational Approach; Structural Family Therapy; Strategic Family Therapy; Experiential and Humanistic Family Therapies; Psychoanalytic and Cognitive Behavioural Family therapy.

Module IV: Recent Developments (12 lectures)
Postmodernism, Feminist and contextual work, Solution focused therapy, Narrative therapy, Integrative models. Application and evaluation of Family therapy. Skill development: Genograms. The stages of Family therapy: Planning; Assessment; Disengaging or recontracting.

Module V: Counselling Couples with Special Issues (10 lectures)
Treating sexual abuse and physical abuse issues in family; Counselling of alcoholics and drug-addicts; Counselling the terminally ill and patients with HIV/AIDS.

Suggested Readings
8. The Family Crucible: The Intense Experience of Family Therapy, Napier, A.Y and Whitaker, C., 1988,
PCFC0034 FOUNDATION OF CLINICAL PSYCHOLOGY
(4 Credits-60 hrs.)
Course Outcomes
1. Definition of clinical psychology, acquire knowledge and understanding the philosophical roots and historical events that have shaped the field of clinical psychology (Remembering)
2. Explore the underlying philosophical assumptions, individual contributors, and various forces that served to shape the emerging field of clinical psychology (Understanding)
3. Demonstrate familiarity with scientific, ethical, legal, and practice-oriented issues in the field (Applying)
4. Acquire a basic understanding of western (and, to an extent, Indian) philosophical thought, to articulate a philosophy of their own, and apply that philosophy to their professional work in field of clinical Psychology (Applying)
5. Think critically about the science of psychology, analyse psychological theory, research, and practice in a historical context, and develop ideas, critiques, and conclusions of their own (Analysis)
6. Adapt and develop a basic understanding about assessment and interventions in the context of clinical psychology (Creating)

Module-I (12 hours) Basic Introduction to Clinical Psychology
Definition, Historical background: Early & Recent history; Nature and scope of the discipline: Theory and research; Developing a professional identity: Education & training, professional activities, ethical issues and employment settings.

Module – II (12 hours) Major theoretical models in clinical psychology
The role of theory; and theoretical models; Psychodynamic; Cognitive-Behavioural; Humanistic; Family systems.

Module- III (18 hours) Diagnostic Techniques
Nature and purpose of clinical interview, mental status examination; Observing behaviour, clinical judgement; communication strategies, diagnosis and assessment, Behavioural assessment, Psychological Assessment: Cognitive and Personality Assessment and case study

Module- IV (18 hours) Competencies in Clinical Psychology
The core competencies: Assessments, Evaluation, Formulation, Intervention, Communication/consultation, and service delivery, Therapeutic Models (Behavioural approaches, cognitive therapy and cognitive-behaviour therapy, Psychodynamic therapy, Systemic and group approaches, Eclectic and integrative approaches)

Suggested Readings

Course outcomes (COs) Mapping

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PCPG0035: PSYCHODIAGNOSTICS
(4 Credits: 60 hours)

COURSE OUTCOMES
1. Define the concept of assessment (Remembering)
2. Gather the significance and scope of psychological assessment in diagnosis and intervention (Understanding)
3. Apply various approaches of assessment in practice (Applying)
4. Estimate the appropriate assessments for different population as per the diagnoses. (Analysing)
5. Assess the socio-cultural factors in various assessments aiding in the diagnoses. (Evaluating)
6. Design psychopathology formulation which will impede the process of effective therapeutic sessions. (Creating)

Module I: Introduction to psychological assessment (15 hours)
Traditional approaches to assessment. Stages in psychological assessment. DSM 5 and ICD-10: Similarities and differences. Screening and Diagnostic tools

Module II: Clinical Interviewing (15 hours)
Types of Clinical Interview. Rapport formation and communication strategies. Diagnostic Interviewing. Interviewing with/children and cultural issues

Module III: Intellectual and Neuropsychological assessment (15 hours)
Theories of intelligence, issues and controversies. Tests batteries: WAIS, WISC, MISION, BKT. Approaches to neuropsychological assessment. Test batteries: Halstead-Reitan, Luria-Nebraska, PGI-BBD, AIIMS Comprehensive Neuropsychological Battery

Module IV: Behavioral and Personality Assessment (15 hours)

Suggested Readings

Mapping of COs to Syllabus

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PCRP0036 FORENSIC PSYCHOLOGY
(3 credits – 45 hours)

Course Outcomes
1. Define forensic psychology and the role of a Forensic Psychologist. (Remembering)
2. Illustrate on the nature of crime. (Understanding)
3. Examine the social, psychological theories of crime. (Analysing)
4. Apply the methods of forensic psychological investigation. (Applying)
5. Explain the concept of Juvenile delinquency, sexual offenders and serial offenders. (Evaluating)
6. Create an idea about the importance of Forensic psychological assessment into practice. (Creating)

Module I: Introduction (11 hours)
Meaning, nature and definition of Forensic Psychology, Historical background, training of a Forensic psychologist, Ethical concerns in Forensic Psychology.

Module II: Theories of crime (12 hours)
Need for scientific understanding of crime, psychoanalytical conceptualization of crime, Eysenck’s biosocial theory of crime social learning theory of crime, frustrated induced criminality, Neuropsychological theories of crime

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Module III: Juvenile offenders and Sexual offenders (10 hours)
Nature and definition of Juvenile offenders, sexual offenders and serial offenders, Social risk factors, Psychological risk factors, family background, Intelligence and delinquency

Module IV: Forensic Psychological Investigation methods (12 hours)
Methods in Forensic Investigation-Polygraph, Brain electrical Oscillations Signature, Narcoanalysis, Applicability of Rorschach Inkblot Test, MMPI-II, Draw-a-Person Test in forensic settings.

Suggested readings

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PCPC0037: PSYCHOTHERAPY
(4 Credits – 60 hours)

Course Outcomes
1. Define psychotherapy. (Remembering)
2. Classify and categorise major disorders with respect to psychotherapy. (Understanding)
3. Apply psychotherapeutic concepts and constructs to diagnose and intervene individuals with mental illnesses. (Applying)
4. Analyse the distinction among different types of psychotherapy. (Analysing)
5. Evaluate the applicability different types to psychotherapy to mental health and illnesses. (Evaluating)
6. Create a psychotherapeutic intervention plan for patients on the basis of clinical features, diagnosis criteria and therapist competence. (Creating)

Module I: Introduction (8 hours)
Historical background of psychotherapy; Principles and goals of psychotherapy; Professional training and ethics in clinical practice

Module II: Psychodynamic Psychotherapy (10 hours)
Psychoanalysis: Background and basic principles Psychoanalytic theory since Freud
Psychodynamic psychotherapy in contemporary clinical psychology

Module III: Humanistic, Experiential and Family Therapies (12 hours)
Humanistic psychotherapy
Eclectic treatment combinations Family therapy
Group therapy

Module IV: Cognitive Behavioural Interventions (15 hours)
Behaviour therapy techniques
Cognitive modification procedures
Cognitive behaviour therapy: specific applications in various psychological disorders Dialectic Behaviour therapy

Module V: Relaxation Therapies (15 hours)
Progressive muscular relaxation
Autogenic training
Biofeedback
Eye Movement desensitization and reprocessing

Suggested Readings:

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**PCNP0038: NEUROPSYCHOLOGY**

(3 Credit-45 hours)

**Course outcomes (COs)**

1. Define the basic concepts of Neuropsychology and naming different biological systems involved in Neurological disorders. (Remembering)
2. Explain the neuropsychological basis of human behaviour. (Understanding)
3. Identify the difference and relation among brain structures, neurological and endocrine systems. (Applying)
4. Classify the sub-systems of the central nervous system of the brain. (Analysing)
5. Compare different neuropsychological systems causing Neuro-pathology. (Evaluating)
6. Discuss the major theoretical perspective, develop the awareness of the neuropsychological basis of behaviour and can able to formulate rehabilitation. (Creating)

**Module-I: Foundation of neuropsychology (15 hours)**


**Module-II: Brain Damage and Neuroplasticity (12 hours)**

Causes of Brain damage, Neuropsychological diseases (Stroke, Tumours, Epilepsy, Dementia, Traumatic Brain injury), Animal models of human neuropsychological diseases, Neuro-plastic responses to nervous system damage: Degeneration, Regeneration, Reorganization, and recovery, Neuroplasticity.

**Module-III: Neuropsychological Assessments and Diagnosis (12 hours)**

General Considerations in Neuropsychological testing, Rationale of the neuropsychological examination, appropriate referrals for neuropsychological evaluation, Psychometric issues in neuropsychological assessment:

Preliminary screening of neuropsychological functioning: Orientation (Arousal), Sensation and Perception, Attention/Concentration, Motor Skills, Verbal Functions/Language, Visuo-spatial Organization, Memory, Judgment/Problem Solving.

**Module-IV: Neuro-Psychological Rehabilitation (6 hours)**

Basic concepts and models of Neuropsychological rehabilitation (Cognitive, Behavioural, Emotional and Psychosocial), Challenges and the guidelines of Neuro-psychological rehabilitation.

**Suggested Readings:**


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PCPG6018 PERSONAL GROWTH I (P/NP)
(2 Credits - Workshop and assignment mode)

Course Outcomes
1. Understand the basic principles of psychology (Remembering)
2. Understand personality traits, values, skills and interests. (Understanding)
3. Gain self-awareness and emotional awareness (Applying)
4. Set specific, achievable short- and long-term goals (Analysing)

Module I: Introduction (15 lectures)
Self esteem, Self awareness, Emotional well being, Self-Motivation

Module II: Introduction (15 lectures)
Critical thinking, Personality development, Communication styles

Suggested Readings

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PCFA6019: PSYCHOLOGICAL FIRST AID (P/NP)
(2 Credits - Workshop and assignment mode)

Course Outcomes
1. Remember the basic concepts of psychological first aid. (Remembering)
2. Understand the steps of psychological first aid. (Understanding)
4. Plan specific, achievable remedial measures (Analysing)

Module I: Introduction (15 lectures)
Definition, Phases, emergency psychological care, mental hygiene.

Module II: Introduction (15 lectures)
Critical thinking, planning emergency psychological intervention.

Suggested Readings

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PCRP6020 RESEARCH PROJECT PHASE I (4 Credits)

Course outcomes
1. Knowledge of the major theoretical approaches and findings in psychology. (Remembering)
2. Demonstrate knowledge about the research methods used in psychology. (Understanding)
3. Apply the knowledge for preparing research design, and data analysis. (Applying)
4. Critically analyse information related to the study of behaviour and mental processes, and use the critical assessment in forming conclusions and arguments. (Analysing)
5. Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria. (Evaluating)
6. Develop the understanding of how to prepare a research proposal. (Creating)

Every student shall undertake a research project work under the supervision and guidance of a faculty member. The student may choose the topic of research and start the preliminary work by the end of the second semester. The students are expected to complete the Literature Review followed by a Literature Review presentation and the Proposal presentation during the Phase I. Students are expected to complete the data collection before the fourth semester.
In Phase II, students are expected to complete the data collection, data analysis and interpretation, and submission of final report. Submission of final copy of the dissertation will be followed by presentation of the research and viva voce examination.

The thesis is to be submitted to the department before the date notified. The mode and components of evaluation of Phase I and Phase II of the research project and the weightages attached to them shall be published by the Department at the beginning of the semester. There shall be a viva voce examination on the research project.

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**PCIS6021 SUPERVISED INTERNSHIP I**

(4 Credits)

**Course outcomes**

1. Remembering the personal integrity, accountability, professional deportment and concern for the welfare of others. (Remembering)
2. Understanding of Psychological disorders, empathy, reflective practice, and self-care. (Understanding)
3. Applying scientific, theoretical, contextual approach to the discipline (Applying)
4. Analyse the symptom severity and clinical features of disorders. (Analysing)
5. Determine ethical and Legal guidelines of practice (Evaluating)
6. Develop effective work skills, including cognitive and expressive skills, self-directed learning & continuing education. (Creating)

**Module I: Introduction**

Analysing the situation: Need of counselling, space for counselling, information to clients, documentation, organizing supervision.

**Module II: Internship**

Taking in clients: first interview, documentation of the case, definition of counselling goals, building the counselling relationship, process of counselling, using skills of counselling, concluding counselling, documentation of the whole counselling process, evaluation; working in a team–role of counselling, resources and challenges, role in the team, case management: discussion, supervision. Evaluation of the internship will be based on the documentation, reports from the organisation, report of the supervisor and the presentation and the viva voce examination of the student at the end of the period of Internship.

**Module III: Phases of Supervised Internship**

The Supervised Internship is divided into two phases; Phase I and Phase II. Each of these phases consists of 45days (100 hours) of intensive practical learning programs in counselling setting under trained supervisors. The phases of the internship spread across the 3rd and 4th semester of Masters Degree program. The total credit for the supervised internship is divided equally across the final year semesters of the Master’s Degree program.

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**PCIP6022 SUMMER INTERNSHIP (Pass/Non-Pass)**

Students are required to undergo a summer internship of two weeks’ during the semester break between the second and third semesters. It is a P/NP course and shall be recorded in the third semester. The Summer Internship gives students an opportunity to apply the theories and principles that they have learnt in class room courses to the “real world” of social service agencies, medical institutions, the criminal justice system, business, and industry. During the internship, students can explore career interests, develop professional skills, learn how community organizations work and expand their clinical and interpersonal skills. The summer internship
enriches the students’ academic experience while making a valuable contribution to the community and utilizing the vacation optimally.

Course Outcomes
1. Define the clinical features of psychological disorders. (Remembering)
2. Demonstrate fundamental knowledge and comprehension of the major concepts, theoretical perspectives, historical trends, and empirical findings in psychology. (Understanding)
3. Develop Scientific reasoning and critical thinking, including effective research methodology in solving problems related to behavior and mental processes. (Applying)
4. Analyse ethically and socially responsible behaviors for professional and personal settings, including development of values that build diverse communities. (Analysing)
5. Determine their basic area of interest to work further/specialize in clinical setting. (Evaluating)
6. Develop the competence in writing case studies, and interpersonal communication skills. (Creating)

Students are required to undergo a summer internship of two weeks’ during the semester break between the second and third semesters. It is a P/NP course and shall be recorded in the third semester. The Summer Internship gives students an opportunity to apply the theories and principles that they have learnt in classroom courses to the “real world” of social service agencies, medical institutions, the criminal justice system, business, and industry. During the internship, students can explore career interests, develop professional skills, learn how community organizations work and expand their clinical and interpersonal skills. The summer internship enriches the students’ academic experience while making a valuable contribution to the community and utilizing the vacation optimally.

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PCST6023 STUDY TOUR (Pass/Non-Pass)

COURSE OUTCOMES
1. Define mental illnesses and rehabilitation. (Remembering)
2. To understand counselling in real life setting. (Understanding)
3. To apply theoretical principles in order to understand the functioning of various mental health settings (Applying)
4. Distinguish clinical features of different mental illnesses. (Analysing)
5. Explain the importance of different models of mental health and illnesses in assessment. (Evaluating)
6. Develop practical knowledge about different psychological practice and rehabilitation setting. (Creating)

Module I: Introduction
During the programme the students shall undertake a study tour, along with the faculty members, to a place approved by the department. The places are to be so chosen as to be of educational benefit to students. During the tour, the focus shall be to visit and interact with NGOs, hospitals, state/national/ international organisations involved in psychological counselling.

Module II: Documentation and Evaluation
A report of the learning outcomes shall be submitted to the department at the end of the tour. The Study Tour shall be a Pass/No Pass course.

Mapping of COs to Syllabus

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PCSI6024: SUPERVISED INTERNSHIP II
(8 Credits)

**Course Outcomes**
1. Remembering and identifying intervention. (Remembering)
2. Understanding dynamics of history taking and therapeutic approach to psychological counselling. (Understanding)
3. Apply the, theories skills and ethics in counselling. (Applying)
4. Analyse the trial and error essence of a counselling relationship and client needs. (Analysing)
5. Evaluate ethico-legal situations. (Evaluating)
6. Creating facilitative environment for clients in practice. (Creating)

**Module I: Introduction**
Analyzing the situation: Need of counselling, space for counselling, information to clients, documentation, organizing supervision.

**Module II: Internship**
Taking in clients: first interview, documentation of the case, definition of counselling goals, building the counselling relationship, process of counselling, using skills of counselling, concluding counselling, documentation of the whole counselling process, evaluation; working in a team—role of counselling, resources and challenges, role in the team, case management: discussion, supervision. Evaluation of the internship will be based on the documentation, reports from the organisation, report of the supervisor and the presentation and the viva voce examination of the student at the end of the period of Internship.

**Module III: Phases of Supervised Internship**
The Supervised Internship is divided into two phases; Phase I and Phase II. Each of these phases consists of 45 days (100 hours) of intensive practical learning programs in counselling setting under trained supervisors. The phases of the internship spread across the 3rd and 4th semester of Masters Degree program. The total credit for the supervised internship is divided equally across the final year semesters of the Master’s Degree program.

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**PCRP6025: RESEARCH PROJECT PHASE II (6 Credits)**

**Course outcomes**
1. Knowledge of the major theoretical approaches and findings in psychology. (Remembering)
2. Demonstrate knowledge about the research methods used in psychology. (Understanding)
3. Apply the knowledge for preparing research design, and data analysis. (Applying)
4. Critically analyse information related to the study of behaviour and mental processes, and use the critical assessment in forming conclusions and arguments. (Analysing)
5. Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on set of criteria. (Evaluating)
6. Develop the understanding of how to prepare a research proposal. (Creating)

Every student shall undertake a research project work under the supervision and guidance of a faculty member. The student may choose the topic of research and start the preliminary work by the end of the second semester. The students are expected to complete the Literature Review followed by a Literature Review presentation and the Proposal presentation during the Phase I. Students are expected to complete the data collection before the fourth semester.

In Phase II, students are expected to complete the data collection, data analysis and interpretation, and submission of final report. Submission of final copy of the dissertation will be followed by presentation of the research and viva voce examination.

The thesis is to be submitted to the department before the date notified. The mode and components of evaluation of Phase I and Phase II of the research project and the weightages attached to them shall be published by the Department at the beginning of the semester. There shall be a viva voce examination on the research project.

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PCPP6026: PSYCHOLOGICAL ASSESSMENT-I (PRACTICUM-I)
(2 credits – 60 hours)

Course/Learning Outcomes
1. Define the important concepts of psychology research, and assessment techniques. (Remembering)
2. Understand the importance and steps associated with planning and conducting an experiment. (Understanding)
3. Apply the basic concepts of research and assessment techniques in measuring important psychological constructs associated with positive psychology. (Applying)
4. Categorize different types of intelligence assessment techniques. (Analyzing)
5. Evaluate the importance of different types of assessment techniques and measurement tools. (Evaluating)
6. Design and conduct an experiment. (Creating)

Module I: Introduction to Practicum (9 hours)
Primary modes of psychological enquiry: Experimental method, Observation, Survey, and Interview
Psychometric Properties: reliability, validity, standardization, sources of error

Module II: Experiment (14 hours)
Memory drum or Maze learning (offline)/serial positioning effect or cluster learning (virtual): Basic concepts, purpose, development, administration, scoring, interpretation

Module III: Positive Psychology - I (12 hours)
General well-being scale or psychological well-being: Basic concepts, purpose, development, psychometric properties, administration, scoring, interpretation

Module IV: Positive Psychology - II (12 hours)
Brief-cope or Coping appraisal or behavior questionnaire: Basic concepts, purpose, development, psychometric properties, administration, scoring, interpretation

Module V: Intelligence tests (13 hours)
Binet-Kamat Test of Intelligence (offline)/Draw-a-person (online): Basic concepts, purpose, development, psychometric properties, administration, scoring, interpretation

Suggested Readings

Mapping of COs to Syllabus

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PCPP6027: PSYCHOLOGICAL ASSESSMENT-II (PRACTICUM-II)
1. Define the basic terms related to aptitude, personality, projective techniques, positive emotions, posttraumatic growth and clinical rating scales.
2. Classify the various types of psychological tests on the basis of their use. (Understanding)
3. Make interpretations and draw conclusions based on the norms given in the manual. (Applying)
Module II: Assessment of Personality: Projective Tests (20 Hours) (Offline/Online Classes):
House Tree Person Test (HTP)/ Picture Completion Test (PCT)/Human Figure Test: Basic concepts, psychometric properties of the test, administration, scoring, results and interpretation.

Module III: Assessment of Positive Emotion (10 Hours) (Offline/Online Classes):
Positive and Negative Affect Schedule (PANAS)/Multidimensional Emotional Questionnaire (MEQ): Basic concepts (Definition, Protective Factors of Mental Health & Resilience), psychometric properties of the test, administration, scoring, results and interpretation.

Module IV: Assessment of Posttraumatic Growth (10 Hours) (Offline/Online Classes):
Posttraumatic Growth inventory: Basic concepts (Definition, Barbara Fredrickson’s Broaden-Build Theory), psychometric properties of the test, administration, scoring, results and interpretation.

Module IV: Clinical Assessment Scales (20 Hours) (Offline/Online Classes):
Beck’s Depression Inventory/State-Trait Anxiety Inventory: Basic concepts, psychometric properties of the test, administration, scoring, results and interpretation.

Suggested Readings

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PCFW6028: FIELD WORK
(2 Credits)

Course Outcomes
1. Define counselling and mental illnesses (Remembering)
2. Understand the value of supervision (Understanding)
3. Apply the theoretical principles to individuals at various setups (Applying)
4. Distinguish clinical features of different mental illnesses. (Analysing)
5. Evaluate the models of mental health and illness. (Evaluate)
6. Create a management plan for patients on the basis of clinical features, diagnosis criteria and therapist competence. (Creating)

Module I: Introduction
The field work practice in the second semester shall focus upon the area of concentration chosen by the students. The students will be placed in the field for a minimum of eight days. The fieldwork setting shall be NGO’s, hospitals, clinics and schools. The students are expected to apply all the skills and techniques of counselling whenever applicable depending upon the organization and their service. The students should be involved in the activities of the institution and fulfil the responsibilities as requested by the agency supervisor.

Module II: Record and Documentation
Students shall prepare a daily report of the fieldwork activities and submit it to the concerned faculty supervisor. The faculty supervisor shall provide the necessary feedback and guidance to the students.

Module III: Evaluation
At the end of the semester the students shall submit a summary report of the cases taken and activities done during their placement. The students shall also appear for the viva voce examination at the end of the semester.

Mapping of COs to Syllabus

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PCPR6029: PRACTICUM-III

(2 credits – 60 hours)

Course/Learning Outcomes
1. Define the basic concepts of disability, intelligence and personality assessment. (Remembering)
2. Extend the theoretical knowledge of disability, personality and intelligence theories and assessment techniques into practice. (Understanding)
3. Make use of the important measurement tools to learn administration and scoring. (Applying)
4. Examining test scores and interpretation of results. (Analyzing)
5. Evaluate the importance of personality, intelligence and disability assessment. (Evaluating)
6. Construct conclusion from the results of psychological assessment. (Creating)

Module 1: Disability Assessment (20 hours)
Indian scale for assessment of autism (ISAA)/WHO Disability Assessment Schedule (WHODAS 2.0): Basic concepts, purpose, development, psychometric properties, administration, scoring, interpretation

Module 2: Intelligence (20 hours)
Bhatia battery of performance test of intelligence (offline) or Vineland Social Maturity scale (online): Basic concepts, purpose, development, psychometric properties, administration, scoring, interpretation

Module 3: Personality assessment (20 hours)
Rorschach Inkblot Test (offline) or Eysenck Personality Inventory (online): Basic concepts, purpose, development, psychometric properties, administration, scoring, interpretation.

(Note. Owing to the importance of Rorschach in psychological testing if it is not possible to conduct this practical due to the mode of conduction of classes, the department will try to make sure that students have the knowledge of this test by conducting workshop on this topic.)

Suggested Readings

Mapping of COs to Syllabus

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PCPR6030: PRACTICUM-IV

(2 Credits, 60 hours)

COURSE/LEARNING OUTCOMES (COs)
At the end of this course students will be able to:
1. Define the basic terms related to cognitive functioning, personality, projective techniques and clinical rating scales & choose a suitable method of psychological test to administer on a subject (Remembering)
2. Classify the various types of psychological and neuropsychological tests on the basis of their use. (Understanding)
3. Make interpretations and draw conclusions based on the norms given in the manual. (Applying)
4. Examine the details of the rating scale/test, the aim, applications, procedure of administration and subject results. (Analysing)
5. Recommend the use of a suitable psychological assessment for a particular disorder. (Evaluating)
6. Test the administrator’s decision making process to select a particular test for assessment of a given psychological disorder. (Creating)

Module I: Neuropsychological screening and test batteries for assessing cognitive functioning and rule out neuropathology (20 hours)
Introduction to Neuropsychological assessments; importance and purpose; various types of Neuropsychological tests; administration, scoring, results and interpretation the tests.
The Bender Visual-Motor Gestalt Test (BVGT) (Online/offline)/Rey-Osterrieth complex figure Test (ROCF) (Online/offline)
Gesell Drawing test of intelligence (Online/offline)/Mini Mental Status Examination (MMSE) PGI-BBD battery (offline)

Module II: Assessment of personality (22 hours)
Objective and Projective tests for assessing personality and psychopathology. Definition of Personality; Measurement of Personality;
Various types of Personality tests, administration, scoring, results and interpretation.
Minnesota Multiphasic Personality Inventory - 2 (MMPI-2) (offline) Sacks sentence completion test (SSCT) (online/offline)
Thematic Apperception Test, other techniques (TAT) (online/offline)

Module III (18 hours)
Rating scales for assessing the severity of Psycho-pathology and Evaluation of Impairment
Introduction to Clinical Rating Scales; Purpose of various rating scales; administration, scoring, results and interpretation; Hamilton Anxiety Rating Scale (HAM-A) (Online/offline)
Hamilton Depression Rating Scale (HDRS) (Online/offline) Barratt Impulsiveness scale (BIS) (offline/Online)

Suggested Readings

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VALUE-ADDED COURSES

PDSP6117: SCHOOL PSYCHOLOGY
(2 credits- 30 hours)

Course Outcomes
1. Gain knowledge about the concept of School Psychology. (Remembering)
2. Understanding the process of school counseling. (Understanding)
3. Analyze the needs of school children in the new digital world. (Applying)
4. Apply principles and concepts of counseling in school set up. (Analyzing)
5. Evaluate the gaps in the current scenario. (Evaluating)
6. Create a comfortable environment for children in need of intervention. (Creating)
Module 1: Introduction (5 hrs)
Historical background of school psychology, Definition nature and scope of School Psychology, Role of a School Psychologist as a Professional

Module 2: Guidance and Counseling in School setting (15 hrs)
Definitions, Ethics and Legal aspects, Characteristics of an effective counselor, Basic Counseling Skills- Active listening, reflecting, paraphrasing, questioning, confronting, Counseling process- Building, maintaining and terminations counselor’s relationships.

Module 3: Tools and Techniques Practice (10 hrs)
Objective tools: Checklist, rating scales, self report inventories and other standardized tools.
Subjective Tools: Observation, anecdotal records, cumulative Records, Interview and case history
Techniques for group intervention: Group tasks, Group discussion, debriefing and interpretation, summary making.
Techniques for individual intervention: role plays, individual assignments, feedback charts
Importance of Record Keeping

Suggested Readings:

Mapping of COs to Syllabus

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PDCM6118: COMMUNITY MENTAL HEALTH
(2 credits- 30 hours)

Course Outcomes
1. Gain knowledge about the underlying principles of Community Mental Health. (Remembering)
2. Understand current trends of practice and intervention. (Understanding)
3. Apply basic intervention skills in their community projects. (Applying)
4. Analyze gaps in the current functioning of Community Mental Health at regional levels. (Analyzing)
5. Evaluate intervention techniques in multicultural set ups. (Evaluating)
6. Organize awareness programmes for communities. (Creating)

Module 1: Introduction (2 hours)
Basic Principles of Community Mental Health, Counseling Skills, Counseling in Multicultural set up

Module 2: Mental Health Issues (6 hours)
Intellectual disability, Addiction, Developmental disorders, Suicide

Module 3: Identification, Assessment and Intervention (7 hours)
Identification of Mental Health Issues, Assessment of Mental Health Issues, Psycho-education, Evidence Based Practices (Behavior Therapy, Cognitive Behavior Therapy, Rational Emotive Behavior Therapy)

Module 4: Practical (15 hours)
Community Mental Health Projects

Suggested Readings:

Mapping of COs to Syllabus

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PCLS6119: Life Skills Education
(2 credits-30 hours)

Course Outcomes:
1. Choose and gain knowledge about themselves, develop consciousness of self, self-confidence, feelings of mattering, manage personal emotions (Remembering)
2. Able to relate and work with others, practice collaborations, controversy with civility, engage across difference, be committed to ethical action (Understanding)
3. Apply self-knowledge, practice self-worth, congruence, commitment, identify passions and develop common purpose (Applying)
4. Able analyse academic knowledge and integrate into all aspects of living (Analysing)
5. Learn to evaluate and improve upon personal leadership strengths and weaknesses (Evaluating)
6. Create effective change and practice collective efficacy, develop critical thinking/decision making skills, common purpose and a sense of connectedness within one’s communities. (Creating)

Module –I: Introduction (5 hours)
- Definition and Importance of Life Skills
- Livelihood Skills, Survival Skills and Life Skills
- Life Skills Education, Life Skills Approach, Life Skills Based Education
- Life Skills Training - Implementation Models
- Life Skills Education in the Indian Context

Module-II: Social Skills and Negotiation Skills (8 hours)
Introduction
Life Skills: Generic, Problem Specific and Area Specific Skills
- Self-Awareness
  - Definition, Types of Self
  - Self Concept, Body Image, Self Esteem
  - Techniques used for Self Awareness: Johari Window, SWOT Analysis
- Empathy
  - Sympathy, Empathy & Altruism
- Effective Communication
  - Definition, Functions, Models, Barriers
- Interpersonal Relationship
  - Definition, Factors affecting Relationships

Module-III: Coping Skills (5 Hours)
Coping with Emotions
Coping Skills
- Coping & Emotions
  - Definition, Characteristics, Types
  - Classification: Wheel Model, Two-Dimensional Approach
  - Coping Strategies
- Coping with Stress
  Definition, Stressors
DEPARTMENT OF PSYCHOLOGY

- Sources of Stress
- The General Adaptive Syndrome Model of Stress
- Coping Strategies

Module-IV: Practical (12 hours)
Life Skills in Specialized Areas

- Peer Education
- Life Skills for Disaster Preparedness
- Life Skills for Corporate Sector
- Life Skills for Special Population
- Life Skills for Geriatric and Palliative Care
- Life Skills in Practice in Educational Settings

Suggested Readings:
10. Family Health International, NACO, USAID (2007), Life Skills Education tool kit for Orphans and vulnerable children in India

Mapping of COs to Syllabus

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SCHOOL OF HUMANITIES AND SOCIAL SCIENCES
DEPARTMENT OF PUBLIC ADMINISTRATION
BA (HONOURS) IN PUBLIC ADMINISTRATION

Programme Outcomes:
PO 1:  **Disciplinary Knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more other disciplines that form a part of an undergraduate programme of study.
PO 2:  **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives. Critically evaluate practices, policies and theories by following a scientific approach to knowledge development.
PO 3:  **Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; communicate with others using appropriate media; confidently share one’s views and express herself/himself; demonstrate the ability to listen carefully; and present complex information in a clear and concise manner to different groups.
PO 4:  **Social Interaction:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group and act together as a group or a team in the interests of a common cause. Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO 5:  **Effective Citizenship:** Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO 6:  **Moral and Ethical Awareness:** Ability to embrace moral/ethical values in conducting one’s life, possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
PO 7:  **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.
PO 8:  **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes. Critical sensibility to lived experiences, with self-awareness and reflexivity of both and society.
PO 9:  **Information and Digital Literacy:** Capability to use ICT in a variety of learning situations. Demonstrate ability to access, evaluate and use a variety of relevant information sources; and use appropriate software for analysis of data.
PO 10: **Research-related skills:** A sense of inquiry and capability for asking relevant/appropriate questions, problematizing, synthesizing and articulating; Ability to recognize cause and affect relationships, define problems, formulate hypotheses, interpret and draw conclusions from data, ability to plan, execute and report the results of an experiment or investigation. Ability to apply one’s learning to real-life situations.

**MAPPING OF COURSES WITH POS/PSOS:**

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MA PUBLIC ADMINISTRATION

PROGRAM OUTCOMES – MA PROGRAMME

PO 1:  Critical Thinking: Inculcate critical thinking to carry out scientific investigation objectively. Formulate coherent arguments; critically evaluate practices, policies and theories by following a scientific approach to knowledge development. Critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.

PO 2:  Knowledge Skill: Equip the student with skills to analyse problems, formulate a hypothesis, evaluate and validate results, and draw reasonable conclusions thereof. Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge.

PO 3:  Scientific Communication Skills: Imbibe effective scientific and/or technical communication in both oral and writing. Ability to show the importance of the subject as a precursor to various scientific developments since the beginning of civilization.

PO 4:  Ethics: Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate the highest standards of ethical issues in the subject concerned. Ability to identify unethical behaviour such as fabrication, falsification or misrepresentation of data and adopt an objective, unbiased and truthful action in all aspects.

PO 5:  Enlightened Citizenship: Create awareness to become an enlightened citizen with a commitment to deliver one’s responsibilities within the scope of bestowed rights and privileges.

PO 6:  Analytical Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyse and synthesise data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.

PO 7:  Multicultural Competence: Development of a set of competencies in order to enhance and promote the growth of multicultural sensitivity within universities. Integrating multicultural awareness such as race, gender, physical ability, age, income and other social variables, and creating an environment that is, “welcoming for all students”.

PO 8:  Lifelong Learning: Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning throughout life, through self-paced and self-directed learning aimed at personal development, and adapting to changing academic demands workplace through knowledge/ skill development/reskilling.

PO 9:  Leadership Qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination in a smooth and efficient way.

PO 10:  Research Skills: Prepare students for pursuing research or careers in industry in the concerned subjects and allied fields. Capability to use appropriate software to solve various problems in various scientific investigations, problem-solving and interpretation.

MA PUBLIC ADMINISTRATION (HONOURS) MAPPING OF COS TO PO/PSO

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MA Public Administration - DETAILED SYLLABUS

PASE0001: STATE AND ITS ELEMENTS
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Trace the evolution and emerging perspectives of the State (Remembering & Understanding)
2. Understand the relationship between State, Society and Public Administration (Understanding)
3. Analyze the origin and changing role of the state (Analyzing)
4. Evaluate the Interface between Citizens and Administration (Applying)

Module – I (15 hours)
Evolution and Perspectives of the State: Origin of the State, the Theory of Divine Origin, Force Theory, Matriarchal and Patriarchal Theory, Social Contract Theory, Evolutionary Theory; Elements and Functions of State; Changing Role of the State; Liberal and Marxist Perspective of the State, Neo-liberal Perspective, and Gandhian Perspective; Autonomy of the indirect economy, and kindness economy.

Module - II (10 hours)

Module – III (10 hours)

Module - IV (10 hours)
Relationship between State, Society and Public Administration; People’s Struggle for Democracy- Case Studies, Interface between Citizens and Administration; Political Parties, Pressure Groups, Electoral Reforms; Digital economy; Self-reliant theory.

Suggested Readings
1. An Introduction to Political Theory, Gauba · 2009 Publisher: Macmillan Publishers India Limited
2. Political theory ideas and concepts by Sushila Ramaswamy, 2010, Publisher: PHI Learning
4. Political Theory: An Introduction, by Rajeev Bhargava, Ashok Acharya, Pearson Education India
5. Political Man, The Social Bases of Politics (Classic Reprint), 2017
6. Rawls, R.H. - A Theory of Justice
7. Sharma, U., Sharma, S.K. - Principles & Theory of Political Science

Mapping of COs to Syllabus

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PAIA0002: INTRODUCTION TO THE PUBLIC ADMINISTRATION
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the meaning, nature and scope of Public Administration (Remembering & Understanding)
2. Comprehend the changing paradigms of Public Administration (Understanding)
3. Analyse the events that gave shape to the discipline (Analyzing)
4. Evaluate the concept of Good Governance and its implications (Applying)

Module – I (10 hours)
Meaning, nature, scope and significance of Public Administration; Relation with other disciplines of social sciences;

Module – II (10 hours)
Evolution of the discipline and its present status; Ecology, Public and Private Administration.

Module III (15 hours)
New Public Administration; Public Choice Theory; New Public Management; State vs. Market Debate.
Module IV (10 hours)
Recent Developments in Public Administration; Challenges of Liberalization, Privatization and Globalization; Good Governance: concept and application; Good Governance indexes.

Suggested Readings
1. Henry, Nicholas - Public Administration And Public Affairs
2. Nigro, Felix, A. - Modern Public Administration
3. Dixit Manoj (et. al) - Modern Public Administration
4. Awasthi & Maheshwari - Public Administration
5. Sharma & Sharma - Public Administration
6. Bhattacharya, M. - New Horizons of Public Administration
7. Bhamri, C.P. - Public Administration

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PACD0003: COMPARATIVE AND DEVELOPMENT ADMINISTRATION
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the Concept, Nature, Scope and Significance of Comparative Public Administration (Remembering & Understanding)
2. Understand the ecological impact on the Public Administration (Understanding)
3. Analyze the problems of Comparative Research and development administration (Analyzing)
4. Evaluate the Changing pattern of Development Administration (Applying)

Module – I (15 hours)

Module – II (10 hours)
Fred Riggs’s Typology of Societies and Features; Problems of Comparative Research; Salient Features of the administrative systems of UK, USA, France and Japan

Module – III (15 hours)
Genesis of Development Administration; Development Administration: Meaning, characteristics, Traditional Administration versus Development Administration; Administration of Development and Development of Administration; Politics of Development Administration.

Module – IV (05 hours)
Temporal and Spatial Dimensions of Development Administration; Changing pattern of Development; A critique of Development Administration

Suggested Readings
1. Arora, R.K.- Comparative Public Administration
2. Chaturvedi, T.N.- Comparative Public Administration
3. Chatterjee, S.K.- Development Administration
4. Sapru, R.K.- Development Administration
5. Riggs, F.W.- The Ecology of Public Administration
6. Sharma, S.K.- Development Administration in India
7. Bhattacharya, Mohit – Bureaucracy & Development Administration

Mapping of COs to Syllabus

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PAPP0004: PUBLIC POLICY
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. CO1: Understand the public policy process (Remembering & Understanding
2. CO2: Understand the Models and Trends of Public Policy in India (Understanding)
3. CO3: Analyze the issues related to Policy formulation; Implementation and evaluation (Analyzing)
4. CO4: Evaluate the public policies in India (Applying)

Module – I (10 hours)
Public Policy: Articulation, significance and approaches; Public Policy Process

Module – II (10 hours)
Public Policy and Globalization; Public Policy process in India; Models and Trends of Public Policy in India

Module – III (10 hours)
Policy formulation; Implementation; evaluation

Module – IV (15 hours)
Environmental Policy in India; Education Policy in India; Public Health Policy in India; MSME Policy of India.

Suggested Readings
5. Madan, K.D. et. al - Public Policy making in Government; Publication Division, Ministry of Information and Broadcasting, New Delhi, 1982
7. Sapru, R.K. - Public Policy Formulation, Implementation and Evaluation; Sterling, New Delhi, 2000

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PAEP0005: ENGAGED POLICY AND GOVERNANCE
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the concept of Participatory Governance (Remembering & Understanding)
2. Understand the Pitfalls in Participatory Governance (Understanding)
3. Analyze the issues related to Community engagement at the Grassroots Level (Analyzing)
4. Evaluate Issues of local Engagement and Participation (Applying)

Module I (10 hours)
Participatory Governance: An Overview; The Rationale of Participation: Concepts and Challenges; New Governance Paradigm: The Emerging Partnerships/Engagement Initiatives

Module II: (10 hours)
Democracy, Social Inclusion and Development: Democracy and Development; Political Regimes, Political Participation and Social Inclusion; Innovations and Pitfalls in Participatory Governance

Module III: (10 hours)
Engaged Governance: Government Transparency in Policy Decisions; Engaging the Community at Grassroots Level; Electronic Platforms for Receiving and Implementing Public Input

Module IV: (15 hours)
Participatory Local Governance: Participatory Governance Toolkits; Measuring Engagement or Participation; Issues in Engagement and Participation; Case Studies a) Kudumbashree in Kerala, India b) Grameen Bank in Bangladesh c) Participatory Budgeting, Brazil d) Watershed Development Programme in Ralegansiddhi, India

Suggested Readings

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PANE0006: NORTH EAST AND PUBLIC ADMINISTRATION (Elective Course - II)

Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES

At the end of this course students are able to:
1. Understand the Colonial Historiography of North East India (Remembering & Understanding)
2. Understand the Constitutional Mechanisms of Integration of North East India (Understanding)
3. Analyze the Developmental Challenges and Issues Associated with North East India (Analyzing)
4. Evaluate the role of International Institutions (Applying)

Module I (10 hours)

Module II (15 hours)
Tribal Development in the Northeast: Constitutional Mechanisms of Integration of North East India: Two Models of Autonomy- Sixth Schedules and States under the Indian Constitution; Constitutional Safeguards and Protective Legislation for Tribals; Concept of Integrated Development and Tribal Sub-Plan; Forest Rights Act, 2006, Tribal Customary Law in Northeast India.

Module III (10 hours)

Module IV (10 hours)
Globalization and North East India: North East India and Neighboring Countries; Borders and Frontiers in a Globalised World; North East India: Look East and Act East Asia Policy; Foreign Investments in the Northeast India and Role of International Institutions; New Scheme by the Government of India for the development of North-Eastern states; present and future role of international institutions.

Suggested Readings
2. APRSO, Nationality Question in India, Hyderabad, Peace Book Centre, 1992.
3. B. Datta Ray, (Ed.), The Emergence and Role of the Middle Class in North East India, Delhi, COSMO, 1983.

### Mapping of COs to Syllabus

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### PAAP0007: ADMINISTRATIVE THEORY AND PRINCIPLES (Core Course)

Credits: -3 (45 lectures) (45 Hours)

#### COURSE OUTCOMES

At the end of this course students are able to:
1. Trace the evolution theories of Public Administration (Remembering & Understanding)
2. Understand the principles of Public Administration (Understanding)
3. Analyze the State of Administrative Theory in 21st Century (Analyzing)
4. Evaluate the theory and practice of public administration (Applying)

#### Module – I (15 hours)

Classical Perspectives: Woodrow Wilson: The Politics Administration-Dichotomy; Scientific Management: Taylor and the Movement; Classical Theory: Fayol, Urwick, Gulick and others; Bureaucratic Theory: Weber and his critics. Human relations perspectives/post-classical theorists: Elton Mayo and others; Mary Parker Follett; Behavioural approach: Chester Barnard, Chris Argyris, Douglas McGregor, Rensis Likert; Organizational development and system approach.

#### Module – II (10 hours)


#### Module-III (10 hours)

Basic Principles: Organization; Hierarchy; Unity of Command; Span of Control; Authority and Responsibility; Coordination; Centralization and Decentralization.

#### Module –IV (10 hours)

Delegation; Supervision; Line and Staff; Accountability and Control: Concept; Legislative Control; Executive Control; Judicial Control; Citizen and Administration; Role of Civil Society; People’s participation; Right to information

#### Suggested Readings

1. Henry, Nicholas - Public Administration And Public Affairs
2. Taylor, Frederick W. - The Principles of Scientific Management
3. Etzioni, Amitai - Modern Organizations
5. Blau, Peter H. - Bureaucracy in Modern Society
7. Dixit Manoj (et. al) - Public Administration
8. Sahni, Pardeep (et al) - Administrative Theory
9. Awasthi & Maheshwari - Public Administration
10. Sharma & Sharma - Public Administration
11. Bhattacharya, M. - New Horizons of Public Administration
12. Bhambri, C.P. - Public Administration

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PAIA0008: INDIAN ADMINISTRATION
Credits: -3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Trace the evolution of Indian Administration (Remembering & Understanding)
2. Understand the Structure & Functions of Public Administration in India (Understanding)
3. Analyze the role of District Administration in 21st Century (Analyzing)
4. Evaluate the Relationship between Police and Public (Applying)

Module – I (10 hours)
Evolution of Indian Administration: Mauryan, Mughal & British Period and British Legacies to Indian Administration.

Module – II (10 hours)
Central Administration: Structure & Functions of Central Secretariat: Cabinet Secretariat, Cabinet Secretary, Prime Minister's Office (PMO)

Module-III (10 hours)
State Administration: Structure & Functions of State Secretariat, Chief Secretary; State Secretariat Vs Directorate; Divisional Administration & The Divisional Commissioner.

Module –IV (15 hours)
District Administration; District Collector: Powers, Functions & Role, Law and Order in DM-SSP & Commissionery System, Relationship between Police and Public.

Suggested Readings
1. Maheshwari, S.R. - Indian Administration
2. Singh, Hoshiar - Indian Administration
3. Arora, R.K. & Goel. Rajni - Indian Public Administration
4. Johari, J.C. - Indian Govt & Politics
5. Maheshwari, S.R. - State Administration
6. Avasthi, A. & Avasthi, A.P. - Indian Administration
7. Fadia, B.L. & Fadia, Kuldeep - Public Administration in India
8. Singh, Hoshiyar and Singh, Mohinder - Public Administration in India
10. Johari, J.C. - The Constitution of India
11. Ramchandran, Padma – Public Administration in India
12. Charabarty, Bidut& Chand, Prakash – Indian Administration

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PAPP0009: PUBLIC PERSONNEL ADMINISTRATION
Credits: -3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Trace meaning, nature, scope and significance of Public Personnel Administration (Remembering & Understanding)
2. Understand the recruitment process in civil services (Understanding)
3. Analyze the Role of Civil services in Developing Countries (Analyzing)
4. Evaluate the issues related to Administrative Ethics and Reforms (Applying)

Module – I (05 hours)
Public personnel administration: meaning, nature, scope and significance

Module – II (10 hours)
Civil Services – Structure, Recruitment and training; Promotion; Pay and service conditions; Position Classification; Public Service Commissions; Union and state.

Module-III (20 hours)
Role of Civil services in Developing Countries. Civil Services-Citizenry Interface: Civil Society and Administration; Technology and Changing Nature of Public Services; Ethics and Accountability

Module – IV (10 hours)
Generalist and Specialist; Minister-Civil servant relationship; Administrative Ethics; Administrative Reforms.

Suggested Readings
1. Yoder, Dale - Personnel Management & Industrial Relations
2. Flippo, Edwin B. - Principles of Personnel management
3. Davar, Rustom S. - Personnel Management & Industrial Relations
6. Stahl, O Glenn - Public Personnel Administration
7. Hays, S.W. & Kearney, R.C. - Public Personnel
8. Goel, S.L. - Public Personnel Administration
9. Sinha, V.M. - Public Personnel Administration
10. P. N. Parashar- History and Problems of Civil Services in India
11. Yogendra Narain- Civil Services: Challenges And Resolutions
12. Abhay Prasad Singh & Krishna Murari - Constitutional Government and Democracy in India
13. S.K. Das - The Civil Services in India
14. Lohit Matani, Vishal - An Introduction to Civil Services
15. S.N. Singh - Politician Civil Servant Relationship and Public Administration in India
16. Sandeep Sharma- Indian Civil Service And Public Administration

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PARM0010: RESEARCH METHODOLOGY
Credits: -3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Trace the role of Research in Theory-building (Remembering & Understanding)
2. Understand the Scientific Methods in Social Science Research (Understanding)
3. Analyze the role Sampling and Sampling Techniques (Analyzing)
4. Evaluate trends of Research in Public Policy and Governance; (Applying)

Module – I (15 hours)
Social Science Research: Meaning, Objectives, Scope and Importance of Social Science Research, Normativity and Objectivity in Social Science Research; Distinction between Method and Methodology; Role of Research in Theory-building; Types of Research: Quantitative Research, Qualitative Research, Applied Research, Basic Research, Problem Oriented and Problem Solving.

Module – II (10 hours)
Scientific Methods in Social Science Research; Problem Formulation and Hypothesis; Identification of Variables, Concepts and Operationalization of Concepts; Hypothesis and Procedure of Hypothesis Testing and Estimation; Data: Sources-Primary and Secondary, Methods of Data Collection.

Module-III (15 hours)
Sampling and Sampling Techniques; Scales of Measurement: Measures of Central Tendency and Dispersion, Mean, Mode
and Median, Standard Deviation, Correlation; Tools of Data Collection: Observation, Questionnaire, Interview Schedules; Processing and Analysis of Data; Research Design and Research Report Writing; Citation Pattern and Bibliography

Module IV (05 hours)
Trends of Research in Public Policy and Governance; Ethics of Research in Public Administration; Use of Computers in Social Science Research.

Suggested Readings

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PAED0011: ENVIRONMENT ADMINISTRATION AND DISASTER MANAGEMENT
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Acquire a conceptual understanding of disasters, their types and management (Understanding)
2. Identifying the strategies, leadership and management skills required for disaster management (Remembering)
3. Analyse the major disasters and their impact in India (Analyse)
4. Review the National legislations on Disaster Management (Assessing)
5. Evaluate Case Studies in India (Evaluation)

Module I (10 hours)

Module II (10 hours)
Agencies for Environmental Administration: Role of UNEP, World Bank; Role of Pollution Control Board, Bio-diversity Authority, State and Local government in Environmental Administration in India 6. Public Participation and Role of NGOs and Judiciary in Environmental Administration

Module III (10 hours)
Human Affairs and Environment: Growth and Control of Human Population, Health and Environment; Rural and Urban Challenges in Environmental Administration (Deforestation, Soil Erosion, Solid Waste Management; Environmental Issues: Global Warming and Climate Change, Sustainable Development, Environmental Protection Versus Development

Module IV (15 hours)
Disaster Management: Meaning, Nature and Types of Disasters; Elements of Disaster Management; Disaster and Environment; Disaster Mitigation (Risk Assessment, Protective measures and Public Information), Disaster preparedness (Disaster Plan, Disaster Forecasting, Warning and prediction): Role of Government and NGOs in Economic and Social Rehabilitation during Disasters (Shelter, Food and medical Supply, Mass Media Coverage, Maintenance of Public Order).

Suggested Readings
3. Vinod Kumar Sharma, Disaster Management, Medtech Publisher, 2019
6. Centre for Science and Environment; Down to Earth, Vol. 10, No. 6, New Delhi; 2001;

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PAOB0012: ORGANIZATIONAL BEHAVIOUR
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the concepts and approaches to organizational behaviour (Remembering & Understanding)
2. Understand the concepts of Attitude, Personality and Motivation (Understanding)
3. Analyze the Stress Management and Organizational Change (Analyzing)
4. Evaluate resistance to Change (Applying)

Module I (10 hours)
Concepts and Approaches: Organisational Behaviour (OB) - Meaning and Concept, Traditional and Modern Approaches to OB; Typologies of Organisation, Genesis, Needs and Goals of OB; Challenges of Organisational Behaviour

Module II (15 hours)
Attitude, Personality and Motivation: Attitude- Concept, Factors in Attitude formation, Attitude and Behaviour; Personality: Concept, Theories and determinants, Personality and Behaviour; Motivation: Concept, Theories, Motivation and Behaviour, Motivational system and Incentives, Quality Work Life (QWL), Job Design and Motivation.

Module III (10 hours)
Stress Management and Organizational Change: Power and Politics - Concept, Significance, Concentration and Types of power, Reasons and Management of Organizational Politics.

Module IV (10 hours)

Suggested Readings

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PABF0013: BUDGET AND FINANCIAL ADMINISTRATION IN INDIA
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the concept and significance of Budget (Remembering & Understanding)
2. Understand the Budget Policy orientation in India (Understanding)
3. Analyze the Budgetary Process in India (Analyzing)
4. Evaluate Central-State Financial Relations (Applying)

**Module – I (10 hours)**
Meaning, nature and scope of Financial Administration; Concept of Budget; Definitions of Budget; Significance of Budget; Types of Budget

**Module – II (10 hours)**
Budget Policy Orientation in India; Major actors in Budgetary Process in India

**Module – III (10 hours)**
Budget system in India; Budgetary Process in India; Financial Management in India;

**Module – IV (15 hours)**
Budget system reforms in India; Financial System reforms in India; Finance Commission; Central-State Financial Relations.

**Suggested Readings**
1. Lall, G.S. - Public Finance & Financial Administration in India
2. Mokherjee, S.S. - Financial Administration in India
3. Chand, Prem - Performance Budgeting
5. Sury, M. M. - Government Budgeting in India
6. Geol, S.L. - Public Financial Administration
7. Thavaraj, M.J.K. - Financial Administration of India
8. Tyagi, B.P. - Public Finance

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**PASW0014: SOCIAL WELFARE ADMINISTRATION**
Credits: 3 (45 lectures) (45 Hours)

**COURSE OUTCOMES**
At the end of this course students are able to:
1. Understand the concept and significance of social welfare administration in India (Remembering & Understanding)
2. Understand the Social Welfare Administration in New Economic Order (Understanding)
3. Analyze the role of various agencies in social welfare administration (Analyzing)
4. Evaluate the role of International Agencies for Social Welfare (Applying)

**Module – I (10 hours)**

**Module – II (10 hours)**
Social Welfare Administration at Union Level:Composition and Functions of Ministry of Social Justice and Empowerment; Ministry of Tribal Affairs; Ministry of Women and Child Development, Ministry of Minority Affairs; CSWB & SSWAB; Social welfare administration at the state level.

**Module – III (15 hours)**
Social Welfare Policies and Programmes for SC/ST, OBCs, Women, Child, Disabled and Aged at Central & State level; Composition and Functions of National Commission: for SC/ST, Women, Other Backward Classes and Minorities; Sub Plan strategies for Welfare of Weaker Section.

**Module – IV (10 hours)**

**Suggested Readings**
1. Mokherjee, Radhakamal - Social Welfare Administration
3. Sachdeva, D.R. - Social Welfare Administration
4. Prasad, R. - Encyclopedia of Social Welfare Administration
5. Shukla, K.S. - Social Welfare Administration in India
6. Chandra, Sushil - Social Work in Uttar Pradesh

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PAEG0015: ENVIRONMENTAL GOVERNANCE
Credits: 3 (45 lectures) (45 hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the concept of Global Environmental Governance (Remembering & Understanding)
2. Understand the Development and Environmental issues in India (Understanding)
3. Analyze the Impact of urbanization on Environment (Analyzing)
4. Evaluate the Urban Environmental Governance in India (Applying)

Module – I (10 hours)
Development – Environment Discourse; Global Environmental Governance

Module – II (15 hours)
Development and Environmental issues in India; Environmental Policy in India; Role of Judiciary in Environmental governance in India; Civil Society and Environmental protection in India

Module-III (10 hours)
Urban Environmental governance and politics in India; Impact of urbanization on Environment and Public Health.

Module –IV (10 hours)
Urban Environmental Governance: Major initiatives; Environmental politics in Urban India; Environmental Protection and Peoples right.

Suggested Readings
1. Ajith Sankar- Environmental Management
2. Bruckmeier, Karl - Global Environmental Governance: Social-Ecological Perspectives
3. Arild Vatn- Environmental Governance: Institutions, Policies and Actions
4. J.P. Evans - Environmental Governance
5. Jean-Frederic Morin, Amandine Orsini- Essential Concepts of Global Environmental Governance
6. Frank Biermann, Philipp H. Pattberg - Global Environmental Governance Reconsidered
7. Prakash Chand Kandpal- Environmental Governance in India: Issues and Challenges
8. Albert Breton- Environmental Governance and Decentralisation

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PACA0016: CITIZENS AND ADMINISTRATION
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the Interaction between Citizens and Administration (Remembering & Understanding)
2. Understand the Preconditions for Citizens-centric Administration (Understanding)
3. Analyze the Mechanism for Redressal of Public Grievances (Analyzing)
4. Evaluate the Changing role of Citizens (Applying)

**Module – I (10 hours)**
Interaction between Citizens and Administration; Citizens’ Perception about Administration

**Module – II (10 hours)**
Preconditions for Citizens-centric Administration; Peoples participation in India

**Module –III (10 hours)**
Administrative Accountability; Mechanism for Redressal of Public Grievances

**Module –IV (15 hours)**
Grievance Redressal Mechanism in India; Governance Discourse and the Changing Role of Citizens.

**Suggested Readings**
1. S. N. Sadasivan - Citizen and Administration
2. Nita Sanghvi - Administration and the Citizen
3. Citizen, Customer, Partner, Engaging the Public in Public Management, by John Clayton Thomas · 2014

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**PADL0017: DECENTRALIZATION AND LOCAL GOVERNANCE**
Credits: 3 (45 lectures) (45 Hours)

**COURSE OUTCOMES**
At the end of this course students are able to:
1. Understand various approaches of decentralization (Remembering & Understanding)
2. Understand the concept of democratic decentralization (Understanding)
3. Analyze the implication of the 73rd and 74th Amendment Acts (Analyzing)
4. Evaluate the role of Peoples participation in Rural and Urban Development (Applying)

**Module – I (10 hours)**
Decentralization: The concept; the significance of decentralization; Approaches to Decentralization

**Module – II (10 hours)**
Types of Decentralization; Democratic decentralization and local governance in India

**Module–III (10 hours)**
Rural local government; Urban local government; Implication of 73rd and 74th Amendment Acts; Critical appraisal

**Module – IV (15 hours)**
Peoples participation in Rural and Urban development; Major Rural and Urban development programmes.

**Suggested Readings**
1. Pranab Bardhan, Dilip Mookherjee - Decentralization and Local Governance in Developing Countries – A Comparative Perspective
2. T. R. Raghunandan - Decentralisation and Local Governments: The Indian Experience
3. Rémi de Bercegol - Small Towns and Decentralisation in India: Urban Local Bodies in the Making
5. Chandan Sengupta, Stuart Corbridge - Democracy, Development and Decentralisation in India: Continuing Debates
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PAEG0018: E-GOVERNANCE
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand Electronic Service Delivery mechanism (Remembering & Understanding)
2. Understand the Models of E-Governance (Understanding)
3. Analyze the Evolution in E-Governance (Analyzing)
4. Evaluate the significance of Technological Infrastructural Preparedness (Applying)

Module – I (10 hours)
Introduction to E-Government and E-Governance: Difference between E-Government and E-Governance; E-Government as Information System; Benefits of E-Government; E-Government Life Cycle; Online Service Delivery and Electronic Service Delivery; Evolution, Scope and Content of E-Governance; Present Global Trends of Growth in E-Governance

Module – II (15 hours)

Module-III (10 hours)
E-Government Infrastructure Development: Network Infrastructure; Computing Infrastructure; Data centres; E-Government Architecture; Interoperability Framework; Cloud Governance; E-readiness; Data System Infrastructure; Legal Infrastructural Preparedness; Institutional Infrastructural Preparedness; Human Infrastructural Preparedness; Technological Infrastructural Preparedness

Module –IV (10 hours)
Case Studies: E-Government Initiatives in USA, UK and India.

Suggested Readings
1. R.P. Sinha - E-governance in India: Initiatives and Issues
2. Prabhu- E-Governance: Concepts and Case Studies
3. Sri Ram Khanna- Digital Drive, E-governance and Internet Services in India: Quality Dimensions
4. Suri, P.K., Sushil - Strategic Planning and Implementation of E-Governance
7. Bhattacharya, J. - E-gov2.0: policies, progress and technologies
9. B. Srinivas - E-Governance Technique

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PAAL0019: ADMINISTRATIVE LAW, ETHICS AND GOVERNANCE
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the fundamentals of Administrative Law (Remembering & Understanding)
2. Understand the Concepts relating to administrative law (Understanding)
3. Analyze the Constitutional values and their relationship with ethics (Analyzing)
4. Evaluate the role of Administrative Tribunals (Applying)

Module – I (10 hours)

Module – II (10 hours)
Concepts relating to administrative law: Rule of Law, Doctrine of Separation of Powers, Principles of Checks and Balances, Doctrine of Ultra-vires; Delegated Legislation, Principles of Natural Justice; Administrative Adjudication, Review of Administrative acts and redress of grievances – Vigilance and Control

Module – III (10 hours)
Governance and Ethics: Ethical foundations of Governance, Codes and Norms of Ethics in India: Public Service and Business Organizations; Constitutional Values and its relationship with ethics; Family, Society, Education and Ethics.

Module – IV (15 hours)

Suggested Readings
5. Boulding Kenneth E (1968), Beyond Economics-- essays in society, religion and ethics, Ann Arbor
14. Sharma, Manoj (2004), Indian administrative law, Anmol Publisher, New Delhi.

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PAIC0020: INDIAN CONSTITUTION
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the evolution of the Indian Constitution (Remembering & Understanding)
2. Understand the Constitutional Philosophy (Understanding)
3. Analyze the structure and functioning of the Union Government (Analyzing)
4. Evaluate the administrative, legislative and judicial functionalities (Applying)

Module – I (10 hours)

Module – II (10 hours)
Module – III (15 hours)
Union Government: President, Prime Minister, Council of Ministers; State Government: Governor, Chief Minister, Council of Ministers, Governor-CM Relations.

Module – IV (10 hours)
Powers and Functions of Union & State legislature, Structure and Functions of Judiciary, Public Interest Litigation, Judicial Activism.

Suggested Readings
1. Arora, R.K. & Goel, Rajni - Indian Public Administration
2. Johari, J.C. - Indian Govt. & Politics
3. Maheshwari, S.R. - State Administration
4. Avasthi, A. & Avasthi, A.P. - Indian Administration
5. Fadia, B.L. & Fadia, Kuldeep - Public Administration in India
6. Singh, Hoshiyar and Singh, Mohinder - Public Administration in India
7. Basu, D.D. Introduction to the Constitution of India
8. Johari, J.C. - The Constitution of India

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PADP6001: DISSERTATION – Phase I
Credits: -6 (90 Hours)
Every student shall undertake a research project work which has bearing on his/her area under the supervision and guidance of a faculty member. The preliminary work may begin in the third semester. The students are expected to complete the Literature Survey and Synopsis before going for data collection. The thesis is to be submitted to the department before the date notified. The mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the 3rd semester. There shall be a viva voce examination on the research project. 6 Credits of this course will be allotted in the 4th semester.

PADP6005: DISSERTATION – Phase II
Credits: -6 (90 Hours)
Every student shall undertake a research project work which has bearing on his/her area under the supervision and guidance of a faculty member. The preliminary work may begin in the third semester. The students are expected to complete the Literature Survey and Synopsis before going for data collection. The thesis is to be submitted to the department before the date notified. The mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the 3rd semester. There shall be a viva voce examination on the research project. 6 Credits of this course will be allotted in the 4th semester.
VALUE ADDED COURSES

PAEP0021: ENVIRONMENTAL POLICY AND ADMINISTRATION
Credits: 3 (45 lectures) (45 hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the Development and Environmental issues in India (Understanding)
2. Understanding the Environmental Policies in India and recent developments (Remembering and understanding)
3. Analyze the Impact of urbanization on Environment (Analyzing)
4. Evaluate the Urban Environmental administration in India (Applying)

Module – I (10 hours)
Development and Environmental issues in India; Environmental Policy in India; Role of Judiciary in Environmental administration in India; Civil Society and Environmental protection in India

Module – II (15 hours)
Development – Environment Discourse; Global Environmental Governance

Module –III (10 hours)
Urban Environmental administration and politics in India; Impact of urbanization on Environment and Public Health.

Module –IV (10 hours)
Urban Environmental administration: Major initiatives; Environmental politics in Urban India; Environmental Protection and People’s right and duties; Steps taken by the government for environmental protection in the recent years.

Suggested Readings
1. Ajith Sankar - Environmental Management
2. Bruckmeier, Karl - Global Environmental Governance: Social-Ecological Perspectives
3. Arild Vatn- Environmental Governance: Institutions, Policies and Actions
4. J.P. Evans - Environmental Governance
5. Jean-Frederic Morin, Amandine Orsini- Essential Concepts of Global Environmental Governance
6. Frank Biermann, Philipp H. Pattberg - Global Environmental Governance Reconsidered
7. Prakash Chand Kandpal- Environmental Governance in India: Issues and Challenges
8. Albert Breton- Environmental Governance and Decentralisation

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PACS0022: CIVIL SERVICE IN INDIA (Value Added Course - I)
Credits: 3 (45 lectures) (45 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the Concept, Significance and Evolution of Civil Services (Remembering & Understanding)
2. Understand the Concept of Bureaucracy and its historical evolution (Understanding)
3. Analyze the Changing Nature of Public Services (Analyzing)
4. Evaluate the Civil Services in the context of Globalisation (Applying)

Module I (10 hours)
Civil Services: Concept, Significance and Evolution of Civil Services; Classification of Civil Services (All India Services, Central Services, State Services and Local Services); Union Public Service Commission and Other Service Commissions

Module II (10 hours)
Bureaucracy: Concept of Bureaucracy – Historical Evolution; Civil Service: Neutrality and Commitment; Relationship between Politicians and Civil Servants

Module III (10 hours)
Public Personnel Administration: Recruitment; Methods and Significance; Training of Public Servants in India- Promotion System in India; Disciplinary Procedure for Civil Servants

**Module IV (10 hours)**
Civil Services-Citizens Interface: Civil Society and Administration; Technology and Changing Nature of Public Services; Ethics and Accountability

**Module V (05 hours)**
Indian Civil Services: Major Issues - Generalists and Specialists Controversy, Civil Services in the context of Globalisation, Civil Service Reforms- Ind ARC Recommendation

**Suggested Readings**
1. P. N. Parashar- History and Problems of Civil Services in India
2. Yogendra Narain- Civil Services: Challenges And Resolutions
3. Abhay Prasad Singh & Krishna Murari - Constitutional Government and Democracy in India
4. S.K. Das - The Civil Services in India
5. Lohit Matani, Vishal - An Introduction to Civil Services
6. S.N. Singh - Politician Civil Servant Relationship and Public Administration in India
7. Sandeep Sharma- Indian Civil Service And Public Administration

**Mapping of COs to Syllabus**

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**PAIG0023: INNOVATION IN GOVERNANCE (Value Added Course - II)**
Credits: 3 (45 lectures) (45 Hours)

**COURSE OUTCOMES**
At the end of this course students are able to:
1. Understand the Institutional Framework for Promoting Innovations (Remembering & Understanding)
2. Understand the Methodological Approach for studying best Practices (Understanding)
3. Analyze the Innovations in Public Services (Analyzing)
4. Evaluate the role of citizen’s participation in governmental innovations (Applying)

**Module – I (10 hours)**
Innovations in Governance: Meaning of innovation in governance; Perspectives and Challenges; Characteristics and Patterns of Innovations; Institutional Framework for Promoting Innovations; Public Governance and Innovations: Administrative Reform to Innovation Discourse

**Module – II (10 hours)**
Understanding Innovations: Innovation for Achieving a Quality of Life, Methodological Approach for studying best Practices, Capacities for Innovation and Best Practices

**Module – III (10 hours)**
Innovations in Public Services: Recent trends; Innovation Capacity in Organizations; Leadership and Innovation; Innovations in different sectors: General Administration, Urban Administration, Health Administration, Private Sector, Agriculture, etc

**Module – IV (10 hours)**

**Module – V (05 hours)**
Issue Areas: Originality and Replication of Innovations; Innovation with or Without Improvement; Citizen Participation in Government Innovations; Research in Innovative Governance

**Suggested Readings**

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PASL0200: SERVICE LEARNING
Course Code: Credits: 2 (30 lectures) (60 Hours)

**COURSE OUTCOMES**
At the end of this course students are able to:
1. Learn the concept of service learning and community engagement. (Remembering)
2. Understand the importance of service learning and community engagement for developing the skills of addressing real life issues in one’s own community. (Understanding)
3. Develop an understanding of the importance of communication skills in interacting with community members. (Understanding)
4. Be exposed to and empathize with people who are less fortunate than they are, politically, economically, socially, academically etc. (Applying)
5. Organize awareness programmes, rallies, campaigns, social service etc. (Analysing)
6. Develop the skills of problem solving and reflective thinking. (Analysing)
7. Realize one’s potentiality to make a difference in the life of their community members. (Evaluating)
8. Understand and experience various political and administrative issues that exist in the Society. (Evaluating)

**Module I: Introduction to Service learning (10 hours)**
Nature, Objectives, Historical Overview, Models, Qualities, Role of Higher Education Institutions (HEIs), Benefits, Challenges and Opportunities of Service Learning.

**Module II: Social Responsibilities of HEIs (10 hours)**
Understanding Social Responsibilities of HEIs, Community-University Engagement, Engaged Teaching, Research and Service, Principles for Community Engagement, Forms of Community Engagement, Community Based Participatory Research.

**Module III: Understanding Rural Society (20 hours)**
Rural Life Style, Rural Society, Rural Economy and Livelihood, Rural Institutions (Traditional Rural Organisations, Self-Help Groups, Panchayati Raj Institutions), Rural Development Programmes (Sarva Siksha Abhiyan, Beti Bachao Beti Padhao, Swatchh Bharat, Ayushman Bharat, MNREGA etc.).

**Module IV: Practices for Service learning and Community (10 hours)**
Internship, Community Mobilization, Awareness/Advocacy campaign, community meetings, rural reporting, case studies.

**Suggested Readings**


Mapping of COs to Syllabus

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BA PUBLIC ADMINISTRATION (HONOURS) - DETAILED SYLLABUS

PAIP0101: INTRODUCTION TO PUBLIC ADMINISTRATION
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))
Theory- 75 lectures (75 Hours)

Course Outcomes
At the end of this course students will be able to:
1. Acquire in-depth knowledge of Public Administration as a theoretical discipline (Knowledge).
2. Understand the approaches of Public Administration as evolved over the years (Understanding).
3. Apply the basic principles and approaches of Public Administration (Applying).
4. Analyse the basic concepts and dynamics of Public Administration (Analysing).
5. Evaluate growth and trends in Public Administration, organization and their principles (Evaluating).

Module – I (15 hours)

Module – II (20 hours)
Growth and Trends in Public Administration: New Public Administration (NPA), New Public Management (NPM), Globalization and Public Administration, Paradigm Shift from Government to Governance, New Public Service (NPS), Feminist Perspectives.

Module – III (20 hours)

Module - IV (20 hours)
Chief Executive, Leadership and Accountability: Chief Executive: Meaning, Types, Functions and Role; Line, Staff and Auxiliary Agencies; Headquarter and Field relationships; Decision Making; Communication; Leadership; Accountability

Suggested Readings

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PAAD0102: ADMINISTRATIVE THEORY
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))
Theory- 75 lectures (75 Hours)

Course Outcomes
At the end of this course students will be able to:

1. Acquire in-depth knowledge of the administrative theories (Knowledge).
2. Understand the different phases in the development of the theoretical constructs of Public Administration (Understanding).
3. Apply the philosophy and principles of Public Administration expounded by various thinkers (Applying).
4. Differentiate and analyse the classical theories with the modern/contemporary theories of Public Administration (Analysing).
5. Evaluate the significance and applicability of the different theories (Evaluating).
6. Evaluate the different phases in the development of the theoretical constructs of Public Administration (Evaluating).

Module - I (20 hours)
Indian and Classical Theories: Kautilya; Scientific management (Taylor and his associates); Bureaucratic theory of organization (Weber); Administrative management theory (Henry Fayol, Luther Gulick and others).

Module – II (20 hours)
Human Relations and Behavioural Theories: Human Relations theory (Elton Mayo and his Colleagues); Behavioral theory (Chester Barnard and Herbert Simon)

Module – III (20 hours)
Administrative Behaviour Theories: Leadership; Communication; and Motivation (Maslow and Herzberg)

Module – IV (15 hours)
Modern Administrative Theories: Minnowbrook Prespectiv; New Public Service; and Post Modernism

Suggested Readings

Mapping of COs to Syllabus

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PAIA0103: INDIAN ADMINISTRATION
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))
Theory- 75 lectures (75 Hours)

Course Outcomes
At the end of this course students are able to:

1. Acquire in depth knowledge about the Indian Administration (Knowledge).
2. Understand the constitutional framework of the Indian Administration (Understanding).
3. Apply the acquired knowledge and understanding about the Indian Administration for citizen-state interface (Applying).
4. Analyse the constitutional provisions and dynamics of the union-state relationship (Analysing)
5. Evaluate the in-built control mechanisms over constitutional bodies in particular and administration in general (Evaluating).

Module- I (20 hours)
Evolution & Constitutional Framework: Evolution of Indian Administration during Ancient, Medieval and British period; Constitutional Framework of Indian Administration; and Salient Features of Indian Administration

854|ADBU| Regulations and Syllabus|2022-23
Module – II (15 hours)
Union Government: President; Prime Minister & Council of Ministers; Central Secretariat, Cabinet Secretariat, Cabinet Committees, Prime Minister Office; Ministry of Home Affairs and Finance Ministry.

Module – III (20 hours)
Constitutional Institutions, Union State Relations & Control over Administration: Election Commission of India; Union Public Service Commission; Union State Relations (Legislative, Executive and Financial); Parliamentary, Executive and Judicial Control over Administration

Module - IV (20 hours)
Citizen and State Interface: Citizens’ Grievances Redressal Institutions and Mechanisms; Institutional Mechanism for Prevention of Corruption: Central Vigilance Commission; Lok Pal and Lok Ayukta; Politician and Civil Servant relationship.

Suggested Readings

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PAPP0104: PUBLIC POLICY AND GOVERNANCE
(Credits: Theory-5, Tutorial: 1 (5+1=6 Credit))
Theory- 75 lectures (75 Hours)

Course Outcomes
At the end of this course students are able to:
1. Acquire in depth knowledge about the Public Policy Process (Knowledge).
2. Understand various approaches and models of Policy formulation, implementation, education and evaluation (Understanding).
3. Apply the acquired knowledge and understanding in analysing contemporary policies and governance (Applying).
4. Analyse the role of different stake holders involved in the Policy Process (Analysing)
5. Evaluate the public policy process in different countries (Evaluating).

Module - I (20 hours)

Module – II (15 hours)
Concepts and Theories of Governance: Governance as per the World Bank, UNDP and others; Public Choice Theory, Public Value Theory; Governance as Theory, Governance and Public Governance; Role of State, Market and Civil Society in Governance.

Module -III (20 hours)
Role of Various stakeholders in Public Policy formulation: Role of Legislature, Executive, Judiciary, Planning Machinery at the Central, State and local levels. Role of other Stakeholders in Policy-formulation: Political Parties, Interest Groups, Mass
Media.

**Module - IV (20 hours)**

**Suggested Reading**
5. Madan, K.D. et. al - Public Policy making in Government; Publication Division, Ministry of Information and Broadcasting, New Delhi, 1982
7. Sapru, R.K. - Public Policy Formulation, Implementation and Evaluation; Sterling, New Delhi, 2000

**Mapping of COs to Syllabus**

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**PAPU0105: PUBLIC PERSONNEL ADMINISTRATION**
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))
Theory- 75 lectures (75 Hours)

**Course Outcomes**
At the end of this course students are able to:
1. Acquire conceptual clarity about the Public Personnel Administration, its issues, career system and other aspects. (Knowledge)
2. Understand the public personnel system of the Indian Republic. (Understanding)
3. Analyse the issues and processes of the Administrative Reforms. (Applying)
4. Analyse various mechanisms and their role in Public Personnel Administration (Analysing)
5. Evaluate the role of employee associations and other adjudication institutions. (Evaluating)

**Module - I (15 hours)**

**Module - II (15 hours)**
Civil Service System: Career Systems – Concepts and types; Classification – Concepts and types; Recruitment; Training; Salary; Code of Conduct

**Module - III (20 hours)**
Public Personnel system in India-I: Constitutional Provisions; Classification; Recruitment; Recruitment agencies at the Union and State levels; Training; Salary Administration; Performance Appraisal and Promotion mechanism.

**Module - IV (25 hours)**
Public Personnel system in India-II: Code of Conduct for All India, Central Services and State Civil Services; Disciplinary Action; Employer-Employees Relations-Right to Form Association, Joint-Consultative Council; Central Administrative Tribunal; Recent Civil Service Reforms

**Suggested Readings**
2. Sharma M. K., Personnel Administration, Anmol Publications Pvt Ltd

Mapping of COs to Syllabus

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PARL0106: RURAL LOCAL GOVERNANCE
(Credits: Theory-5, Tutorial-1 (5+1=6 Credit))
Theory- 75 lectures (75 Hours)

Course Outcomes
At the end of this course students are able to:
1. Acquire knowledge about the Institutional Framework for PRIs in India. (Knowledge)
2. Understand the evolution and growth of rural local governance with special reference to Panchayati raj institutions in India. (Understanding)
3. Analyse the need and significance of decentralization. (Applying)
4. Analyse the significance of people's participation at the PRI's level. (Analysing)
5. Evaluate the role and relationships of rural local democratic decentralized institutions (PRIs) with other institutions. (Evaluating)

Module - I (25 hours)
Introduction: Rural local governance- meaning and significance; Evolution and Growth of rural local governance in India focusing on constitutional provisions, community development programs and committees and commissions on Panchayati raj constituted by the Government of India.

Module - II (25 hours)
Panchayati Raj Institutions: 73rd Constitutional Amendment Act, 1992; Gram Sabha – composition, functions and role; Gram Panchayat – composition, functions and role; Panchayat Samiti – composition, functions and role; and Zila Parishad – composition, functions and role.

Module - III (15 hours)
Institutional Framework for PRIs: District Rural Development Agency; District Planning Committee; State Election Commission; State Finance Commission.

Module-IV (10 hours)
Issues: Panchayati Raj Finance; Devolution of powers, functions and Activity Mapping; Panchayati Raj Bureaucracy in Rural Development.

Suggested Readings

Mapping of COs to Syllabus
COURSE OUTCOMES
At the end of this course students are able to:
1. Acquire a theoretical understanding of administrative process of regulation and regulatory governance (Knowledge and Understanding)
2. Describe key concepts and knowledge relating to regulation, regulatory governance and independent regulatory commissions. (Remembering)
3. Analyse the concepts of transparency and inhibiting factors and their remedies of regulatory governance in Indian context (Analyse)
4. Assess the mechanisms and efficacy of regulators in various leading sectors (Evaluate)
5. Evaluate the role and functions of the regulatory bodies and commissions in India (Evaluate)

Module – I (15 hours)
Introduction: Regulation – concept, rationale and theories; Regulatory Governance – Concept, significance and limitations; and Independent Regulatory Commission – concept and rationale

Module - II (20 hours)
Issues in Regulatory Administration: Independence of regulator; Transparency and accountability of regulator; Failures or inhibiting factors in regulatory Administration and their remedies

Module - III (20 hours)
Sectoral Regulation: Telecom – Telecom Regulatory Authority of India (TRAI) - structure, functions and role; Insurance – Insurance Regulatory and Development Authority of India (IRDAI) - structure, functions and role; and Electricity – Central Electricity Regulatory Commission (CERC) - structure, functions and role

Module - IV (20 hours)
Sectoral Regulation: Higher Education: University Grants Commission (UGC) – composition, functions and role; Food Safety – Food Standards and Safety Authority of India (FSSAI) - structure, functions and role; and Environment – Central Pollution Control Board (CPCB) - composition, functions and role

Suggested Readings
5. OECD (2014) Regulatory Enforcement and Inspection: OECD Best Practice Principles for Regulatory Policy. OECD Publishing:
7. The World Bank Group (2010) Regulatory Governance in Developing Countries,
8. OECD (2011) Regulatory Policy and Governance: Supporting Economic Growth and Serving the Public Interest

Web Resources:
1. www.trai.gov.in
2. www.irdai.gov.in
3. www.cpcb.nic.in

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PASA0108: SOCIAL AUDIT
(Credits: 2) Theory-30 lectures (30 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Acquire conceptual and theoretical understanding of social audit. (Knowledge and Understanding)
2. Acquire appropriate skills to conduct social audits independently. (Applying)
3. Assimilating social audit process. (Analyse)
4. Assess the mechanisms and efficacy of regulators in various leading sectors (Evaluate)
5. Writing a social audit report. (Evaluate)

Module – I (15 hours)
Conceptual Constructs: Meaning, objectives, principles, types, process, advantages and disadvantages; Social Audit Rules 2011; Ecology of social audit; Impediments of Social Audit.

Module – II (15 hours)
Application of Social Audit: Tools and modes of social audit; Training module; Case Studies – national and international – for instance Dungarpur, Rajasthan; Ananatpur, Andhra Pradesh and likewise from other countries; Project Report (maximum 20 pages)

Suggested Readings

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PAEG0109: E-GOVERNANCE
(Credits: Theory-2) Theory-30 lectures (30 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Acquire theoretical understanding about the concept, theory and models of governance (Knowledge)
2. Understand practical application of e-governance (Understanding)
3. Understand various e-governance initiatives undertaken to deliver Public services to the stakeholders (Remembering)
4. Developing necessary skills to use and operate e-governance or digital service delivery (Applying)
5. Analyse the E-governance framework in India. (Evaluating)

Module - I (15 hours)
Concepts and Initiatives: Meaning, Definitions, Scope (Including stages and types of interactions in e-Governance) and Significance of e-Governance, Theories of e-Governance (Six perspectives and six theories). Models of e-Governance (The General Information Dissemination Model, the Critical Information Dissemination Model, the Advocacy Model, the Interactive Model). Growth of e-Governance initiatives in India, Pre-National e-Governance Plan and Post NeGP (NeGP 2006). e-Governance Initiatives in the area of Government to Citizens (G2C), Government to Business (G2B) and Government to Government G2G).
Module - II (15 hours)
Legal Framework, Issues & Challenges for e-Governance: I T Act – 2001 (ICT Act and important features of the Act); Information and Cyber Security. e-Readiness; Digital Divide (Gender, Geographic, Economic, Social and Political); Challenges; Resistance to Change, Capacity Building, Adaptation of Technology and Administrative Reforms.

Suggested Readings

Mapping of COs to Syllabus

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PACP0110: COMPARATIVE PUBLIC ADMINISTRATION
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit)
Theory-75 lectures (75 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Be equipped with the knowledge and conceptual clarity of approaches, indices, and models of comparative Public Administration. (Knowledge)
2. Gain clarity regarding administrative systems and accountability mechanisms of UK, USA and France. (Understanding)
3. Analyse the local governmental system, grievance redressal mechanisms and relevance of comparative approach in globalized perspective. (Analysis)
4. Evaluate the relevance of Comparative Public Administration in the era of Liberalization, Privatization and Globalization. (Evaluating)
5. Evaluate the application of the grievance redressal mechanisms. (Applying)

Module - I (15 hours)
Introduction: Comparative Public Administration: Meaning, Nature, Scope and Significance. Salient Features of Administration in Developed & Developing Countries: Social, Economic, Political and Administrative

Module - II (15 hours)
Approaches: Structural Functional Approach; Behavioural Approach; and Ecological Approach

Module - III (20 hours)
Administrative Systems & Accountability: Salient features of Administration in UK, USA, Japan. Chief Executive of UK, USA, Japan. Accountability: Control Machinery of UK, USA, Japan

Module - IV (25 hours)
Local government of UK, USA, Japan. Grievance Redressal Machinery of UK, USA, Japan. Relevance of Comparative Public Administration in the era of Liberalization, Privatization and Globalization

Suggested Readings

860|ADBU| Regulations and Syllabus|2022-23

Mapping of COs to Syllabus

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PAPF0111: PUBLIC FINANCIAL ADMINISTRATION
(Credits: Theory-5, Tutorial-1 (5+1=6 Credit))
Theory-75 lectures (75 hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Acquire knowledge of various aspects of Public Financial Administration in general and in the Indian context in particular (Knowledge)
2. Understanding public budgeting and financial resource mobilization strategies in the Indian context (Understanding)
3. Identify the system and dynamics of Indian fiscal federalism (Remembering)
4. Describe the functions and relations of financial institutions (Applying)
5. Illustrate the role of the Comptroller and Auditor General in Public Financial Administration (Evaluating)
6. Evaluate the Legislative control over finances with special reference to Parliamentary Committees (Evaluating)

Module - I (15 hours)

Module -- II (20 hours)
Budgetary systems: Concept and Types of Budgets: Traditional Budgeting; Performance Budgeting; and Zero-Base Budgeting. Budget Preparation, Authorisation and Execution with special reference to India

Module - III (20 hours)

Module - IV (20 hours)

Suggested Readings

Mapping of COs to Syllabus

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PAUL0112: URBAN LOCAL GOVERNANCE (Core Course)
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))
Theory-75 lectures (75 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Identify the composition, role, functions and resources of urban local governance (Remembering)
2. Describe the evolution and growth of urban local bodies in India (Remembering)
3. Analyse the relevance of the 74th Constitutional Amendment (Analyse)
4. Assess the understanding of the historical contexts in reading the literary texts. (Applying)
5. Evaluate development programmes of the State (Evaluate)

Module – I (10 hours)
Introduction: Evolution of Local Governance in India. Urbanization: Concept; Trends; Challenges

Module – II (25 hours)
Organizational Framework for Urban Governance: 74th Constitutional Amendment Act; Structure, Composition and Functions of Metropolitan Committees, Municipal Corporations, Municipal Councils and Nagar Panchayats; State Finance Commission; State Election Commission

Module - III (25 hours)
Urban Development Programmes and Urban Governance: Urban Development Programmes like AMRUT, NUHM etc.; SMART cities and other recent trends; Sources of Finance of Urban Local Government; Personnel Administration; Bureaucracy and Local Governance

Module – IV (15 hours)
Issue Areas in Urban Governance: State-Local relations; Rural-Urban relations; Globalization and Urban governance; Administrative Reforms in Local Governance

Suggested Readings

Mapping of COs to Syllabus

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PAEP0113: ENVIRONMENTAL POLICY AND ADMINISTRATION
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))
Theory-75 lectures (75 hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the concepts of environment, natural resources, biodiversity and Conservation and Management of waste (Knowledge)
2. Understand the environment from scientific, economic, political and institutional perspectives (Understanding)
3. Analysing Indian Environment policies (Analyzing)
4. Evaluate the attainment of Sustainable Development Goals (Evaluating)
5. Compare and evaluate case studies on environmental policies from a global perspective (Evaluating)
Module – I (20 hours)

Module - II (15 hours)
Environment Policies and Evaluation: National Environment Policy, 2006; Environmental Impact Assessment; and Impact Prediction, Evaluation and Mitigation

Module - III (15 hours)
Environmental Administration: Ministry of Environment; Central Pollution Control Board – Structure, Functions and Role; State Pollution Control Board – Structure, Functions and Role; National Green Tribunal

Module - IV (25 hours)

Suggested Readings

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PAME0114: MONITORING AND EVALUATION OF DEVELOPMENT PROGRAMMES
(Credits: Theory-2)
Theory-30 lectures (30 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Acquire a theoretical understanding of the monitoring and evaluation process of governmental development programs (Understanding)
2. Acquired technical and managerial competencies to monitor performance and evaluate efficiency (Develop skills and Competencies)
3. Assess effectiveness, relevance and sustainability of development programs and projects (Evaluating)
4. Apply various management tools and techniques for effective project monitoring, control and reporting (Applying)

Module - I (20 hours)

Module – II (10 hours)
Case Studies: Ministry of Human Resource Development; Ministry of Health & Family Welfare; Ministry of Rural Development; Ministry of Urban Development. Big Data and Integration of Big Data with the Monitoring & Evaluation process.
Suggested Readings

Mapping of COs to Syllabus

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PAAE0115: ADMINISTRATIVE ETHICS AND GOVERNANCE
(Credits: Theory-5, Tutorial-1 (5+1=6 Credit)
Theory-75 lectures (75 hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Understand the philosophy of ethics with special reference to ethics in Public life and accountability of Public services. (Knowledge and Understanding)
2. Understand the concepts of Dharma, Freedom, Equality and Fraternity (Remembering)
3. Relate practices of Satyagraha and truth in the present context (Understanding & Analysing)
4. Applying ethical principles in addressing issues of inequalities (Applying)
5. Create logical and effective communication on ethics and governance (Creating)
6. Evaluating institutions like Lokpal and Lokayuktah through case studies (Evaluation)

Module - I (25 hours)
Introduction: Ethics – concept and significance; Key concepts – Right, Duty, Freedom, Equality, Fraternity, Karma, Purusharthas, and Dharma. Contribution of Kautilya: Character Building, Measures to tackle Corruption; Contribution of Mahatma Gandhi – Satyagraha and Truth. Contribution of Western Administrative Thinkers to Ethics with special reference to Socrates (Moral Theory) and Immanuel Kant (Deontological Theory)

Module - II (15 hours)
Applied Ethics: Issues of Inequality, Abortion, Foeticide, Suicide, Environment Degradation, Capital Punishment; and Nature of Moral Dilemmas

Module - III (15 hours)
Ethics in Public Life: Civil Service Neutrality and Anonymity; Significance of Ethical and Moral Values in Governance. Code of Ethics and Code of Conduct for Civil Services in India

Module - IV (20 hours)
Probity in Governance: Corruption – Causes, Remedies; Institutional Arrangements for fighting Corruption in India: CVC, CBI, Lokpal and Lokayuktah

Suggested Readings

Mapping of COs to Syllabus

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PARM0116: RESEARCH METHODOLOGY
(Credits: Theory-5, Tutorial-1 (5+1=6 Credit))
Theory-75 lectures (75 hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Develop an intellectual understanding of the fundamental knowledge of research methodology. (Knowledge)
2. Comprehend the research process in an appropriate manner (Understanding)
3. Inculcation of the necessary skills to use research tools to undertake research study (Understanding)
4. Evaluate governmental policy or programme/projects on the basis of primary and secondary data (Evaluating)
5. Analyse the issues and challenges of research in Public Administration. (Analysing)

Module - I (20 hours)
Foundations of Public Administration Research: Key concepts in research methods; Types of research; Research process – Defining research problem, steps of research and application of research methods in Public Administration; Hypothesis; Current trends in research

Module – II (15 hours)
Research Design: Concept and importance; Types of research designs; Application of various types of research designs in Public Administration; Problems of research design

Module – III (20 hours)
Scientific Method, Measurement and Sampling Techniques: Concept of scientific method; Measurement and scaling concept; Basics of sampling and types of sampling

Module – IV (20 hours)
Data Collection, Processing and Analysis: SSRT-Observation method, Questionnaire, Interview; Case Study method; Secondary data analysis; Data preparation, Analysis and Report writing.

Suggested Readings

Mapping of COs to Syllabus

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PAHA0117: HEALTH ADMINISTRATION
(Credits: Theory-5, Tutorial-1 (5+1=6 Credit))
Theory-75 lectures (75 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Identify the concepts and theoretical constructs of health and health care policies. (Remembering)
2. Understanding the various governmental programs and institutions/organizations at national and international levels (Remembering)
3. Assess the challenges in implementing health policies by the Administration (Evaluation)
4. Analyse the framework of health administration in India (Analysis)
5. Evaluate acceptability and accessibility of health care schemes at community levels (Evaluation)
Module – I (20 hours)
Introduction: Public Health Administration – Nature, Significance and Scope; Sustainable Development Goals (SDGs) and Public Health; World Health Organization (WHO) – structure, functions and role in Asia

Module – II (20 hours)
Institutional Framework of Health Administration at national level: Union Ministry of Health and Family Welfare – organization, functions and role; Healthcare Programmes in India – Family Welfare Programme; Reproductive Child Healthcare; Immunization Programme; National Health Mission (NHM)

Module – III (20 hours)
Institutional Framework of Health Administration at state level: Organization, functions and role of the Department of Health; Health Programmes at state level; Administration of Primary Healthcare at the local level

Module – IV (15 hours)
Other Healthcare Institutions: National Institute of Health and Family Welfare – structure, functions and role; Medical Council of India – structure, functions and role; Challenges of Public Health Administration

Suggested Readings
4. Bergerhoff, Petra; Lemann,Dieter; Novak, P (Eds.)(1990) Primary Health Care: Public Involvement, Family Medicine, Epidemiology and Health Economics. Springer-Verlag: Berlin and Heidelberg.

Mapping of COs to Syllabus

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PAAL0118: ADMINISTRATIVE LAW
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))
Theory-75 lectures (75 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Developing an understanding of principles of natural justice, rule of law, administrative legislation, and adjudication (Understanding)
2. Distinguishing between constitutional law, administrative law and droit administratif (Understanding and Analysis)
3. Analyse the merits and demerits of administrative tribunals and especially Central Administrative Tribunals (Analysis)
4. Trace the evolution, growth and concept of ombudsman, lokpal and lokayukta and central vigilance commission (Evaluating)
5. Assessing the role and functions of institutions of Ombudsman in delivering justice (Evaluating)

Module - I (15 hours)

Module - II (15 hours)
Basics Tools: Rule of Law; Principles of Natural Justice; Judicial Review of Administrative Action - concept and writs

Module - III (20 hours)
Delegated Legislation and Adjudication: Delegated Legislation- concept, rationale, merits and demerits; Administrative Tribunals-concept, merits and demerits; and Central Administrative Tribunal: structure and functions

Module - IV (25 hours)
Ombudsman: Institution of Ombudsman: concept and genesis; Central Vigilance Commission: structure, functions, role and significance; and Lok Pal and LokAyukta in India—composition, powers, functions and significance.

Suggested Readings

Mapping of COs to Syllabus

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PACR0119: CULTURAL RESPONSIVENESS IN PUBLIC ADMINISTRATION
(Credits: Theory-5, Tutorial-1 (5+1=6 Credit))
Theory-75 lectures (75 Hours)

COURSE OUTCOMES
On completion of this course, students may be able to:
1. Understand and explain the concept of responsiveness (Knowledge)
2. Understand and describe the important mechanisms of bringing about responsiveness in public systems management (Understanding)
3. Analyse the relationship between responsiveness and accountability (Analysis)
4. Evaluate the significance of public-private partnerships towards improving responsiveness in public systems management. (Evaluation)

Module – I (10 hours)
Responsiveness: Concept, influencing factors

Module – II (30 hours)
Responsiveness Mechanisms: Citizen Monitoring; Setting Standards; Incentives and Performance Measurement; Organizational Culture Ethos; Transparency; Information Access; New Rights for Citizens

Module – III (20 hours)
Accountability and Responsiveness

Module – IV (15 hours)
Public - Private Partnership

Suggested Readings

Mapping of COs to Syllabus

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PACG0120: CITIZEN CENTRIC GOVERNANCE
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))
Theory-75 lectures (75 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Identify the concepts and theoretical constructs of Citizen Centric Administration. (Remembering)
2. Understand the functioning of governmental regulatory and service providing (Remembering)
3. Assess the challenges of Citizen’s participation in Administration (Evaluation)
4. Analyse the Machineries of Public Grievance Redressal (Analysis)
5. Review acceptability and accessibility of citizens at the governance levels (Reviewing)

Module – I (15 hours)

Module – II (20 hours)
Accountability: Concept of Accountability, Accountability of Administration and Citizen, Administration and Judiciary-Judicial Activism and Public-Interest Litigation (PIL)

Module – III (20 hours)
Citizen Charters: Evolution, features and Applications. Citizen’s participation in Administration: Concept, Agencies, Significance and Limitations

Module – IV (20 hours)

Suggested Readings
6. Website: www.permin.nic.in, (Ministry of Personal and Public Grievances, Govt. of India)

Mapping of COs to Syllabus

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PADA0121: DEVELOPMENT ADMINISTRATION
COURSE OUTCOMES
At the end of this course students are able to:

1. Develop a basic intellectual understanding of development, its approaches and sustainable development (Understanding)
2. Identify the concepts of Development Administration including the ecological and post-globalization contexts (Remembering)
3. Gaining familiarity with issues/new perspectives such as Public Private Partnership, Corporate Social Responsibility, Inclusive Development, Sustainable Development Goals and Human Development Indicators (Knowledge and remembering)
4. Assessing role of bureaucracy in Development Administration (Analysing)
5. Identify the Sustainable Development Goals and evaluate any one from a global perspective (Evaluating)

Module - I (20 hours)
Introduction: Development and its dimensions; Development and Modernization; Approaches to Development; Ecology of Development Administration; Sustainable Development and Anti-Development

Module - II (20 hours)
Conceptual Constructs: Development Administration – concept, nature, scope and objectives; Features and Significance of Development Administration; Contribution of Ralph Braibanti, Edward Weidner, Fred W. Riggs and Dwight Waldo

Module - III (15 hours)
Issues: Globalization and Development Administration; Emergence of Non-State Actors in Development Administration; Gender Parity in Development; Role of Bureaucracy in Development

Module – IV (20 hours)
New Perspectives of Development: Public Private Partnership; Corporate Social Responsibility; Inclusive Development; Sustainable Development Goals (SDGs); Human Development Indicators and Social Audit

Suggested Readings

Mapping of COs to Syllabus

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PAEG0122: ADMINISTRATIVE ETHICS IN GOVERNANCE
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))
Theory-75 lectures (75 Hours)

COURSE OUTCOMES
At the end of this course students are able to:

1. Understand the philosophy of ethics with special reference to ethics in Public life and accountability of Public services. (Knowledge and Understanding)
2. Understand the concepts of Dharma, Freedom, Equality and Fraternity (Remembering)
3. Relate practices of Satyagraha and truth in the present context (Understanding & Analysing)
4. Applying ethical principles in addressing issues of inequalities (Applying)
5. Create logical and effective communication on ethics and governance (Creating)
6. Evaluating institutions like Lokpal and Lokayuktah through case studies (Evaluation)
Module - I (25 hours)
Introduction: Ethics – concept and significance; Key concepts – Right, Duty, Freedom, Equality, Fraternity, Karma, Purusharthas, and Dharma. Contribution of Kautilya: Character Building, Measures to tackle Corruption; Contribution of Mahatma Gandhi – Satyagraha and Truth. Contribution of Western Administrative Thinkers to Ethics with special reference to Socrates (Moral Theory) and Immanuel Kant (Deontological Theory)

Module - II (15 hours)
Applied Ethics: Issues of Inequality, Abortion, Foeticide, Suicide, Environment Degradation, Capital Punishment; and Nature of Moral Dilemmas

Module - III (20 hours)
Ethics in Public Life: Civil Service Neutrality and Anonymity; Significance of Ethical and Moral Values in Governance. Code of Ethics and Code of Conduct for Civil Services in India

Module - IV (15 hours)
Probity in Governance: Corruption – Causes, Remedies; Institutional Arrangements for fighting Corruption in India: CVC, CBI, Lokpal and Lokayuktah

Suggested Readings

Mapping of COs to Syllabus

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PADM0123: DISASTER MANAGEMENT
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))
Theory-75 lectures (75 Hours)

COURSE OUTCOMES
At the end of this course students are able to:
1. Acquire a conceptual understanding of disasters, their types and management (Understanding)
2. Identify the strategies, leadership and management skills required for disaster management (Remembering)
3. Analyse the major disasters and its impact in India (Analyse)
4. Review the National legislations on Disaster Management (Assessing)
5. Evaluate Case Studies in India (Evaluation)

Module - I (15 hours)
Conceptual constructs: Disaster – concept and dimensions; Natural Disasters – Earthquakes, Volcanic Eruptions, Floods, Cyclones; Climate Change; Man-made Disasters – Anthropogenic, Soil Degradation, Desertification and Deforestation

Module - II (25 hours)
Disaster Management in India: Organisational Framework for Disaster Administration in India at the Union, State and Local levels (including Nodal Agency, National Disaster Management Authority, State Authority) as per the Disaster Management Act, 2005; National Policy on Disaster Management, 2009; Disaster Profile of India – Mega Disasters of India and Lessons Learnt; Case Studies: Tsunami 2005 and Kedarnath Floods 2013

Module -III (20 hours)
Application of Science and Technology for Disaster Management: Role of Geoinformatics/ Information and Communication Technology Systems in Disaster Management (Remote Sensing, GIS and GPS); Disaster Communication System (Early
Warning and its Dissemination); Land Use Planning and Development Regulation

**Module - IV (15 hours)**
Disaster Risk Reduction – Sustainable Development, Inter-state and International Cooperation for Disaster Management; Role of NGOs and Army in Disaster Management and Disaster Management Training

**Suggested Readings**

**Mapping of COs to Syllabus**

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**PAEN0124: EDUCATION ADMINISTRATION**
(Credits: Theory-5, Tutorial: 1 (5+1=6 Credit))
Theory-75 lectures (75 Hours)

**COURSE OUTCOMES**
At the end of this course students are able to:
1. Develop an understanding about the different concepts and models education and educational Administration (Understanding)
2. Familiarity with the National Policy on Education, Sarva Shiksha Abhiyan and institutions and agencies involved in promoting education in India (Remembering)
3. Identifying and understanding the socio-economic context in implementation of education policies (Understand and Analyse)
4. Review the National Education Policy 2020 and its implication in strengthening the education sector in India. (Assessing)
5. Evaluate the Socio-economic problems of educational development. (Evaluating)

**Module - I (20 hours)**
Introduction: Educational Administration – Concept, Significance and Scope; Concepts: Universalization of Elementary Education (UEE), Non-Formal Education (NFE), Vocationalization of Secondary Education, Autonomous Colleges etc.

**Module - II (20 hours)**

**Module - III (20 hours)**

**Module - IV (15 hours)**
Socio-economic Problems of Educational Development: Equality of Opportunity; Employment and Productivity; Nation Building and Citizenship; and Globalization and Education

**Suggested Readings**

### Mapping of COs to Syllabus

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### PAND0125: NGO’s AND SUSTAINABLE DEVELOPMENT

(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))

Theory-75 lectures (75 Hours)

#### COURSE OUTCOMES

At the end of this course students are able to:
1. Acquire a theoretical understanding of environment, sustainable development and Non-Governmental Organizations (Understanding)
2. Gain awareness about environmental concerns and challenges (Knowledge)
3. Understand types of NGOs and their significance and role in fostering sustainable development (Comprehension and Remembering)
4. Analyse the Civil Societies initiatives in environment management and sustainable development. (Analysing)
5. Evaluate sustainable development programme and policies. (Evaluating)

#### Module - I (15 hours)

The Global Responsibility of Environmental Concern: Importance of Environment in our life; Pollution and its Types; Pollution Control and Treatment of Waste; Legal Measures to Control Pollution

#### Module - II (20 hours)

NGOs and Participatory Management: Community Development Programmes; Participation of NGOs in Environment Management and Sustainable Development; NGOs and Corporate Social Responsibility; Civil Society Initiatives in Environment Management and Sustainable Development

#### Module - III (20 hours)

Sustainable Development: Programme and Policies: Environmental Legislation In India; Implementation of Environmental Laws in India; Global Initiatives in Protecting Global Environment; World Summit on Sustainable Development (Johannesburg Summit 2002)

#### Module - IV (20 hours)

Issues and Challenges of Sustainable Development: Legal Protection of Forests Act 1927; Legal Protection of Wild Life; Renewable, Non-Renewable and Nuclear Resources; Legal Regulation of Hazardous Substances

### Suggested Readings

5. Niko Roorda, 2017, Fundamentals of Sustainable Development
PARG0126: RIGHT’S BASED GOVERNANCE
(Credits: Theory-5, Tutorial- 1 (5+1=6 Credit))
Theory-75 lectures (75 Hours)

**COURSE OUTCOMES**
At the end of this course students are able to:

1. Trace the evolution and growth of Human Rights movement (Remembering)
2. Distinguish between ‘right based governance’ and ‘welfare-based governance’ (Knowledge and Analyse)
3. Illustrate the governmental welfare schemes in the context of the Rights based approach (Application)
4. Describe the national and international human rights perspectives (Understand and Remember)
5. Assess the working of Human Rights Agencies in India (Assessing)

**Module – I (20 hours)**

**Module – II (20 hours)**

**Module – III (20 hours)**
Rights Based Governance in India: Meaning of Rights Based Governance; Right to Health and other positive rights; Right to Privacy; Rule of Law; Enforcement of Human Rights in India: National Human Rights Commission(NHRC), State Human Rights Commissions, National Commission for Women, Scheduled Castes, Scheduled Tribes and Child Rights Commissions; Role of Judiciary in protecting these rights

**Module – IV (15 hours)**

**Suggested Readings**

**Mapping of COs to Syllabus**

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# SCHOOL OF PROFESSIONAL STUDIES  
## DEPARTMENT OF HOSPITALITY & HOTEL ADMINISTRATION  
### BACHELOR OF SCIENCE IN HOSPITALITY AND HOTEL ADMINISTRATION  
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DEPARTMENT OF HOSPITALITY AND HOTEL ADMINISTRATION

VISION
To develop design and deliver research-based personalized education that equips students to become global hospitality professionals. Our aim is to impart knowledge, skills and abilities to the students through the holistic approach for nurturing them as dependable human leaders. We do develop our students to interface with stakeholders and to deliver hospitality professionals that add to the financial, intellectual, environmental, ethical, cultural and social growth of the nation.

MISSION
The mission of this department is to be a leading hospitality institution imparting quality education of global excellence leading to hospitality ready professionals carrying ethical and social values.

PROGRAMME OUTCOMES (PO)
PO 1: Critical Thinking: Demonstrate professional aptitude, critical thinking, problem solving skills, and leadership skills needed for all sectors in the hospitality industry.
PO 2: Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one more foreign language.
PO 3: Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in the organizational and operational structure of hospitality industry.
PO 4: Effective Citizenship: Demonstrate awareness and understanding necessary for social concern and equity towards national development.
PO 5: Ethics: Apply ethical standards in the professional field and accept responsibility for them.
PO 6: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
PO 7: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the field of hospitality management.

PROGRAMME SPECIFIC OUTCOMES (PSO)
PSO 1: Conceptual skills: Proficient in the core functional and support areas of hospitality sectors to plan and coordinate business related events.
PSO 2: Management skills: Manage structures and finance of the industry, as well as disaster management.
PSO 3: Problem solving skills: Develop legal awareness for handling real-life challenges of hospitality industry.
PSO 4: Entrepreneurial skills: Achieve necessary skills to become a hospitality entrepreneur.

LIST OF COURSES
1.1 Foundation Course in Food Production – I
1.2 Foundation Course in Food & Beverage Service – I
1.3 Foundation Course in Front Office – I
1.4 Foundation Course in Housekeeping – I
1.5 Business Communication & Etiquettes – I
1.6 Food Science and Nutrition
1.7 Computer Application in Hospitality
1.8 Foundation Course in Food Production – I-Practical
1.9 Foundation Course in Food & Beverage Service – I-Practical
1.10 Foundation Course in Front Office – I-Practical
1.11 Foundation Course in Housekeeping – I-Practical
2.1 Foundation Course in Food Production – II
2.2 Foundation Course in Food & Beverage Service – II
2.3 Foundation Course in Front Office – II
2.4 Foundation Course in Housekeeping – II
2.5 Basics of Tourism
2.6 Food Safety & Hygiene
2.7 Business Communication & Etiquettes – II
2.8 Facility Planning
2.9 Foundation Course in Food Production – II-Practical
2.10 Foundation Course in Food & Beverage Service – II-Practical
2.11 Foundation Course in Front Office – II-Practical
2.12 Foundation Course in Housekeeping – II-Practical
3.1 Food Production Operations
3.2 Food & Beverage Operations
3.3 Front office Operations
3.4 Housekeeping Operations
3.5 Hospitality Sales & Marketing
3.6 Disaster Management
3.7 Environmental Science
3.8 Hotel Accounts
3.9 Food Production Operations-Practical
3.10 Food & Beverage Operations-Practical
3.11 Front office Operations-Practical
3.12 Housekeeping Operations-Practical
4.1 Project Report Presentation
4.2 Log Book
4.3 Industrial Training
4.4 Viva
5.1 Advance Food Production Operations-I
5.2 Advance Food & Beverage Operations
5.3 Front office Management—I
5.4 Housekeeping Management—I
5.5 Research Methodology
5.6 Organizational Behavior & Human Resource Management
5.7 Food & Beverage Controls
5.8 Hospitality Economics
5.9 Advance Food Production Operations-I-Practical
5.10 Advance Food & Beverage Operations-Practical
5.11 Front office Management—I-Practical
5.12 Housekeeping Management—I-Practical
6.1 Advance Food Production Operations – II
6.2 Food & Beverage Management
6.3 Front office Management—II
6.4 Housekeeping Management—II
6.5 Hotel Law & Ethics
6.6 Entrepreneurship Development
6.7 Strategic Management
6.8 Research Project
6.9 Advance Food Production Operations – II-Practical
6.10 Food & Beverage Management-Practical
6.11 Front office Management-II - Practical
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MAPPING of COURSES to PO/PSOs

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DEPARTMENT OF HOSPITALITY AND HOTEL ADMINISTRATION

DETAILED SYLLABUS
THEORY COURSES

HAFP0101: FOUNDATION COURSE IN FOOD PRODUCTION – I
(3-0-0)

Course Outcomes
1. To outline cookery and skills required.
2. To identify and analyze basic food commodities and their preparations
3. To apply the basic principles of basic hygiene practices at the workplace
4. To Demonstrate the safety procedures in handling kitchen equipment’s
5. To explain the operation flow of the food production department

Module I: INTRODUCTION TO COOKERY (04 Hours)
a. Levels of skills and experiences
b. Attitudes and behavior in the kitchen
c. Personal hygiene
d. Uniforms & protective clothing
e. Safety procedure in handling equipment

Module II: CULINARY HISTORY (02 Hours)
a. Origin of modern cookery

Module III: HIERARCHY AREA OF DEPARTMENT AND KITCHEN (03 hours)
a. Classical Brigade
b. Modern staffing in various category hotels
c. Roles of executive chef
d. Duties and responsibilities of various chefs
e. Co-operation with other departments

Module IV: CULINARY TERMS (02 Hours)
a. List of culinary (common and basic) terms
b. Explanation with examples

Module V: AIMS & OBJECTIVES OF COOKING FOOD (03 Hours)
a. Aims and objectives of cooking food
b. Various textures
c. Various consistencies
d. Techniques used in pre-preparation
e. Techniques used in the preparation

Module VI: VEGETABLE AND FRUIT COOKERY (05 hours)
a. Introduction – classification of vegetables
b. Pigments and color changes
c. Effects of heat on vegetables
d. Cuts of vegetables
e. Classification of fruits
f. Uses of fruit in cookery
g. Salads and salad dressings

Module VI: STOCKS (04 hours)
a. Definition of stock
b. Types of stock
c. Preparation of stock
d. Recipes
e. Storage of stocks
f. Uses of stocks
g. Care and precautions

Module VII: SAUCES (04 Hours)
a. Classification of sauces
b. Recipes for mother sauces
c. Storage & precautions

Module VIII: METHODS OF COOKING FOOD (05 hours)
a. Roasting
b. Grilling
c. Frying
d. Baking
e. Broiling
f. Poaching
g. Boiling
h. Principles of each of the above
i. Care and precautions to be taken
j. Selection of food for each type of cooking

Module IX: SOUP (04 Hours)
a. Classification with examples
b. Basic recipes of Consommé with 10 Garnishes

Module X: EGG COOKERY (03 Hours)
a. Introduction to egg cookery
b. Structure of an egg
c. Selection of egg
d. Uses of egg in cookery

Module XI: COMMODITIES (06 Hours)
a. Shortenings (Fats & Oils)
b. Role of Shortenings
c. Varieties of Shortenings
d. Advantages and Disadvantages of using various Shortenings
e. Fats & Oil – Types, varieties
f. Raising Agents
g. Classification of Raising Agents
h. Role of Raising Agents
i. Actions and Reactions
j. Thickening Agents
k. Classification of thickening agents
l. Role of Thickening agents
m. Sugar
n. Importance of Sugar
o. Types of Sugar
p. Cooking of Sugar – various

Suggested Readings

Mapping of COs to Syllabus

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882 | ADBU | Regulations and Syllabus | 2022-23
HABS0102: FOUNDATION COURSE IN FOOD & BEVERAGE SERVICE – I
(3-0-0)

COURSE OUTCOMES
1. To explain the Food and Beverage Industry and Service Areas.
2. To demonstrate types and usage of food and beverage service equipment’s
3. To relate types of Attributes required to become a Food and Beverage Service Personnel.
4. To familiarize with ancillary departments of Food and Beverage Operations.
5. To illustrate the operation flow of the food and beverage service department.
6. To describe non-alcoholic beverages and their manufacturing process.

Module I: THE HOTEL & CATERING INDUSTRY (07 hours)
   a. Introduction to the Hotel Industry and Growth of the hotel Industry in India
   b. Role of catering establishment in the travel/tourism industry
   c. Types of F&B operations
   d. Classification of Commercial, Residential/Non-residential
   e. Welfare Catering - Industrial/Institutional/Transport such as air, road, rail, sea, etc.
   f. Structure of the catering industry - a brief description of each

Module II: DEPARTMENTAL ORGANISATION & STAFFING (08 Hours)
   a. Organization of F&B department of the hotel
   b. The principal staff of various types of F&B operations
   c. French terms related to F&B staff
   d. Duties & responsibilities of F&B staff
   e. Attributes of a waiter
   f. Inter-departmental relationships (Within F&B and other departments)

Module III: FOOD SERVICE OUTLETS (08 hours)
   a. Specialty Restaurants
   b. Coffee Shop
   c. Cafeteria
   d. Fast Food (Quick Service Restaurants)
   e. Grill Room
   f. Banquets
   g. Bar
   h. Vending Machines
   i. Discotheque

Module IV: ANCILLIARY DEPARTMENTS (06 Hours)
   a. Pantry
   b. Food pick-up area
   c. Store
   d. Linen room
   e. Kitchen stewarding

Module V: F & B SERVICE EQUIPMENTS (06 Hours)
   a. Familiarization & Selection factors of - Cutlery - Crockery - Glassware - Flatware – Hollowware- All other equipment used in F&B Service • French terms related to the above

Module VI: NON-ALCOHOLIC BEVERAGES (10 hours)
   a. Classification (Nourishing, Stimulating and Refreshing beverages)
   b. Tea - Origin & Manufacture - Types & Brands
   c. Coffee - Origin & Manufacture - Types & Brands
   d. Juices and Soft Drinks
   e. Cocoa & Malted Beverages - Origin & Manufacture

Suggested Readings
Mapping of COs to Syllabus

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HAFO0103: FOUNDATION COURSE IN FRONT OFFICE – I
(3-0-0)

COURSE OUTCOMES
1. To understand the history of the Hospitality Industry and to classify hotels
2. To explain the operational flow of the front office department and to demonstrate the organization chart of the front office personnel
3. To illustrate the different types of guest rooms and accommodations types.
4. To apply knowledge of different functions of the front desk and the responsibilities of staff.
5. To classify the hotels.

Module I: INTRODUCTION TO TOURISM, HOSPITALITY & HOTEL INDUSTRY (8 hours)
a. Tourism and its importance
b. Hospitality and its origin
c. Hotels, their evolution, and growth
d. A brief introduction to hotel core areas with special reference to Front Office

Module II: CLASSIFICATION OF HOTELS (12 Hours)
a. Size
b. Star
c. Location & clientele
d. Ownership basis
e. Independent hotels
f. Management contracted hotel
g. Chains
h. Franchise/Affiliated
i. Supplementary accommodation
j. Time shares and condominium

Module III: TYPES OF ROOMS (06 hours)
a. Types of Guest Rooms

Module IV: TIME SHARE & VACATION OWNERSHIP (05 Hours)
a. Time share, Referral chains & condominiums
b. How is it different from the hotel business?
c. Classification of timeshares
d. Types of accommodation and their size

Module V: FRONT OFFICE ORGANIZATION (06 Hours)
a. Function areas
b. Front office hierarchy
c. Duties and responsibilities
d. Personality traits

Module VI: HOTEL ENTRANCE, LOBBY AND FRONT OFFICE (04 hours)
a. Layout
b. Front office equipment (non-automated, semi-automated, and automated)

Module VII: BELL DESK (04 hours)
a. Functions
b. Procedures and records

Suggested Readings
Mapping of COs to Syllabus

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HAHK0104: FOUNDATION COURSE IN HOUSEKEEPING – I
(3-0-0)

COURSE OUTCOMES
1. To define housekeeping department and attributes required for Housekeeping personnel.
2. To explore the basic operational procedure of various sections of housekeeping
3. To outline various types of rooms- design and layout along with fixtures, furniture, and accessories
4. To classify various cleaning agents and equipment used for operations along with their care and maintenance to know how different surfaces could be taken care of with the use of them.
5. To illustrate cleaning procedures for different surfaces

Module I: THE ROLE OF HOUSEKEEPING IN HOSPITALITY OPERATION (5 hours)
a. Role of Housekeeping in Guest Satisfaction and Repeat Business

Module II: ORGANISATION CHART OF THE HOUSEKEEPING DEPARTMENT (8 Hours)
a. Hierarchy in small, medium, large, and chain hotels
b. Identifying Housekeeping Responsibilities
c. Personality Traits of housekeeping Management Personnel.
d. Duties and Responsibilities of Housekeeping staff
e. The layout of the Housekeeping Department

Module III: CLEANING (10 hours)
a. Principles of cleaning, hygiene, and safety factors in cleaning
b. Methods of organizing cleaning
c. Frequency of cleaning daily, periodic, special
d. Design features that simplify cleaning
e. Use and care of Equipment

Module IV: CLEANING AGENTS (08 Hours)
a. General Criteria for selection
b. Classification
c. Polishes
d. Use, Care, and Storage
e. Distribution and Controls
f. Use of Eco-friendly products in Housekeeping

Module V: CARE AND CLEANING OF DIFFERENT SURFACES (10 Hours)
a. Metals
b. Glass
c. Leather, Leatherettes, Rexines
d. Plastic
e. Ceramics
f. Wood
g. Wall finishes
h. Floor finishes

Module VI: INTER DEPARTMENTAL RELATIONSHIP (04 hours)
a. Coordination with inter departments
Suggested Readings

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HABE0105: BUSINESS COMMUNICATION & ETIQUETTES – I
(2-0-0)

COURSE OUTCOMES
1. To understand the written skills as well as oral skills
2. To implement various techniques of writing skills for the industrial applications
3. To create the importance of remedial English
4. To implement the concept of communication skills in corporate/ social life
5. To explain the different body languages.

Module I: GRAMMAR AND VOCABULARY (04 hours)
   a. Tenses
   b. Active – Passive voice,
   c. Concord

Module II: TYPES & MEDIUM OF COMMUNICATION (03 hours)
   a. Introduction and suitability of different types of communication to different situations.

Module III: DEVELOPING LISTENING AND SPEAKING SKILLS (08 hours)
   a. Listening – traits of a good listener
   b. Picture/Video Description,
   c. Presentation

Module IV: DEVELOPING READING AND WRITING SKILLS (05 Hours)
   a. Note Making and developing notes into drafts- rewriting of draft
   b. Preparing summaries and abstracts for oral presentation
   c. Dialogue Writing and Paragraph development, Email writing,
   d. story writing

Module V: Importance of Non-Verbal Communication (05 Hours)
   a. Body Language
   b. Posture
   c. Facial Expression & Eye Contact

Module VI: Etiquettes (05 hours)
   a. Building a professional image
   b. Phone Etiquettes
   c. Email Etiquettes

Suggested Readings

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HAFN0106: FOOD SCIENCE AND NUTRITION
(2-0-0)

COURSE OUTCOMES
1. To relate the food and nutrition
2. To illustrate metabolism and sources of nutrients
3. To explain the importance of a balanced diet
4. To introduce food sources
5. To analyze the value of meals

Module I: INTRODUCTION TO FOOD SCIENCE & NUTRITION (08 hours)
a. Food & its relation to health
b. Objectives in the study of nutrition

Module II: METABOLISM & FOOD SOURCES OF NUTRIENTS (08 hours)
a. Introduction to metabolism & Nutrients
b. Functions, food sources & effect of deficiencies of Carbohydrates, Lipids, Proteins, Vitamins.

Module III: BALANCED DIET (14 hours)
a. Definition,
b. Importance of Balance Diet,
c. Types of Diet
d. RDA for various nutrients – age, gender, physiological state
e. Planning of nutritionally balanced meals based upon the three-food group system
f. Factors affecting meal planning
g. Calculation of nutritive value of dishes/meals.
h. Food allergy and precautions

Suggested Readings

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HAFP0107: FOUNDATION COURSE IN FOOD PRODUCTION – II
(3-0-0)

COURSE OUTCOMES
a. To understand the basic recipes and outline the different Soups and Sauces preparations
b. To classify different food commodities.
c. To compare and translate between different Indian cuisines
d. To explain the basic culinary terms with special reference to Indian and International cuisines
e. To illustrate meat and fish cookery
f. To relate basic Indian gravies

Module I: Soups (06 hours)
a. Basic recipes other than consommé with menu examples
   I. Broths
II. Bouillon
III. Puree
IV. Cream
V. Velouté
VI. Chowder
VII. Bisque etc.
b. Garnishes and accompaniments
c. International soups

Module II: Sauces (06 hours)
a. Difference between sauce and gravy
b. Derivatives of mother sauces
c. Contemporary & Proprietary

Module III: MEAT COOKERY (08 hours)
a. Introduction to meat cookery
b. Cuts
c. Variety meats
d. Poultry
e. Menu examples of each

Module IV: FISH COOKERY (06 hours)
a. Introduction to fish cookery
b. Classification of fish with examples
c. Cuts of fish with menu examples
d. Selection of fish and shellfish
e. Effects of heat on the cooking of fish

Module V: Basic Indian Masalas & Gravies (06 hours)
a. Garam masala, pulao masala, curry powder, sambhar powder, rasam powder, chaat masala etc
b. tandoori marination
c. White, red, green, and yellow gravies

Module VI: Food commodities (08 hours)
a. Classification with examples and uses in Cookery –
b. Fruits- kinds with examples
c. Nuts- names of nuts commonly used in cooking
d. Cream- types, description and their uses
e. Yogurt- types
f. Cereals- types and uses
g. Pulses used in Indian cooking
h. Herbs- uses of herbs
i. Spices & condiments- uses of different spices and condiments
j. Food Allergens

Suggested Readings
2. P. S. Bali, Quantity Food Production Operations and Indian Cuisine, Oxford University Press, New Delhi, 2012

Mapping of COs to Syllabus

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888 | ADBU | Regulations and Syllabus | 2022-23
HABS0108: FOUNDATION COURSE IN FOOD & BEVERAGE SERVICE – II
(3-0-0)

COURSE OUTCOMES
1. To explain the different types of breakfast and other meals and their service techniques
2. To understand and demonstrate the different types of menus provided by different food outlets.
3. To relate and understand the different aspects of control methods used in food and beverage departments
4. To classify the different types of Cigars and cigarettes.
5. To illustrate customer care and situation handling

Module I: TYPES OF MEALS (05 hours)
a. Breakfast-Introduction, Types, Service Methods,
b. Ala carte and TDH setups
c. Brunch, Lunch, Hi-Tea, Dinner, Supper, and others

Module II: MENU TYPES (08 hours)
a. Introduction to menu; Types-Ala Carte & Table D’hote
b. Menu Planning, considerations, and constraints, Menu Terms
c. French Classical Menu- 11, 13, and 17 courses separately
d. Classical Foods & its Accompaniments with Cover
e. Indian regional dishes, accompaniments, and service

Module III: PREPARATION FOR SERVICE (10 hours)
a. Organizing Mise-en-scene
b. Organizing Mise en place
c. TYPES OF FOOD SERVICE
   I. Silver service
   II. Pre-plated service
   III. Cafeteria service
   IV. Room service
   V. Buffet service
   VI. Gueridon service
   VII. Lounge service

Module IV: SEQUENCE OF SERVICE (06 hours)
a. Handling Table reservation
b. KOTs & BOTs Duplicate & Triplicate System, Computerized K.O.T’s
c. The sequence of Food Service
d. Table Clearing Process
e. Billing Methods, Payment methods, and Cash

Module V: CUSTOMER CARE AND HANDLING SITUATIONS (08 hours)
a. Unavailability of Table/reservation
b. Wrong Order Taking, Handling Unavailability of Food items
c. Handling Special Requests
d. Order Delays, Spillages, Return Food
e. Lost and found properties
f. Illness
g. Drunken Guest, Un expectable appearance of Guest
h.Dealing with children and Infants
i. Handling Handicaps, Old age guest, Customer with communication difficulties

Module VI: TOBACCO (06 hours)
a. History
b. Processing for cigarettes, pipe tobacco & cigars
c. Cigarettes – Types and Brand names
d. Pipe Tobacco – Types and Brand names
e. Cigars – shapes, sizes, colors, and Brand names
f. Care and Storage of cigarettes & cigars

Module VII: Food & Beverage Terminology (02 hours)
Suggested Readings

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HAFO0109: FOUNDATION COURSE IN FRONT OFFICE – II
(2.0-0.0)

COURSE OUTCOMES
1. To recall and describe the entire room reservation system of the hotel
2. To identify with the entire room registration system of the hotel and its all aspects.
3. To explain the form and formats
4. Ability to understand the concepts of Property Management Systems
5. To illustrate a guest cycle

Module I: ROOM TARIFF (06 hours)
- Room tariff, Tariff fixation / calculating room tariff
- Types of room tariff: Rack rate, discounted rates.
- Meal Plan and its type
- Forms & Format/ Tariff Card/Brochure

Module II: ROOM RESERVATION (06 hours)
- Importance, Functions, Different Channels & sources, and Types of reservation.
- Cancellations and Amendments
- Handling Individual & Group reservations
- Various Forms & Formats

Module III: CONCIERGE & BELL DESK OPERATIONS (06 hours)
- Introduction of Bell desk and Equipment’s used in Bell desk
- Functions of Bell desk
- Luggage handling left luggage procedure
- Mail and Message handling, Change of the room, etc.
- Functions of information department
- Forms & Formats

Module IV: GUEST CYCLE & FRONT OFFICE SYSTEMS (06 hours)
- Pre-arrival, Arrival, Stay, Departure & Post Departure

Module V: REGISTRATION PROCESS (06 hours)
- Introduction & Steps of registration with or without reservation
- Pre-registration activities.
- Processing VIP, Foreigners & group registration.

Suggested Readings
5. Michael Kasavana and Cahell, Managing computers in the hospitality industry, AHLA, 1996

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HAHK0110: FOUNDATION COURSE IN HOUSEKEEPING – II
(2-0-0)

COURSE OUTCOMES
1. To recall and describe the entire cleaning process.
2. To identify with the different surfaces.
3. To explain the form and formats.
4. Ability to understand guest room cleaning procedures.
5. To special cleaning program.

Module I: CLEANING PROCESSES (05 hours)
a. Principles of Cleaning
b. Identification & Types Of stains

Module II: DIFFERENT SURFACES (06 hours)

Module III: CLEANING OF GUEST ROOMS (06 hours)
a. Daily Cleaning of Room.
b. Weekly Cleaning/ Spring Cleaning
c. Evening Service/ Turndown Service
d. Replenishment of guest supplies & amenities.
e. Lost and Found Procedure

Module IV: FORMS & FORMATS (06 hours)
a. Staff placement register, floor registers, guest special request register, Logbook, Memo book, baby-sitting register, lost & found register, store indent book, etc.
b. Room occupancy report, guest room inspection form/checklist, housekeeping report, work order, room boys report.

Module V: SPECIAL CLEANING PROGRAMME (07 hours)
a. Daily, Weekly, Fortnightly, and Monthly Cleaning
b. Routine cleaning, spring cleaning, and Deep Cleaning

Suggested Readings

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HABT0111: BASICS OF TOURISM
(2-0-0)

COURSE OUTCOMES
1. To Contextualize tourism within broader cultural, environmental, and economic dimensions of society.
2. To Outline the resources of tourism and different aspects of tour operations.
3. Explain the diverse nature of tourism, including culture and place, global/local perspectives, and experience design and provision.
4. Examine the different elements of geography and their relationship with tourism.
5. To illustrate the tour operations

**Module I: CONCEPT OF TOURISM (04 hours)**

a. Origin, objectives, Elements, Scope & Nature of tourism
b. Job opportunities and employment generation in the tourism Industry

**Module II: TOURISM PRODUCTS AND RESOURCES (06 hours)**

a. Architectural heritage
b. Culture & Fairs and festivals of India
c. Natural and other tourism resources

**Module III: TOUR OPERATIONS (07 hours)**

a. Meaning & Definition
b. Types of Tourists: Inbound, Outbound & Domestic.
c. Tour Packaging – definition, components of a tour package
   Types of Package Tour: Independent Tour, Inclusive Tour, Escorted Tour, Business Tour
d. Guides & escorts – Their role and function
   Qualities required to be a guide or escort

**Module IV: ITINERARY PLANNING (08 hours)**

a. Steps to planning a Tour, Planning Route map
b. Transport booking – reservation,
c. Accommodation – Reservation & Food facilities
d. Tour Costing

**Module V: SOCIO-ECONOMIC IMPACT OF TOURISM (05 hours)**

a. Impact of tourism on culture
b. People to people contact enhancement
c. Environmental hazards

**Suggested Readings**


**Mapping of COs to Syllabus**

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**HASH0112: FOOD SAFETY & HYGIENE**

(2-0-0)

**COURSE OUTCOMES**

1. To develop an understanding of the theoretical foundations and techniques used in food safety management
2. To enable students to explore and extend our extensive knowledge base and critical appreciation of the control and management of food-borne diseases in the global context.
3. To enable students to apply the principles of food safety management to develop effective management systems for the production of safe and legal food products.
4. To develop an understanding of theoretical foundation regarding HACCP- based food safety management systems
5. To analyze the wider aspects of systems effectiveness such as food safety culture.

**Module I: INTRODUCTION (04 hours)**

a. Food Safety & Food hygiene
b. Food Hazards & risk

**Module II: FOOD BORNE DISEASES (06 hours)**

a. Types (Infections and intoxications)
b. Common diseases caused by food borne pathogens
c. Preventive measures

Module III: FOOD CONTAMINANTS & ADULTERANTS (06 hours)
a. Introduction to Food Standards  
b. Types of Food contaminants (Pesticide residues, bacterial toxins, mycotoxins, seafood toxins, metallic contaminants, residues from packaging material)  
c. Common adulterants in food  
d. Method of their detection (basic principle)

Module IV: FOOD LAWS AND REGULATIONS (06 hours)
a. National – Essential Commodities Act (FPO, MPO, etc.)  
b. International food laws & regulations  
c. Regulatory Agencies  
d. Consumer Protection Act

Module V: HYGIENE (08 hours)
a. General Principles of Food Hygiene  
b. Hygiene equipment and work area  
c. Safety aspects of processing water (uses & standards)  
d. Waste Water & Waste disposal  
e. HACCP (Basic Principle and implementation)

Suggested Readings

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HABE0113: BUSINESS COMMUNICATION & ETIQUETTES – II  
(2-0-0)

COURSE OUTCOMES
1. To understand the written skills as well as oral skills  
2. To implement various techniques of writing skills for the industrial applications  
3. To create the importance of remedial English  
4. To implement the concept of communication skills in corporate/ social life  
5. To demonstrate business etiquettes

Module I: EFFECTIVE SPEAKING (08 hours)
a. Polite and effective inquiries and responses  
b. Addressing a group  
c. Essential qualities of a good speaker  
d. Audience analysis  
e. Defining the purpose of a speech, organizing the ideas and  
f. delivering the speech

Module II: COMMUNICATION SKILLS IMPROVEMENT (10 hours)
a. Pronunciation, stress, accent  
b. Important of speech in hotels  
c. Common phonetic difficulties  
d. Connective drills exercises  
e. Introduction to frequently used foreign sounds

Module III: Global Business Etiquettes (06 hours)
a. Personal Appearance  
b. Work Place Etiquette
c. Interview Etiquettes
d. Public Speaking Etiquette

Module IV: Strategies for successful Listening, Speaking and Interpersonal Communication (06 hours)

a. Dyadic Communication & self-perception
b. Different Types of Interviews,
c. Kinds of Meetings, Solving problems in meetings and groups

Suggested Readings
1. Trish Stott and Alison, English for the hotel and catering industry, Pohl, Oxford University Press, 2010

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HAFP0114: FACILITY PLANNING
(2-0-0)

COURSE OUTCOMES
1. To understand network analysis and basic rules of network analysis
2. To be able to examine interiors and exteriors of building facilities and plan accordingly
3. To explore and understand various operation criteria of hotel design, space management, parking, etc
4. To relate CPM and PERT
5. To illustrate flow process and flow diagram in systematic layout planning

Module I: HOTEL DESIGN (10 hours)

a. Design Consideration
   I. Attractive Appearance
   II. Efficient Plan
   III. Good location
   IV. Suitable material
   V. Competent Management

Module II: FACILITIES PLANNING (08 hours)

a. The systematic layout planning pattern (SLP)
b. Planning consideration
c. Flow process & Flow diagram
d. Architectural consideration
e. Planning For Physically Challenged

Module III: PROJECT MANAGEMENT (12 hours)

a. Introduction to Network analysis
b. Basic rules and procedures for network analysis
c. C.P.M. and Project Evaluation and Review Technique (PERT)
d. Comparison of CPM and PERT

Suggested Readings
1. Tarun Bansal, Hotel Facility Planning, Oxford University Press, 2010

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HAPO0115: FOOD PRODUCTION OPERATIONS
(3-0-0)

COURSE OUTCOMES
1. To demonstrate and explain the requirement of equipments for volume feeding.
2. Ability to understand the concepts of bulk cooking and banqueting menus.
3. To conceptualize all aspects regarding the institutional and industrial catering
4. To evaluate, analyze and interpret theoretical and practical skills of usage of different commodities in the kitchen
5. To explain the quantity purchase system.

Module I: QUANTITY FOOD PRODUCTION EQUIPMENTS (08 hours)
   a. Equipment required for mass/volume feeding
   b. Heating and Cooling equipment
   c. Care and maintenance of equipment
   d. Modern developments in equipment manufacture

Module II: MENU PLANNING (10 Hours)
   a. Basic principles of menu planning-recapitulation
   b. Points to consider in menu planning for various volume feeding outlets such as Industrial, Institutional, Mobile Catering Units
   c. Planning menus for School/ College students, Industrial workers, Hospitals, Outdoor parties, Theme dinners, Transport facilities, cruise lines, airlines, railway
   d. Nutritional factors

Module III: INDENTING (08 hours)
   a. Principles of Indenting for volume feeding
   b. Portion sizes of carious items for different types of volume feeding
   c. Modifying recipes for indenting for large scale catering

Module IV: PLANNING (08 Hours)
   a. Principles of planning for quantity food production concerning Space allocation, Equipment selection, and Staffing

Module V: VOLUME FEEDING (11 Hours)
   a. Institutional and industrial Catering
   b. Hospital Catering,
   c. Highlights of Hospital Catering for patients, staff, visitors Diet menus, and nutritional requirements
   d. Off-Premises Catering, Problems associated with off-premises catering
   e. Reasons for growth and development Menu Planning and Theme Parties
   f. Concept of a Central Production Unit
   g. Mobile Catering
   h. Characteristics of Rail, Airline (Flight Kitchens and Sea Catering)
   i. Quantity Purchase & Storage Introduction to the purchasing system

Module VII: Indian Regional Cuisine (05 hours)
   a. A detailed study on North and South Indian
   b. Regional Cuisine: Goa, Kashmir, Andhra Pradesh, Karnataka, Tamil Nadu, Bengal, Assam, Gujarat, Punjab, Rajasthan, etc., as regarding ingredients used
   c. Traditional preparation methods
   d. Utensils and accompaniments

Suggested Readings
1. P. S. Bali, Quantity Food Production Operations and Indian Cuisine, Oxford University Press, New Delhi, 2012

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HABO0116: FOOD & BEVERAGE OPERATIONS  
(2-0-0)

COURSE OUTCOMES
1. To explain and understand the operation of the room service department.
2. To understand the concepts of wine making process, viticulture wine-based beverages.
3. To describe the beer production procedure and classify beer
4. To identify and classify other fermented beverages
5. To demonstrate order taking and suggestive selling.

Module I: IN-ROOM DINING SERVICE (5 hours)
- Introduction, general principles, and types care to be taken while dealing with active and passive guest
- The cycle of Service, scheduling, and staffing
- Forms and Formats
- Order Taking, Suggestive Selling, breakfast cards
- Time management- the lead time from order taking to clearance

Module II: ALCOHOLIC BEVERAGES (06 Hours)
- Definition & Classification of Alcoholic Beverages
- Introduction to fermented beverages

Module III: BEERS (05 hours)
- Introductions to beer
- A brief introduction to Beer Production
- Types and Brands – Indian and International

Module IV: WINE (05 Hours)
- Introduction,
- Grapes (Varieties) viticulture & vinification,
- Classification,
- Wine making, Storage, Brand Names.

Module V: AROMATIZED BEVERAGES (04 Hours)
- Definition, Types- Wine based & spirit-based
- Usage and storage

Module VI: SAKE (05 hours)
- Introduction, definition, manufacturing, Storage & Brands

Suggested Readings

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HAOO0117: FRONT OFFICE OPERATIONS
(2-0-0)

COURSE OUTCOMES
1. To understand the idea about the structural layout of the lobby area of the hotel and the functions of the bell desk
2. To formulate the process of settling bills of the guests, accounting procedures, and handling front office cash
3. To understand and analyze the idea about the night auditing and the job responsibilities of the night auditor
4. To illustrate foreign exchange handling.
5. To explain different forms, formats, and PMS of front office

Module I: PROPERTY MANAGEMENT SYSTEM (5 hours)
a. Importance of Computer in Front Office
b. Introduction to PMS
c. PMS application in Front Office (Reservation, Front Desk, Room, Cashier, Night Audit, set up, Reporting, back-office Module)
d. Different PMS systems

Module II: CHECK-IN PROCEDURE (06 Hours)
a. Check-in Procedure in different situations like: guest having confirmed reservation, Walk-in Guest, Group/crew, Scanty Baggage Guest, International Travelers, Club floor guest
b. Check-in Procedure in Fully automated hotels
c. Forms & Formats

Module III: CHECK OUT PROCEDURE (06 hours)
a. Check out activity at various desks: Bell Desk, lobby, Reception, Cashier
b. Different Methods of Settlement: -Cash, Credit Card, Cheques, Travel’s cheques, Bill to company, Combined settlement method, checking of minibar and taking of guest feedback.
c. Check out options: - On Desk Express Check out, Self-Check Front Office Record, Forms & Formats

Module IV: MANAGING CASH & CREDIT (05 Hours)
a. Front office Accounting Cycle
b. Credit control process in various cases: - guest pay by Credit Card, Travel agent voucher, airline, Scanty baggage, Credit control during the stay, credit facility to companies, check-in tour group. Problems may arise in credit control
c. The process required in cash Control
d. Handling Foreign Exchange

Module V: NIGHT AUDITING (08 Hours)
a. Importance of Night Auditing.
b. Duties & Responsibility of Night Auditor
c. Common Revenue Centers of a Hotel
d. Basis steps involved in preparing Night Audit: - Complete posting, reconcile room status discrepancies, verify room rates, verify no show reservations, Cash Deposit, Clear & Back up the system, Distribute report
e. Vouchers/Folios/Ledgers/Allowances/Reports

Suggested Readings

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HAHO0118: HOUSEKEEPING OPERATIONS
(2-0-0)

COURSE OUTCOMES
1. To demonstrate and explain the linen and uniform exchange procedure.
2. To identify and classify the various linen & uniform required for hotel operations
3. To classify the different types of flower arrangements used in hotels.
4. To understand the basic concept of Laundry management and examine the relevance of contract services in housekeeping.
5. Describe the safety & security procedures and pest control activities in the hotel

Module I: LINEN ROOM (8 hours)
- Activities, Layout, and equipments of linen room
- Selection criteria for linen purchasing
- Calculating linen requirement
- Linen control measures, the importance of color coding and tagging
- Inventory handling and Discard

Module II: LAUNDRY (08 Hours)
- OPL and Contract laundry
- Layout and machinery
- Laundry aids and their handling
- Flow process of OPL, Wash cycle,
- The average life cycle of linen, Dry cleaning, and stain removal
- Guest Laundry delivery procedure

Module III: FLOWER ARRANGEMENT AND INDOOR PLANTS (04 hours)
- Introduction to different types of flowers and indoor plant, types of it used in industry, Need and importance, Equipment’s & Tools required
- Care and conditioning of cut flowers, types
- Principal of design, Styles of flower arrangement
- Selection and care of indoor plants
- The procedure of layering the pot

Module IV: HOUSEKEEPING IN INSTITUTION AND FACILITIES OTHER THAN HOTELS (04 Hours)
- Hospitals, Malls, Multiplex and Airlines

Module V: PEST CONTROL & FIRE FIGHTING (06 Hours)
- Types of pests, Methods to eradicate
- Types of fire, causes, Fire extinguishers, prevention of accidents

Suggested Readings

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HASM0119: HOSPITALITY SALES & MARKETING
(2-0-0)

COURSE OUTCOMES
1. To understand the concept of marketing in hospitality.
2. To analyze market segments for sustainability.
3. To explain different products available in the hospitality sector
4. To illustrate promotion techniques.
5. To relate different marketing policies.

Module I: BASIC OF MARKETING (6 hours)
- The development of concept: - definition of marketing; concept of exchange- needs and wants;
- Evolution of marketing- production era, sales era, and marketing era.
- Hotel marketing: - Difference between goods and services
- Features of Hospitality marketing; Customer expectation from
- Hospitality services; Value chain linkage in the hotel industry. Marketing Mix in services marketing (7 Ps).
Module II: MARKET SEGMENTATION (06 Hours)
  a. Need for segmentation, market segmentation level- segment marketing, individual marketing,
  b. Selection of segmentation variables- criteria for segmenting
  c. The consumer market, criteria for segmenting the organizational market
  d. Effective segmentation measurable, sustainable, and accessible.

Module III: MARKET SEGMENTATION (05 Hours)
  a. Hospitality products, Branding, Product Life Cycle, Product Differentiation, the importance of social media marketing, and the role played by them.

Module IV: PRODUCT (04 hours)
  a. Hospitality products: rooms, food and beverage and value-added products like recreation &
  b. health, shops, car rental service, gymnasium, etc;
  c. Travel agency and tour operator’s products
  d. New service product development

Module V: PRICE (04 Hours)
  a. Services pricing policy, Approaches, Methods, Factors influencing pricing policy

Module VI: PROMOTION (02 Hours)
  a. Marketing communication mix-Advertising, sales promotion, personal selling- negotiation, Publicity
  b. Public relations in the hotel industry.

Module VII PLACE (DISTRIBUTION) (03 Hours)
  a. Channels of distribution, selection criterion of channel
  b. Channels members like-Agents, brokers, etc.

Suggested Readings

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HADM0120: DISASTER MANAGEMENT
(2-0-0)

COURSE OUTCOMES
1. To explain the meaning and scope of disaster management.
2. To identify and classify the various types of disasters
3. To illustrate national disaster management.
4. To understand the vigilance during disasters
5. To describe the National Calamity Management Act, Disaster Management Act

Module I: DISASTER MANAGEMENT (6 hours)
  b. Introduction, meaning
  c. Distinct
  d. The terminology used in Disaster management,
  e. Types of Disasters,
  f. Impact of Disasters

Module II: NATIONAL DISASTER MANAGEMENT (06 Hours)
  a. Institutional Structure
b. Disaster Prevention/mitigation, Early Warning system  
c. Disaster preparedness, mitigation & Response  

Module III: MAN-MADE DISASTERS AND MANAGEMENT (04 hours)  
a. Gas Leaks, Nuclear Radiation leaks, Terrorist attacks, Health Hazards, Accidents  

Module IV: AWARENESS AND MOTIVATION (04 Hours)  
a. Vigilance, Motivation  

Module V: TRAINING IN DISASTER MANAGEMENT (05 Hours)  
a. Objectives, Communication improves motivation  
b. Target – Ministry/Department/ Cadre,  
c. Disaster Awareness in school, curriculum, Information, Education & Communication  
d. Teamwork  

Module V: LEGISLATIONS (05 Hours)  
a. National Calamity Management Act, Disaster Management Act  

Suggested Readings  
2. S.L. Goel, Disaster Administration & Management, Jain Depot, 2011  
3. Dr. V.V. Ghanekar, Disaster Management Act and Management, Preshak Prakashan, 2011  

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HAES0121: ENVIRONMENTAL SCIENCE  
(2-0-0)  

COURSE OUTCOMES  
1. To explain the environment-friendly practices for employees.  
2. To identify and classify the various types of wastes  
3. To illustrate the waste minimization procedures.  
4. To understand the importance of energy conservation.  
5. To describe the international certifications of green practices  

Module I: EMPLOYEE ENVIRONMENTAL EDUCATION (4 hours)  
a. Environment-friendly practices  
b. Making sustainability a part of the daily routine of employees  

Module II: WASTE MINIMIZATION (08 Hours)  
a. Organic composting  
b. Dumpster monitoring (segregation of dry & wet garbage)  
c. Recycling (e.g., Individual newspapers not sent to rooms, use of bulk soap & shampoo dispensers in guest room bathrooms, using recycled paper products like bags, coasters, etc.)  
d. Alternatives to plastic bottled water  
e. Achieving close to zero-solid waste  
f. Sustainable food & beverage options  

de. Solar panels  
e. Occupancy sensors  
f. Water conservation fixtures  
g. Preventive maintenance
Module IV: GREEN HOUSEKEEPING (04 Hours)
a. Use of environment-friendly cleaning products to clean property
b. Integrated Pest-Management services
c. Tent cards in rooms informing guests about alternate day linen changing

Module V: INTERNATIONAL CERTIFICATIONS OF GREEN PRACTICES (06 Hours)
a. Eco-leaf rating
b. Green Globe rating
c. Green Key rating
d. Nordic Swan rating
e. LEEDS

Suggested Readings
2. Dr. Jasbir Singh, Eco-Tourism, I.K. International Publishing, New Delhi, 2010

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HAHA0122: HOTEL ACCOUNTS
(2-0-0)

COURSE OUTCOMES
1. To understand the concepts and principles of Accounting
2. Application and analysis of accounts records and its importance in Hotels
3. Understand the concepts of financial statements and presentation of Final Accounts
4. Application and analysis of Records and Financial Statements

Module I: INTRODUCTION (08 hours)
b. Bases of accounting: cash basis and accrual basis
c. Basic concepts and conventions: entity, money measurement, going concerned, cost, realization, accruals, periodicity, consistency
d. Recording of transaction: Journal.

Module II: CAPITAL AND REVENUE TRANSACTION (08 Hours)
a. Recording of transaction: Ledger, Capital
b. Expenditure, Revenue Expenditure, Capitalized Expenditure, Deferred Revenue
c. Expenditure, Capital, and revenue receipts. Reserves and provisions: Meaning, Objective

Module III: ACCOUNTING PROCESS (06 hours)
a. From the recording of a business transaction to preparation of trial balance including adjustments and rectification of errors.

Module IV: FINAL ACCOUNTS AND BALANCE SHEET (08 Hours)
a. Classification of assets, liabilities. Working capital, Trading Account
b. Profit and loss Account, Balance Sheet.

Suggested Readings
1. Kotas R & Conlan M. Hospitality Accounting (Elements of Business Series), Cengage Learning EMEA, United Kingdom. 5th edition 1997

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HAA00123: ADVANCE FOOD PRODUCTION OPERATIONS-I
(3-0-0)

COURSE OUTCOMES
1. To understand the layout and use of equipment in the larder section of the kitchen.
2. To explain and demonstrate the preparation of charcuterie.
3. To compare and translate between appetizer and garnishes
4. To explain the basic icing and topping terms with special reference to patisserie
5. To illustrate different sandwiches with making and storing methods

Module I: LARDER (06 hours)
a. Layout & equipment
b. Terms & larder control
c. Duties and responsibilities of the larder chef

Module II: CHARCUTIERIE (10 Hours)
 a. Sausage
 b. Forcemeats
 c. Brines, cures & marinades
 d. Ham, bacon & gammon
 e. Galantines
 f. Pates
 g. Mouse & mousseline
 h. Aspic & gelée
 i. Chaud Froid
 j. Quenelles, parfaits, roulades

Module III: APPETIZERS & GARNISHES (08 hours)
 a. Classification of Appetizers
 b. Examples of Appetizers
 c. The historic importance of culinary Garnishes
 d. Explanation of different Garnishes

Module IV: SANDWICHES (08 Hours)
 a. Parts of Sandwiches
 b. Types of Bread
 c. Types of filling – classification
 d. Spreads and Garnishes
 e. Types of Sandwiches
 f. Making of Sandwiches
 g. Storing of Sandwiches

Module V: CAKE (06 Hours)
a. Introduction, types of bases, flavors, garnishes, tools and equipment & commodities

Module VI: IcINGS & TOPPINGS (04 hours)
a. Varieties of icing, Using of Icings Differ
ence between icings & Toppings

Module VII: USE OF WINE AND HERBS IN COOKING (03 hours)
a. Uses of wine in cooking
b. Classification of herbs

Suggested Readings
4. Y. Ashok Kumar, Textbook of bakery and confectionary, PHI, 2012
6. L J Hanneman, Patisserie, Routledge, 2005

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HAFB0124: ADVANCE FOOD & BEVERAGE OPERATIONS – I
(3-0-0)

COURSE OUTCOMES
1. Recall and describe the layout of functional areas
2. Ability to understand the concepts of function catering in the hotel industry.
3. To understand the gueridon service origin and specialty
4. To impart the skills required for Guerdon service and their preparation
5. Illustrate bar operations
6. To explain and demonstrate different Cocktail preparations

Module I: PLANNING & OPERATING VARIOUS F&B OUTLET (10 hours)
a. The physical layout of functional and ancillary areas, Objective of a good layout
b. Steps in planning, Factors to be considered while planning
c. Calculating space requirement
d. Various set ups for seating
e. Planning staff requirement
f. Menu planning, Constraints of menu planning
g. Selecting and planning of heavy-duty and light equipment
h. Requirement of quantities of equipment required like crockery, Glassware, Cutlery - steel or silver, etc.
i. Planning Décor, furnishing fixtures, etc.

Module II: FUNCTION CATERING (06 Hours)
a. Banquets
b. Banquet protocol
c. Informal banquet
d. Buffets

Module III: GUERIDON SERVICE (08 hours)
a. History of gueridon
b. Definition
c. General consideration of operations
d. Advantages & Dis-advantages
e. Types of trolleys
f. Factor to create impulse, Buying – Trolley, open kitchen
g. Gueridon equipment
h. Common preparations, flambe dishes, Carving, Salad making, etc., Trolley service - Beverages, Starters, Desserts, etc.

Module IV: AFTERNOON, HIGH TEA & TABLE CHEESE (08 Hours)
a. Introduction of afternoon tea & high tea
b. Menu, Cover & Service of afternoon tea & high tea
c. Introduction of cheese, Types, Brands & Service, Storage of cheese

Module V: BAR OPERATIONS (06 Hours)
a. Types of Bars
b. Cocktail
c. Dispense
d. Area of Bar
e. Front Bar
f. Back Bar
g. Under Bar (Speed Rack, Garnish Container, Ice well, etc.)
h. Bar Stock
i. Bar Control
j. Bar Staffing
k. Opening and closing duties

Module VI: COCKTAILS & MIXED DRINKS (07 hours)
a. Definition and History
b. Classification
c. Recipe, Preparation, and Service of Popular Cocktails

Suggested Readings
5. Albert W.A. Schmid & Laloganes John P. The Beverage Manager’s Guide to

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5. Michael Kasavana and Cahell, Managing computers in hospitality industry, AHLA, 1996

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HAHM0126: HOUSEKEEPING MANAGEMENT –I
(2-0-0)

COURSE OUTCOMES
1. To explain first aid and key control with the demonstration
2. To elaborate on the safety and security aspects in regards to guests and staff of the hotel.
3. To discuss planning and organizing the housekeeping department
4. To analyze different budgets for the department

Module I: GUEST SAFETY & SECURITY (10 hours)
- Importance of Security systems
- Control over room keys
- Items kept in First aid box
- Handling situations like accident, illness, theft, fire, bomb
- Forms & Formats

Module II: SAFETY & SECURITY IN ROOMS DIVISION (08 hours)
- Hotel Security Aspects and Implementation
- Safety Awareness & Accident Prevention
- Case Studies

Module III: PLANNING AND ORGANISING (12 hours)
- Area inventory list
- Frequency schedules
- Performance and Productivity standards
- Time and Motion study in House Keeping operations
- Standard Operating manuals – Job procedures
- Job allocation and work schedules
- Calculating staff strengths & Planning duty rosters, team work and
- Leadership in House Keeping
- Training in HKD, devising training programs for HK staff
- Inventory level for non-recycled items
- Budget and budgetary controls
- The budget processes
- Planning capital budget
- Planning operation budget
- Operating budget – controlling expenses – income statement
- Purchasing systems – methods of buying
- Stock records – issuing and control

Suggested Readings
Mapping of COs to Syllabus

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HARM0127: RESEARCH METHODOLOGY – I
(2-0-0)

COURSE OUTCOMES
1. To discuss the basics of research and its process.
2. To analyze different research problems, explain probabilities.
3. To elaborate research designs and types of research.
4. To illustrate data collection procedure and observation methods.
5. To explain sampling methods, errors frame research instruments.

Module I: FUNDAMENTALS OF RESEARCH (05 hours)
a. Meaning, Objectives, Motivation, Utility
b. Barriers in accepting research
c. Research Process

Module II: PROBLEM DEFINITION AND HYPOTHESIS (05 hours)
a. Problem Identification and Definition - Management Question, Research Question,
b. Investigation Question, Hypothesis – Meaning, Qualities of a Good Hypothesis, Null
c. Hypothesis & Alternative Hypothesis. Hypothesis Testing - Logic & Importance

Module III: RESEARCH DESIGN (03 hours)
a. Concept and Importance in Research
b. Features of a good research design
c. Types of research
d. designs – Exploratory, Descriptive, and Experimental
e. Approaches in research – Qualitative and Quantitative

Module IV: TYPES AND SOURCES OF DATA AND DATA COLLECTION METHODS (04 hours)
a. Secondary Data - Definition, Sources, Characteristics. Primary Data - Definition, Sources,
b. Characteristics, Comparison of primary and secondary data.
c. Data Collection Methods
d. Observation method, Experimental method, Focus Group, Case Study
e. Survey -Questionnaire method, Interviews, Schedule

Module V: RESEARCH INSTRUMENT (03 hours)
a. Questionnaire and Schedule, Questionnaire designing, electromechanical instruments

Module VI: SAMPLING (04 hours)
a. Concepts of Sample, Population, Sampling Unit, Sampling Frame, Sampling Error

Module VII: DATA ANALYSIS AND INTERPRETATION (03 hours)
a. Data Processing, Data Analysis

Module VIII: REPORT WRITING (03 hours)
a. Importance and Layout of a Research report

Suggested Readings
1. C. R. Kothari, Research Methodology, KB Center, 2014
3. Alan Bryman & Emma Bell, Business Research Methods, Oxford University Press.2011

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906|ADBU| Regulations and Syllabus|2022-23
HAOB0128: ORGANIZATIONAL BEHAVIOR & HUMAN RESOURCE MANAGEMENT
(2-0-0)

COURSE OUTCOMES
1. To discuss organizational behavior and human resource management.
2. To relate knowing and managing oneself.
3. To explain theories and factors of motivation
4. To illustrate leadership and organizational communication.
5. To explain appraisal, recruitment, and selection methods.

Module I: INTRODUCTION (04 hours)
   a. What is Organizational Behavior (OB) and Human Resource Management
   b. Management (HRM) Difference between corporates and development
   c. organizations OB and HRM and Sustainable development

Module II: KNOWING AND MANAGING YOURSELF (05 hours)
   a. Individual Behavior: MARS model of individual behavior Values: Values across cultures
   b. Personality: Big five model, Personality attributes influencing OB
   c. Emotions: Understanding emotions
   d. Intelligence Attitudes: Attitudes v/s values
   e. Organizational Commitment Perception: Factors influencing perception

Module III: MOTIVATION IN THE WORKPLACE (02 hours)
   a. What is motivation
   b. Theories of motivation
   c. Factors influencing motivation of employees

Module IV: WORK TEAMS (03 hours)
   a. Teams v/s groups; Why teams; A model of Team effectiveness
   b. Turning individuals into team players

Module V: COMMUNICATION (04 hours)
   a. Organizational communication
   b. Improving Interpersonal Communication: Empathy and Active listening

Module VI: LEADERSHIP (03 hours)
   a. Difference between managers and leaders
   b. Perspectives of leadership: Trait, Behavioral, Contingency; Inspirational leadership

Module VII: JOB ANALYSIS (02 hours)
   a. Job description; Job Specification; Job Evaluation

Module VIII: RECRUITMENT, SELECTION, ORIENTATION (03 hours)
   a. Sources of recruitment: Internal and external; Steps in the selection process
   b. Socialization and Induction

Module IX: PERFORMANCE MANAGEMENT (02 hours)
   a. What is performance appraisal; Purposes, Process, and Uses
   b. Methods of Performance Appraisal

Module X: COMPENSATION MANAGEMENT (02 hours)
   a. What is compensation
   b. Objectives and factors determining compensation

Suggested Readings
   e. Pynes, J.E., Human Resources Management for Public and Nonprofit Organizations,
Mapping of COs to Syllabus

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HAFC0129: FOOD & BEVERAGE CONTROLS
(2-0-0)

COURSE OUTCOMES
1. To illustrate methodology and personnel management in F&B control.
2. To understand & implement various costing techniques & policies for effective F&B Cost Control.
3. To implement various techniques of F&B fraud control.
4. To understand the concepts of food and beverage control.
5. To learn and evaluate the need for labor and labor cost.

Module I: F&B CONTROL OVERVIEW (04 hours)
a. Introduction, Objectives of F&B Control
b. Problems in F&B Control
c. Methodology of F&B Control
d. Personnel Management in F&B Control

Module II: COST & SALES CONCEPTS (06 hours)
a. Definition of Cost, Elements of Cost,
b. Classification of Cost, Sales defined, Ways of expressing sales concepts
c. Cost/Volume/Profit Relationships (Break-even analysis)

Module III: FOOD CONTROL (08 hours)
a. Food Purchasing Control, Food Receiving Control, Food Storing, and Issuing Control, Food Production Control, Food Cost Control, Food Sales Control

Module IV: BEVERAGE CONTROL (08 hours)
a. Beverage Purchasing Control, Beverage Receiving Control, Beverage Storing, and Issuing Control, Beverage Production Control, Beverage Cost Control, Beverage Sales Control

Module V: LABOUR CONTROL (04 hours)
a. Labor cost considerations

Suggested Readings

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HAHE0130: HOSPITALITY ECONOMICS
(2-0-0)

COURSE OUTCOMES
1. To illustrate nature, scope, and types of managerial economics.
2. To understand & implement various contracts and agreements forms for business ownership.
3. To explain determinants and demand of the market.
4. To relate competition of different markets in terms of pricing.
5. To learn and evaluate pricing strategies and profit policies.

**Module I: INTRODUCTION (06 hours)**

- Definition, Nature, and Scope of Managerial Economics
- Microeconomic and Macroeconomics
- Managerial Economics and decision-making.

**Module II: FORMS OF BUSINESS OWNERSHIP (04 hours)**

- Sole Proprietorships, Partnerships, Joint-stock company, Public Limited Company, Private Limited Company, Cooperative Business ownership

**Module III: MEANING AND DETERMINANTS OF DEMAND (08 hours)**

- Demand Function.
- Law of Demand Market Demand
- The elasticity of demand.
- Methods of Demand estimation. Demand forecasting.
- Forecasting of an established product.
- Forecasting of a new product

**Module IV: PRICING UNDER VARIOUS MARKETS INCLUDING (06 hours)**

- Perfect Competition
- Monopoly
- Monopolistic competition
- Oligopoly
- Cartels
- Price discrimination

**Module V: PRICING STRATEGIES AND PROFIT POLICY (06 hours)**

- Cost-plus pricing
- Marginal cost pricing
- Cyclical pricing
- Penetration Pricing
- Price Leadership
- Price Skimming
- Transfer pricing
- Break-Even Analysis

**Suggested Readings**

2. Varshney and Maheshwari, Managerial Economics, Sultan Chand Sons, New Delhi, 2018
4. HL Ahuja, Managerial Economics, S Chand & Co. New Delhi, 2017

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**HAFO0131: ADVANCE FOOD PRODUCTION OPERATIONS-II**

(3-0-0)

**COURSE OUTCOMES**

1. To illustrate international cuisine concerning geography and history.
2. To classify various frozen desserts, additives, and preservatives.
3. To explain the preparation and processing of chocolates.
4. To relate regional influences for Indian sweets.
5. To learn and evaluate production management testing new techniques and develop new recipes.
Module I: INTERNATIONAL CUISINE (08 hours)

a. Geographic location
b. Historical background
c. Staple food with regional Influences
d. Specialties
e. Recipes
f. Types of equipment

Module II: FROZEN DESSERTS (06 Hours)

a. Types and classification of Frozen desserts
b. Ice-creams – Definitions
c. Methods of preparation
d. Additives and preservatives used in Ice-cream manufacture

Module III: CHOCOLATE (06 hours)

a. History
b. Sources
c. Manufacture & Processing of Chocolate
d. Types of chocolate
e. Tempering of chocolate
f. Cocoa butter, white chocolate, and its applications

Module IV: HALWAI INDIAN SWEETS (06 Hours)

a. Origin and history, ingredients used, regional influences

Module V: MERINGUES (06 Hours)

a. Making of Meringues
b. Factors affecting the stability
c. Cooking Meringues
d. Types of Meringues,
e. Uses of Meringues

Module VI: PRODUCTION MANAGEMENT (08 hours)

a. Kitchen organization
b. Allocation of Work Job Description, Duty Roasters
c. Production Planning, Production Scheduling
d. Production Quality & Quantity Control
e. Forecasting Budgeting, Yield Management

Module VII: PRODUCT & RESEARCH DEVELOPMENT (05 hours)

a. Testing new equipment, Developing new recipes, Food Trail

Suggested Readings

d. Y. Ashok Kumar, Textbook of bakery and confectionary, PHI, 2012
e. W. Gisslen, Professional Baking, John Wiley & Sons, 2009
f. L J Hanneman, Patisserie, Routledge, 2005

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HABM0132: FOOD & BEVERAGE MANAGEMENT  
(2-0-0)

COURSE OUTCOMES
1. To develop an in-depth understanding of planning and operating a restaurant.
2. To learn the different concepts of catering operations.
3. To understand menu management and material management.
4. To illustrate inventory control.
5. To analyze the budget of the department.

Module I: RESTAURANT PLANNING (08 hours)
   a. The physical layout of functional & ancillary areas
   b. Objectives of a good layout,
   c. Steps in planning
   d. Factors to be considered while planning, calculating space requirements
   e. Various set-up for sitting,
   f. Planning staff requirements,
   g. Menu planning
   h. Selection of equipment, lighting, fixtures, crockery, cutlery, etc.

Module II: MENU MANAGEMENT (08 Hours)
   a. Introduction, Types of Menus, Menu Planning Considerations & Constraints
   b. Menu Costing and Pricing
   c. Menu Merchandising, Menu Engineering
   d. Menu Fatigue, Menu as an In-House Marketing Tool.

Module III: INVENTORY CONTROL (04 hours)
   a. Importance, objectives, methods, levels & technique
   b. Perpetual inventory, monthly inventory, pricing of commodity, comparison of physical and perpetual inventory

Module IV: MATERIALS MANAGEMENT (04 Hours)
   a. Introduction, Necessity & Function and Techniques
   b. Classification and Technology used in materials management

Module V: BUDGETARY CONTROL (06 Hours)
   a. Introduction, Objective
   b. Budgetary Control Process, Stages in the preparation of Budgets
   c. Budgeting for F&B Operations,
   d. Variance Analysis.

Suggested Readings
3. Cousins J, Foskett, D, Gillespie C. Food and Beverage Management, Pearson Education India, 2006

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HAFM0133: FRONT OFFICE MANAGEMENT – II  
(2-0-0)

COURSE OUTCOMES
1. To illustrate lodging services and the role of front-office employees.
2. To explain distribution channels e.g. GDS, CRS, Internet, and telephone.
3. To understand passport and different visas and requirements.
4. To describe and implement role plays of guest complaint handling.
Module I: QUALITY SERVICE IN FRONT OFFICE (08 hours)
   a. Lodging as a guest service business, developing a quality culture
   b. Role of Manager in quality, determining guest service expectation,
   c. Planning guest service process – recognizing basic concerns
   d. Determining guest service expectations
   e. Delivering guest service through employees

Module II: DISTRIBUTION CHANNEL MANAGEMENT (08 Hours)
   a. Overview of distribution channels
      i. Use of intermediaries, current distribution channels
   b. Management of distribution channels – walk-in guest, Group sales department,
   c. Global Distribution System, Central reservation system, Internet, Telephone, Fax, etc.
   d. Challenges of distribution channel management.

Module III: PASSPORT & VISA (06 hours)
   a. Passport- meaning and definition
   b. Visa – meaning, Types of Visa-Tourist Visa, Business Visa, Employment Visa, Conference Visa, Student visa, etc

Module IV: GUEST COMPLAINT HANDLING / PROBLEM SOLVING (08 hours)
   a. Process, thumb rules
   b. Common complaints / problems / situations handling
   c. Role of emotions in situation handling
   d. Role of emotions in situation handling

Suggested Readings

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HAAM0134: HOUSEKEEPING MANAGEMENT –II
(2-0-0)

COURSE OUTCOMES
1. To illustrate interior decoration about color, light, and soft furnishings.
2. To explain different furniture required in hotel and their placement.
3. To understand the layout of rooms.
4. To describe and implement special decorations.

Module I: INTERIOR DECORATION (12 hour)
   a. Elements of design
   b. Color and its role in décor –types of color schemes
   c. Windows and window treatment
   d. Lighting and lighting fixtures
   e. Floor finishes
   f. Carpets
   g. Furniture and fittings
   h. Accessories

Module II: LAYOUT OF GUEST ROOMS (08 hours)
   a. Sizes of rooms, sizes of furniture, furniture arrangement
   b. Principles of design
   c. Refurbishing and redecoration

Module III: SPECIAL DECORATION (THEME RELATED TO HOSPITALITY INDUSTRY) (10 hours)
   a. Indenting
b. Costing

c. Planning with time split

d. Executing

Suggested Readings

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HALE0135: HOTEL LAW & ETHICS
(2-0-0)

COURSE OUTCOMES
1. To understand types of contracts and acts.
2. To describe and implement laws related to casualty/accidents in the hotel.
3. To explain food and liquor legislation acts related to food safety and consumer prevention.
4. To relate different licenses and permits required for running a 5-star hotel.
5. To analyze and implement professional ethics.

Module I: BUSINESS LAW (06 hours)
a. The Indian Contract Act, Types of contracts, booking contract
b. Law relating to Registration of guest, Rules for registration, Breach of contract
c. Laws relating to death in a hotel, infectious diseases of a guest, guest causing disturbance, guests’ animals, property lost and found
d. The Partnership Act, Nature of partnership, Rights, and duties of a partner
e. The Companies Act, Essential features of the company,
  f. Legal aspects of corporate social responsibility. Legal aspects of corporate social responsibility. Receiving

Module II: FOOD AND LIQUOR LEGISLATIONS (10 hours)
a. The Prevention of Food Adulteration Act, Public Analysts, and Food Inspectors, Sealing, Fastening and Dispatch of Samples
b. The Food Safety and Standards Act, Food Safety and Standards Authority of India
c. The Consumer Protection Act
d. Remedies for deficiency in services, Liquor legislation. conduct of license premises, sales of liquor, offenses against licensing laws, permitted hours, occasional license, principal matters affecting licenses.

Module III: LICENSES AND PERMITS (08 hours)
a. Licenses and permits required for running Star category of hotels
b. Procedure for applying and renewal of licenses and permits

Module IV: PROFESSIONAL ETHICS (12 hours)
a. Introduction – Meaning - Scope – Types of Ethics – features
b. Factors influencing Business Ethics – the significance of Business Ethics
c. Arguments for and against business ethics- Basics of business ethics
d. Ethical dilemma [basic idea, features, and significance of each element]
e. Corporate Ethics & Governance – an Overview
f. Impact of Corporate governance on Sustainability

Suggested Readings
2. Singh A, Business Law, Eastern Book Company, Lucknow, 2018

Mapping of COs to Syllabus
HAED0136: ENTREPRENEURSHIP DEVELOPMENT
(2-0-0)

COURSE OUTCOMES
1. To understand and relate qualities of being an entrepreneur.
2. To develop business ideas recognizing opportunities.
3. To describe and implement successful business ideas to become an entrepreneur.
4. To relate different market segments to run a firm.
5. To evaluate firm strategies and growth.

Module I: DECISION TO BECOME AN ENTREPRENEUR (06 hours)
  a. Introduction to entrepreneurship-definition
  b. Entrepreneur, characteristics, common myths
  c. Entrepreneurship’s importance, economic impact, impact on society

Module II: DEVELOPING SUCCESSFUL BUSINESS IDEAS (08 hours)
  a. Recognizing opportunities and generating ideas-identifying and recognizing opportunities, solving a problem,
  b. Techniques for generating ideas-brainstorming, focus group, survey
  c. Encouraging and protecting new ideas-establishing focal point, encouraging creativity, protecting new idea; Feasibility Analysis-Product/service, industry/market
  d. Organizational, financial; Industry, and competitor analysis
  e. Porter’s Five Forces, identifying competitors
  f. Competitive analysis grid; Developing an effective business model-business model

Module III: MOVING FROM AN IDEA TO ENTREPRENEURIAL FIRM (06 hours)
  a. Building a new venture team creating, founder, recruitment, professional advisor
  b. Assessing a new venture’s financial strength and viability-financial management, financial statements and forecasts, pro forma financial statements
  c. Preparing the proper ethical and legal Foundation-initial ethical and legal issues facing a new firm-departing from employer, choosing attorney, founders’ agreement, avoiding legal disputes
  d. Form of business organization sole proprietorship, partnership, corporation
  e. Writing a business plan-importance, outline, investors
  f. Getting financing or funding importance

Module IV: MANAGING AN ENTREPRENEURIAL FIRM (06 hours)
  a. Unique marketing
  b. Segmentation, target marketing, positioning, benefits and features, the importance of intellectual property-patents, trademarks, copyrights, Trade secrets

Module V: GROWING AN ENTREPRENEURIAL FIRM (04 hours)
  a. Preparing for and evaluating the challenges of growth-preparing for growth, attributes of successful growth
  b. Firms; Strategies for firm growth-internal growth strategies

Suggested Reading

Mapping of COs to Syllabus

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HASM0137: STRATEGIC MANAGEMENT
(2-0-0)

COURSE OUTCOMES
1. To understand strategic management and learn formulation of strategies.
2. To analyze strategic intent objectives and SWOT.
3. To implement strategic structures.
4. To review the strategic formulation and implementation.

Module I: STRATEGIC PLANNING PROCESS (10 hours)
a. Strategy formulation
b. Corporate level strategies
c. Business level strategies

Module II: STRATEGY PROCESS IN DETAIL (12 hours)
a. Strategic Intent
b. Defining vision
c. Understanding mission
d. Business model
e. Goals and objectives
f. Strengths, Weakness, Opportunities, Threats

Module III: STRATEGY IMPLEMENTATION (08 hours)
a. Organization structures
b. Structures for strategy
c. Systems & Process for implementation
d. Strategic Review

Suggested Readings

Mapping of COs to Syllabus

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LABORATORY COURSES

HACA6001: COMPUTER APPLICATION IN HOSPITALITY
(0-0-1)

COURSE OUTCOMES
1. Able to understand the basic operating principles of computer
2. Able to understand the concept of Operating Systems
3. Able to understand input and output devices
4. To understand the features of Word Processing, Spread Sheets and Presentations
5. To understand and describe the fundamentals of MS-DOS, Excel, and PowerPoint
6. To demonstrate the knowledge of search engines and their operation

Module I: ELEMENTS OF A COMPUTER SYSTEM (4 lectures)
a. Definitions
b. Characteristics of Computers
c. Classification of Computers
d. Limitations

Module II: Hardware (6 lectures)
a. Introduction of Central Processing Unit
b. Processor – Intel, AMD, Clock Speed
c. Input Devices – Keyboard, Mouse, Mic, Scanner, Barcode Reader, RFID, Touch Screen
d. Output Devices – Displays (CRT, TFT, LCD, Plasma, LED, Projector)
e. Display Resolution
f. Printers – Inkjet, Laser, Thermal
g. Storage Devices – Primary (RAM & ROM), Secondary (HDD, Flash Drive, USB, CD/DVD, Blue Ray, Media Players)

Module III: Microsoft word (05 lectures)
a. Introduction & Practice

Module IV: Processing with MS Excel (08 Lectures)
a. Introduction & Practice

Module V: POWERPOINT (04 Lectures)
a. Introduction & Practice

Module VI: Outlook (03 lectures)
a. Introduction & Practice

Suggested Readings

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HAFP6002: FOUNDATION COURSE IN FOOD PRODUCTION – I-PRACTICAL
(0-0-4)

COURSE OUTCOMES
1. To understand the usage of kitchen tools
2. To apply the safety principles at the food production area
3. Identification of commonly used raw material
4. To demonstrate basic cuts of vegetables
Practical
1. Familiarization and Understanding kitchen equipment and tools
2. Understanding Personal Hygiene and Kitchen Hygiene & its importance.
3. Understanding kitchen layouts, kitchen knife, and hand tools
4. Identification of commonly used raw material
5. Basic hygiene practices & Importance of Kitchen Uniform.
6. Various Safety practices to be observed in the kitchen
7. Basic cuts of vegetables
8. Methods of Cooking
10. Preparation of Stock, Soup & Sauces
11. Handling Fire
12. Kitchen First Aid

Mapping of COs to the syllabus

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HABS6003: FOUNDATION COURSE IN FOOD & BEVERAGE SERVICE – I-PRACTICAL
(0-0-1)

COURSE OUTCOMES
1. To apply the principles of basic hygiene practices and body language in the department
2. To demonstrate the process of laying tables arranging things in order.
3. To demonstrate service of water and serving plates
4. To explain care and maintenance procedures of different equipment
5. To familiarize with different tools of F&B service.

Practical:
1. Hygiene and Etiquettes in Restaurant
2. Mis-En – Place and Mis- En – Scene activities
3. Identification of F&B Tools, types of equipment, Cutlery, Crockery, Glass & Chinaware, Flatware, Hollowware, Table appointments, Linen, etc.
4. Care and Maintenance of various Tools, types of equipment, Flatware, Hollowwares.
5. Side board Organization and its importance
6. Laying & Relaying of Table.
7. Rules for Laying Cover, Various types of Napkin folds
8. Importance of Body Language and Dinning etiquettes.
9. Carrying a Salver/Tray, Plates, Glasses & other types of equipment
10. Service of Water
11. Handling the Service Gear
12. Clearing an Ashtray, and precautions to be taken care of for handling operation.

Mapping of COs to the syllabus

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HAFO6004: FOUNDATION COURSE IN FRONT OFFICE – I-PRACTICAL
(0-0-1)

COURSE OUTCOMES
1. To develop communication skills and to recall and describe different countries, their capitals with currencies.
2. To demonstrate different forms and formats used in the front office
3. To identify and classify different front office equipment
4. To explain and demonstrate team building and guest handling.

Practical
1. Identification of Front office equipment and furniture
2. Welcoming Guest
3. Telephone etiquettes
4. Conversations with guests (Escorting, Message handling, eye contact, body language,)
5. Role play: • Reservation • Arrivals • Luggage handling • Message and mail handling
6. Team Building

Mapping of COs to the syllabus

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HAHK6005: FOUNDATION COURSE IN HOUSEKEEPING – I-PRACTICAL PRACTICAL
(0-0-1)

COURSE OUTCOMES
1. To explore the basic operational procedure of equipment.
2. To apply the principles of cleaning.
3. To illustrate the guest rooms with a sample layout.
4. To explain the use of cleaning agents.

Practical
1. Sample Layout of Guest Rooms
2. Guest Room Supplies and Position
3. Cleaning Equipment- (manual and mechanical) • Familiarization • Different parts • Function • Care and maintenance
4. Cleaning Agent • Familiarization according to classification • Function
5. Public Area Cleaning (Cleaning Different Surface)

Mapping of COs to the syllabus

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HAHF6006: FOUNDATION COURSE IN FOOD PRODUCTION – II-PRACTICAL
(0-0-4)

COURSE OUTCOMES
1. To understand the uses of different kitchen equipment.
2. To demonstrate and explain cuts of fish and meat
3. To demonstrate basic preparation of gravies
4. To illustrate cuts of poultry

Practical
1. Familiarization and Understanding kitchen equipment and tools
2. Cuts of fish with menu examples
3. Cuts of Meat with menu examples
4. Various preparation of basic gravies
5. Cuts of Poultry with menu examples
6. To formulate menus, form the following dishes, and include more dishes from respective regions

Mapping of COs to the syllabus

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HABS6007: FOUNDATION COURSE IN FOOD & BEVERAGE SERVICE – II-PRACTICAL
(0-0-1)

COURSE OUTCOMES
1. To explain the different types of breakfast and other meals layout and tray set up with service techniques sequence
2. To understand and demonstrate the different types of service provided in restaurants as per types of menus provided in 5-star hotels in different food outlets.
3. To relate and understand the different aspects of the control method used in food and beverage departments by using KOT
4. To demonstrate service of cold & hot non-alcoholic beverages.
5. Practical
   1. Writing a Menu
   2. Breakfast Table Lay-out.
   3. TDH & A la Carte Cover lay-out.
   4. Receiving the guests
   5. Sequence of Service
   6. Taking an Order of Food & Making a KO T.
   7. Table Service, Practice of meet greet and repeat.
   8. Clearing, Crumbing, Presenting the bill
   9. Service of Cold & Hot - Non-Alcoholic Beverages

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HAFO6008: FOUNDATION COURSE IN FRONT OFFICE – II-PRACTICAL
(0-0-1)

COURSE OUTCOMES
1. To understand basic manners for guest services.
2. To implement communication.
3. To familiarize with different countries and capitals.
4. To evaluate different forms and formats.
5. To demonstrate different tools of the front office.
6. Practical
   1. Basic Manners, Body language, Gestures, Facial expression, Grooming & Hygiene Standards, its importance, Welcoming, receiving, escorting of the guest to room.
   2. Front Office Communication –
   3. Verbal- Practicing Reception Dialogues,
   4. Non-verbal
   5. Preparation and study of countries:
   6. Capitals, currencies, airlines and flags chart, types of credit card
   7. Telecommunication skills – telephonic situation handling
   8. Filling of Forms and formats
   9. Identification of equipment
   10. Basic manners and grooming standards required for Front Office operation

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HAHK6009: FOUNDATION COURSE IN HOUSEKEEPING – II-PRACTICAL
(0-0-1)

**COURSE OUTCOMES**
1. Able to handle and organize the chambermaid’s trolley for the cleaning of various guestrooms.
2. To explain the room layout
3. Application of the cleaning agents
4. To demonstrate uses of cleaning clothes

**Practical**
1. Familiarization of Guest Room Layout
2. Identification of Guest Room Amenities, Room attendant trolley set-up, and preparing a checklist
3. Identification of cleaning equipment – Manual & mechanical
4. Cleaning of different surfaces
5. Practical involving following activities- Scrubbing, polishing, wiping, washing, rinsing, swabbing, mopping, sweeping, brushing, buffing
6. Practical activities involving the usage of cloths and their types, abrasives, polishes, chemical agents, and commercially available products.

**Mapping of COs to the syllabus**

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HAPO6010: FOOD PRODUCTION OPERATIONS-PRACTICAL
(0-0-4)

**COURSE OUTCOMES**
1. Demonstrate the preparation of different menus.
2. Understand the quantity required for volume cooking
3. Ability to describe and handle the food outlet
4. Apply the practical knowledge for planning an elaborate Indian Menu

**Practical**
To formulate/demonstrate 15 sets of menus as volume cooking
1. Menu 1
2. Menu 2
3. Menu 3
4. Menu 4
5. Menu 5
6. Menu 6
7. Menu 7
8. Menu 8
9. Menu 9
10. Menu 10
11. Menu 11
12. Menu 12
13. Menu 13
14. Menu 14
15. Menu 15

**Mapping of COs to the syllabus**

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HABO6011: FOOD & BEVERAGE OPERATIONS-PRACTICAL
(0-0-1)

**COURSE OUTCOMES**
1. To set up tray and trolley lay up for room service
2. Demonstrate the knowledge for taking orders
3. Demonstrate service standards for serving Beer and Wines
4. Explain the importance of conducting briefing and de-briefing.

**Practical**
1. Understanding Room Service Amenities, Room Service equipment’s.
2. Room Service Tray & Trolley Lay-out.
3. Functional Layouts for room service
4. Role play: Knocking & opening the guest door, wishing the guest, placing tray, checking order, presenting the bill, greeting at the exit.
5. Order taking on the telephone
6. Set-up for In Rooms.
7. Conducting Briefing/De-Briefing.
8. Taking an Order & Service of Beer, Other Fermented & Brewed Beverages.
9. Taking an order & Service of –Sparkling, Aromatized, Fortified, Still Wines. Order of service (starting with wine approval from the host, wrapping the bottle with the napkin, etc.)
10. Opening different types of wine bottles. (Different types of cork screws)
11. Use of different glasses, holding & carrying glasses
12. Set up a table with Prepared Menu with wines.

**Mapping of COs to the syllabus**

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HAOO6012: FRONT OFFICE OPERATIONS-PRACTICAL
(0-0-1)

**COURSE OUTCOMES**
1. To formulate and evaluate the occupancy percentage of the hotel
2. To handle and compile different forms and formats of the department
3. Application and analysis of PMS is the front office
4. To demonstrate role plays e.g. telephone handling, luggage handling

**Practical**
1. Preparing & filling up Registration cards during Check-in, handling registration records.
2. Handling Check-In and Check-Out process
3. Filling various vouchers, folios, handling allowances, and various reports
4. Role Play- Bell-Boy, GRE, Telephone Operator

**Mapping of Co to the syllabus**

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HAHO6013: HOUSEKEEPING OPERATIONS-PRACTICAL
(0-0-1)

COURSE OUTCOMES
1. To construct a model using the concept of various elements of décor and design.
2. To describe various stains and stain removal procedures.
3. To choose and make use of various types of flower arrangements used in the hospitality industry.
4. To demonstrate bed-making

Practical
1. Practicing different types of Flower arrangements
2. Making floor plans, wall elevations, and templates
3. Creating a model of a guest room / public area with interior decoration themes
4. Stain removal of 10 common stains
5. Guest Room Cleaning & handling Mini-Bar
6. Bed Making & Turndown Services

Mapping of Cos to the syllabus

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HAPR6014: PROJECT REPORT PRESENTATION
(0-0-2)

COURSE OUTCOMES
1. Students should be able to communicate clearly, confidently their ideas and fundamentals of knowledge – logically on what they have learned during their Industrial Training
2. Demonstrate competency through problem identification, and solution.
3. Explain and analyze the problem formulated.
4. Create a report to present before the viva committee

Module I
a) Students would be assessed based on Presentation before a select panel. The Presentation would be based on experience received during Industrial Exposure Training.

Mapping of Cos to Syllabus

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HALB6015: LOG BOOK
(0-2-0)

COURSE OUTCOMES
1. Generate a report based on the experiences and works carried out.
2. Effectively implement skills in communication.
3. Students are expected to write their daily activities and will be finally endorsed by the company’s supervisor.
4. To understand the use of different registers.

Module I
a) The 22 weeks of industrial training would be divided into the four key areas of Food Production, Food and Beverage Service, Accommodation Operation, and Front Office Operations. It will be the student’s responsibility to get this feedback/assessment in LOG BOOK completed from all the four departments of the hotel for the submission of the institute at the end of Industrial Training. The logbook will be submitted to the Training & Placement Cell and will be evaluated by the concerned faculty in charge.
HAI6016: INDUSTRIAL EXPOSURE TRAINING
(0-0-16) (INDUSTRIAL EXPOSURE TRAINING DURATION: 22 WEEKS)

COURSE OUTCOMES
1. Application and analysis to the practical experience and actual working environment for developing their skills and capabilities, as well as enhancing their intellectual and emotional persona.
2. Integrate classroom theory with workplace practice.
3. Gain an understanding of administrative functions and company culture.
4. To demonstrate various activities of all the core departments.

Module I
a) The 22 weeks of industrial training would be divided by the hotel for the four key areas of Food Production, Food and Beverage Service, Accommodation Operation, and Front Office Operations.

HAVA6017: VIVA
(0-0-2)

COURSE OUTCOMES
1. Students should be able to synthesize and summarize information.
2. To apply their professional ways of communication which they have to learn during their industrial exposure.
3. To express their views in front of panelists.
4. To explain their learning to others.

Module I
a) Students would be assessed based on their knowledge gained during industrial exposure training before a select panel.

HAOO6018: ADVANCE FOOD PRODUCTION OPERATIONS-I-PRACTICAL
(0-0-4)

COURSE OUTCOMES
1. To demonstrate menu preparation of different cuisines.
2. To relate different desserts
3. To explain the different bread-making procedures with the temperature required.
4. To create a course menu.

Practical
1. 03-course menu of Following Cuisine - Italian, French, Thai, Japanese, Chinese- 12 Menus

Mapping of COs to Syllabus

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HAFB6019: ADVANCE FOOD & BEVERAGE OPERATIONS-PRACTICAL
(0-0-1)

COURSE OUTCOMES
1. To application and able to prepare Flambé Dishes
2. To analyze and apply the concepts of Banquet Service and Bar Setup operations
3. To demonstrate beverage services
4. To understand and execute buffet setups

Practical
1. Service of Spirits
2. Service of Wine
3. Service in Guest Room
4. Preparing Function prospectus
5. Different types of buffet setup
6. Preparations of Flambé dishes, Carving, Salad
7. Preparation/Demonstration of Cocktail

Mapping of COs to the syllabus

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HAFM6020: FRONT OFFICE MANAGEMENT –I-PRACTICAL
(0-0-1)

COURSE OUTCOMES
1. To explain and familiarize with different forms and formats.
2. To understand and analyze the idea about night auditing and cashiering.
3. To discuss Roleplay and different situation handling.
4. To familiarize with basic terms used during the guest cycle.

Practical
1. Familiarization with different forms & formats such as: - Expected arrival/ departure sheet, group/crew arrival sheet, C-Form, Bell’s boy errand card, Cashier report, cashier envelop, encashment certificate, Express C/out, High Balance Report, Incident Report
2. Front office cashiering practices and Night audit practice
3. Roleplay on Check out process for Usage of guest name, FIT, GIT (group leader), handling cash/ credit card, foreign currency.
4. Basis phraseology is used during check-in, check out, and handling situations.

Mapping of COs to the syllabus

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HAHM6021: HOUSEKEEPING MANAGEMENT –I-PRACTICAL
(0-0-1)

COURSE OUTCOMES
1. To demonstrate inventory procedures of stores and other areas of housekeeping
2. To apply different colors & lights according to the décor.
3. To explain window maintenance and different treatment techniques.
4. To analyze maintenance needs of different furniture.

**Practical**
1. Inventory of store and public area, ledger maintenance
2. Preparing Sample color schemes
3. Planning Lighting schemes for different setup
4. Caring and maintaining floors
5. Window maintenance and treatment
6. Maintaining furniture and fixtures

**Mapping of COs to the syllabus**

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**HARP6022: RESEARCH PROJECT**

**(0-8-0)**

**COURSE OUTCOMES**
1. To learn research methods and methodology.
2. To implement thinking capacity in finding solutions or suggestions.
3. To explain the problems formulated for the research project.
4. To evaluate the data received from different sources.

**Instructions**

a. **Generate** an innovative understanding of the texts based on their social and cultural setup. (Creating)

b. Each student shall submit a proposal(s) for the project, he/she wants to undertake in order of preference from which the final topic may be selected. The research project shall be done at the institute labs (experimental method) or as a field study (survey method).

c. Once you have finalized the first draft or synopsis in consultation with your supervisor during SEM-V, plan to write the final research paper during SEM-VI

**Mapping of COs to Syllabus**

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**HAF06023: ADVANCE FOOD PRODUCTION OPERATIONS – II –PRACTICAL**

**(0-0-4)**

**COURSE OUTCOMES**
1. Apply the practical knowledge for planning an elaborate international menu
2. Demonstrate the preparation of different dishes using wine.
3. Understand and identify the gateaux, sorbets and parfaits.
4. Ability to describe and handle hot/cold dessert section.

**Practical**
1. Three-course menus to be formulated featuring international cuisines- 12 Menus
2. Uses of wines in cooking
3. Gateaux
4. Sorbets, parfaits
5. Hot/cold desserts
Mapping of COs to the syllabus

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HABM6024: FOOD & BEVERAGE MANAGEMENT-PRACTICAL
(0-0-1)

**COURSE OUTCOMES**
1. To develop a layout plan for different food outlets.
2. To analyze staff requirements and make a duty roster for implementation.
3. To explain and demonstrate operations of the restaurant, bar, and special events
4. To familiarize with different cocktails and preparation methods.

**Practical**
1. F&B Staff Organization-Class Room Exercise (Case Study method)
2. Developing Organization Structure of various Food & Beverage Outlets
3. Determination of Staff requirements in all categories
4. Making Duty Roster
5. Preparing Job Description & Specification
6. Conducting Briefing & Debriefing
7. Restaurant, Bar, Banquets & Special Events
8. Drafting Standard Operating Systems (SOPs) for various F & B Outlets
9. Supervising Food & Beverage operations
10. Preparing Restaurant Log
11. Designing & setting the bar
12. Preparation & Service of Cocktail & Mixed Drinks

Mapping of COs to the syllabus

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HAFM6025: FRONT OFFICE MANAGEMENT –II-PRACTICAL
(0-0-1)

**COURSE OUTCOMES**
1. To establish SOPs for the department.
2. To understand and demonstrate budget preparation.
3. To analyze staff requirements for the department.
4. To evaluate the need for eco-friendly measures in hotels.
5. To implement all SOPs.

**Practical**
1. Preparing SOP for Guest Arrival
2. Handling complete Guest Departure Procedure
3. Handling all types of cleaning procedures
4. Handling complaints
5. Preparing the operating budget for Room Division Operations
6. Calculating staff requirements for Room Division operations
7. Preparing Duty Rotas
8. Practicing yield management aspects
9. Field visit to an Ecotel to understand eco-friendly measures adopted in hotels.
10. Assignment on new concepts adopted in hotels
11. Practicing on software for Hotel Operations
HAAM6026: HOUSEKEEPING MANAGEMENT –II-PRACTICAL
(0-0-1)

COURSE OUTCOMES
1. To understand the concept of energy conservation.
2. To explain and demonstrate report-making on the pre-opening project.
3. To implement conservation plans.
4. To develop new conservation ideas for properties.

Practical
1. Developing Conservation Concept
2. Project on new Ideas for pre-opening property

Mapping of Cos to the syllabus

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OUR VISION

“TO MOULD INTELLECTUALLY COMPETENT, MORALLY UPRIGHT, SOCIALLY COMMITTED AND SPIRITUALLY INSPIRED PERSONS AT THE SERVICE OF INDIA AND THE WORLD OF TODAY AND TOMORROW, BY IMPARTING HOLISTIC AND PERSONALISED EDUCATION”

TAPESIA GARDENS,
SONAPUR – 782402
ASSAM

AZARA,
GUWAHATI – 781017
ASSAM

KHARGULI CAMPUS,
GUWAHATI – 781004
ASSAM

DON BOSCO
Celebrating 100 Years in North East