ANNAMALAI UNIVERSITY

REGULATIONS FOR THE FIVE YEAR INTEGRATED POSTGRADUATE PROGRAMMES
UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

These Regulations are common to all the students admitted to the Five Year Integrated Master’s Programmes in the Faculties of Arts, Science, Languages, Marine Sciences, and Education from the academic year 2019-2020 onwards.

1. Definitions and Nomenclature

   University refers to Annamalai University.

   Department means any of the academic departments and academic centres at the University.

   Discipline refers to the specialization or branch of knowledge taught and researched in higher education. For example, Botany is a discipline in the Natural Sciences, while Economics is a discipline in Social Sciences.

   Programme encompasses the combination of courses and/or requirements leading to a Degree. For example, M.A., M.Sc.

   Course is an individual subject in a programme. Each course may consist of Lectures/Tutorials/Laboratory work/Seminar/Project work/Experiential learning/ Report writing/viva-voce etc. Each course has a course title and is identified by course code.

   Curriculum encompasses the totality of student experiences that occur during the educational process.

   Syllabus is an academic document that contains complete information about an academic programme and defines responsibilities and outcomes. This includes course information, course objectives, policies, evaluation, grading, learning resources and course calendar.

   Academic Year refers to the annual period of sessions of the University that comprises two consecutive semesters.

   Semester is a half-year term that lasts for a minimum of 90 working days. Each academic year is divided into two semesters.

   Choice Based Credit System A mode of learning in higher education that enables a student to have the freedom to select his/her own choice of elective courses across various disciplines for completing the Degree programme.

   Core Course is mandatory and an essential requirement to qualify for the Degree.

   Elective Course is a course that a student can choose from a range of alternatives.

   Value Added Courses are optional courses that complement the students’ knowledge and skills and enhance their employability.

   Experiential Learning is a process of learning through experience. It is specifically defined as “learning through reflection on doing”.

   Extension activities are the activities that provide a link between the University and the community such as lab-to-land, literacy, population education, and health awareness programmes. These are integrated within the curricula with a view to sensitise the students about Institutional Social Responsibility (ISR).

   Credit refers to the quantum of course work in terms of the number of class hours in a semester required for a programme. The credit value reflects the content and duration of a particular course in the curriculum.
Credit Hour refers to the number of class hours per week required for a course in a semester. It is used to calculate the credit value of a particular course.

Programme Outcomes (POs) are statements that describe crucial and essential knowledge, skills, and attitudes that students are expected to achieve and can reliably manifest at the end of a programme.

Programme Specific Outcomes (PSOs) are statements that list what the graduate of a specific programme should be able to do at the end of the programme.

Learning Objectives (also known as Course Objectives) are statements that define the expected goal of a course in terms of demonstrable skills or knowledge that will be acquired by a student as a result of instruction.

Course Outcomes (COs) are statements that describe what students should be able to achieve/demonstrate at the end of a course. They allow follow-up and measurement of learning objectives.

Grade Point Average (GPA) is the average of the grades acquired in various courses that a student has taken in a semester. The formula for computing GPA is given in Section 11.3.

Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student in all the semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters.

Letter Grade is an index of the performance of a student in a particular course. Grades are denoted by the letters S, A, B, C, D, E, and RA.

2. Programmes Offered and Eligibility Criteria

The Integrated Programmes offered by the University and the eligibility criteria are detailed below.

<table>
<thead>
<tr>
<th>Faculty of Arts</th>
<th>Eligibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Programme</td>
</tr>
<tr>
<td>M.A. History</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto.</td>
</tr>
<tr>
<td>M.A. Political Science</td>
<td></td>
</tr>
<tr>
<td>M.A. Economics</td>
<td></td>
</tr>
<tr>
<td>M.A. Sociology</td>
<td></td>
</tr>
<tr>
<td>M.A. Population and Development</td>
<td></td>
</tr>
<tr>
<td>M.Lib.I.Sc.</td>
<td></td>
</tr>
<tr>
<td>M.A. Rural Development</td>
<td></td>
</tr>
<tr>
<td>M.Com.</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto (Commerce and Accountancy Group only).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Faculty of Science</th>
<th>Eligibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Programme</td>
</tr>
<tr>
<td>M.Sc. Mathematics</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto with a minimum aggregate of 40% marks under academic stream in the following subjects viz. Mathematics, Physics &amp; Chemistry.</td>
</tr>
<tr>
<td>M.Sc. Physics</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto with a minimum aggregate of 40% marks under academic stream in the following subjects viz. Physics, Chemistry &amp; Mathematics.</td>
</tr>
<tr>
<td>M.Sc. Botany</td>
<td>A pass in H.S.E. (10+2 level) regular or vocational with Botany/Biology or Vocational course with Agriculture/Plant Protection as one of the courses.</td>
</tr>
<tr>
<td>M.Sc. Biotechnology</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto under academic stream with a minimum aggregate of 40% marks in any one of the following combinations: 1. Physics, Chemistry &amp; Mathematics 2. Physics, Chemistry &amp; Mathematics.</td>
</tr>
<tr>
<td>Course</td>
<td>Qualification</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>M.Sc. Microbiology</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto under academic stream</td>
</tr>
<tr>
<td></td>
<td>with Physics, Chemistry and Biology or Computer Science or Biochemistry or</td>
</tr>
<tr>
<td></td>
<td>Home Science or Agri. or any Vocational Course with Biology or Botany and</td>
</tr>
<tr>
<td></td>
<td>Zoology.</td>
</tr>
<tr>
<td>M.Sc. Geology</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent with Science Subjects.</td>
</tr>
<tr>
<td>M.Sc. Statistics</td>
<td>A pass in H.S.E. (10+2 level) OR an Equivalent examination thereto under</td>
</tr>
<tr>
<td></td>
<td>academic stream with Mathematics / Statistics / Business Mathematics /</td>
</tr>
<tr>
<td></td>
<td>Computer Science as one of the subjects.</td>
</tr>
<tr>
<td>M.Sc. Zoology</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto with a minimum aggregate</td>
</tr>
<tr>
<td></td>
<td>of 40% marks under academic stream in the following subjects viz. Physics,</td>
</tr>
<tr>
<td></td>
<td>Chemistry and Biology or Zoology and Botany.</td>
</tr>
<tr>
<td>M.Sc. Software Engineering</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto under academic stream</td>
</tr>
<tr>
<td></td>
<td>with Mathematics, as one of the Subjects.</td>
</tr>
<tr>
<td>M.Sc. Information Technology</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto under academic stream</td>
</tr>
<tr>
<td></td>
<td>with Mathematics as one of the subjects.</td>
</tr>
</tbody>
</table>

**Faculty of Marine Sciences**

<table>
<thead>
<tr>
<th>Course</th>
<th>Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.Sc. Ocean Science &amp; Technology</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto under Academic Stream in</td>
</tr>
<tr>
<td></td>
<td>the following subjects viz. Mathematics, Physics, Chemistry &amp; Biology.</td>
</tr>
</tbody>
</table>

**Faculty of Languages**

<table>
<thead>
<tr>
<th>Course</th>
<th>Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.A. Tamil</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto.</td>
</tr>
<tr>
<td>M.A. English</td>
<td>A pass in H.S.E. (10+2 level) OR Equivalent thereto.</td>
</tr>
</tbody>
</table>

**Faculty of Education**

<table>
<thead>
<tr>
<th>Course</th>
<th>Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.Sc. Clinical Psychology</td>
<td>A pass in H.S.E. (10 + 2) OR Equivalent thereto.</td>
</tr>
</tbody>
</table>

In the case of SC/ST and Differently-abled candidates, a pass is the minimum qualification for all the above Programmes.

3. **Reservation Policy**
   Admission to the various programmes will be strictly based on the reservation policy of the Government of Tamil Nadu.

4. **Programme Duration**
   The Five Year Master’s Programmes consist of five academic years and ten semesters. Each academic year is divided into two semesters, the first being from July to November and the second from December to April.

   Each semester will have 90 working days (18 weeks).

5. **Programme Structure**
   The Five Year Integrated Programme consists of Language Courses, Core Courses, Allied Courses, Elective Courses, Soft Skills, Experiential Learning and Project. Students shall also participate in Extension Activities as part of their curriculum.

**Language Courses**
   Each student shall take two languages of four courses each, one in each semester for the first two years of the programme.

   Language-I shall be Tamil or another language such as Hindi or French.

   Language-II shall be English.

**Core courses**
These are a set of compulsory courses essential for each programme.

The core courses include both Theory (Core Theory) and Practical (Core Practical) courses.

**Allied Courses**
Each student shall take courses in two disciplines allied to the main subject (Allied-I and Allied-II) of the programme in the first four semesters.

In Arts, Languages, and Education, there will be three Theory Courses each for Allied-I and Allied-II.

In Science and Marine Sciences, there will be two Theory courses and one Practical course each for Allied-I and Allied-II. (Allied Maths two theory paper only)

**Elective Courses**

**Departmental Electives (DEs)** are the electives that students can choose from a range of Electives offered within the Parent Department offering the Programme.

**Interdepartmental Electives (IDEs)** are electives that students can choose from amongst the courses offered by other departments of the same faculty as well as by the departments of other faculties.

*Students shall take a combination of both DEs and IDEs.*

**Soft Skills**
Soft skills are intended to enable students to acquire attributes that enhance their performance and achieve their goals with complementing hard skills.

Soft skills include communication skills, computer skills, social skills, leadership traits, teamwork, development of emotional intelligence quotients, among others.

Each student shall choose four courses on soft skills from a range of courses offered from the First to the Sixth Semester.

**Value Education**
All students shall take a course on Value Education that includes human values, sustainable development, gender equity, ethics and human rights.

**Experiential Learning**
Experiential learning provides opportunities to students to connect principles of the discipline with real-life situations.

In-plant training/field trips/internships/industrial visits (as applicable) fall under this category.

**Extension Activities**
It is mandatory for every student to participate in extension activities.

All the students shall enrol under NSS/NCC/YRC/RRC or any other Service Organisation in the University.

Students shall put in a minimum attendance of 40 hours in a year duly certified by the Programme Co-ordinator.

Extension activities shall be conducted outside the class hours.
**Project**
Each student shall undertake a Project in the final semester.

The Head of the Department shall assign a Project Supervisor to the student.

The Project Supervisor shall assign a topic for the project and monitor the progress of the student periodically.

Students who wish to undertake project work in recognised institutions/industry shall obtain prior permission from the University. The Project Supervisor will be from the host institute, while the Co-Supervisor shall be a faculty in the parent department.

**Value Added Courses (VACs)**
Students may also opt to take Value Added Courses beyond the minimum credits required for the award of the Degree. VACs are outside the normal credit paradigm.

VACs enhance the students’ employability and life skills. VACs are listed on the University website and in the Handbook on Interdepartmental Electives and VACs.

Each VAC carries 2 credits with 30 hours of instruction, of which 60% (18 hours) shall be Theory and 40% (12 hours) Practical.

Classes for VACs are conducted beyond the regular class hours and preferably in the VIII and IX Semesters.

**Online Courses**
The Heads of Departments shall facilitate enrolment of students in Massive Open Online Courses (MOOCs) platform such as SWAYAM to provide academic flexibility and enhance the academic career of students.

5.11.2 Students who successfully complete a course in the MOOC platform shall be exempted from one elective course of the programme.

**Credit Distribution**
The credit distribution is detailed in the Table.

<table>
<thead>
<tr>
<th>Semester I to VI</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language-I (Tamil or any other Language)</td>
<td>12</td>
</tr>
<tr>
<td>Language-II (English)</td>
<td>12</td>
</tr>
<tr>
<td>Core Courses</td>
<td>60-65</td>
</tr>
<tr>
<td>Allied-I</td>
<td>10</td>
</tr>
<tr>
<td>Allied-II</td>
<td>10</td>
</tr>
<tr>
<td>Electives</td>
<td>15</td>
</tr>
<tr>
<td>Soft skills</td>
<td>12</td>
</tr>
<tr>
<td>Environmental studies (UGC mandated)</td>
<td>2</td>
</tr>
<tr>
<td>Value Education</td>
<td>2</td>
</tr>
<tr>
<td>Experiential learning</td>
<td>4</td>
</tr>
<tr>
<td>Extension activities</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Credits (Semester I to VI)</strong></td>
<td><strong>140-145</strong></td>
</tr>
</tbody>
</table>

<p>| Semester VII to X | |
|-------------------| |</p>
<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td>65-75</td>
</tr>
<tr>
<td>Electives</td>
<td>15</td>
</tr>
<tr>
<td>Project</td>
<td>6-8</td>
</tr>
<tr>
<td>Total Credits (Semester VII to X)</td>
<td>90-95</td>
</tr>
<tr>
<td>Total Credits Semester I to X (Minimum requirement for the award of Degree)</td>
<td>*230-240 *</td>
</tr>
</tbody>
</table>

*Each Department shall fix the minimum required credits for award of the Degree within the prescribed range of 230-240 credits.*

**Credit Assignment**

Each course is assigned credits and credit hours on the following basis:

1 Credit is defined as:

1. Lecture period of one hour per week over a semester
2. Tutorial period of one hour per week over a semester
3. Practical/Project period of two or three hours (depending on the discipline) per week over a semester.

**6. Attendance**

Each faculty handling a course shall be responsible for the maintenance of *Attendance and Assessment Record* for students who have registered for the course.

The record shall contain details of the students’ attendance, marks obtained in the Continuous Internal Assessment (CIA) Tests, Assignments and Seminars. In addition, the record shall also contain the organisation of lesson plan of the Course Instructor.

The record shall be submitted to the Head of the Department once a month for monitoring the attendance and syllabus coverage.

At the end of the semester, the record shall be duly signed by the Course Instructor and the Head of the Department and placed in safe custody for any future verification.

The Course Instructor shall intimate to the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students.

Each student should earn a minimum of 75% attendance in the courses of the particular semester failing which he or she will not be permitted to write the End-Semester Examination. The student has to redo the semester in the next year.

Relaxation of attendance requirement up to 10% may be granted for valid reasons such as illness.

**7. Mentor-Mentee System**

To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as a Mentor throughout their period of study.

The Mentors will guide their mentees with the curriculum, monitor their progress, and provide intellectual and emotional support.

The Mentors shall also help their mentees to choose appropriate electives and value-added courses, apply for scholarships, undertake projects, prepare for competitive examinations such as NET/SET, GATE etc., attend campus interviews and participate in extracurricular activities.
8. Examinations
The examination system of the University is designed to systematically test the student's progress in class, laboratory and fieldwork through Continuous Internal Assessment (CIA) Tests and End-Semester Examination (ESE).

There will be two CIA Tests and one ESE in each semester.

The Question Papers will be framed to test different levels of learning based on Bloom’s taxonomy, viz. Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation/Creativity.

Continuous Internal Assessment Tests

The CIA Tests shall be a combination of a variety of tools such as class tests, assignments, seminars, and viva-voce that would be suitable for the course. This requires an element of openness.

The students are to be informed in advance about the assessment procedures.

The pattern of question paper will be decided by the respective faculty.

CIA Test-I will cover the syllabus of the first two units while CIA Test-II will cover the last three units.

CIA Tests will be for one to three hours duration depending on the quantum of syllabus.

A student cannot repeat the CIA Test-I and CIA Test-II. However, if for any valid reason, the student is unable to attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

End Semester Examinations (ESEs)
The ESEs for the odd semester will be conducted in November and for the even semester in May.

A candidate who does not pass the examination in any course(s) will be permitted to reappear in such course(s) in the subsequent semester/year.

The ESE will be of three hours duration and will cover the entire syllabus of the course.

9 Evaluation
Marks Distribution
Each course, both Theory and Practical, as well as Project/Internship/Fieldwork/In-plant training, shall be evaluated for a maximum of 100 marks.

For the theory courses, CIA Tests will carry 25% and the ESE, 75% of the marks.

For the Practical courses, the CIA Tests will constitute 40% and the ESE 60% of the marks.

Assessment of CIA Tests
For the CIA Tests, the assessment will be done by the Course Instructor
For the Theory Courses, the break-up of marks shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-I &amp; Test-II</td>
<td>15</td>
</tr>
<tr>
<td>Seminar</td>
<td>5</td>
</tr>
<tr>
<td>Assignment</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

For the Practical Courses (wherever applicable), the break-up of marks shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-I</td>
<td>15</td>
</tr>
<tr>
<td>Test-II</td>
<td>15</td>
</tr>
<tr>
<td>Viva-voce and Record</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
</tr>
</tbody>
</table>

**Assessment of End-Semester Examinations**

Double Evaluation for the ESE is done by the University Teachers.

In case of a discrepancy of more than 10% between the two examiners in awarding marks, third evaluation will be resorted to.

**Assessment of Project/Dissertation**

The Project Report/Dissertation shall be submitted as per the guidelines laid down by the University.

The Project Work/Dissertation shall carry a maximum of 100 marks.

CIA for Project will consist of Review of literature, experimentation/fieldwork, attendance etc.

The Project Report evaluation and viva-voce will be conducted by a committee constituted by the Head of the Department.

The Project Evaluation Committee will comprise of the Head of the Department, Project Supervisor, and a senior faculty.

9.4.7 The marks shall be distributed as follows:

<table>
<thead>
<tr>
<th>Continuous Internal Assessment (25 Marks)</th>
<th>End Semester Examination (75 Marks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review-I 10</td>
<td>Project / Dissertation Evaluation</td>
</tr>
<tr>
<td>Review-II: 15</td>
<td>Viva-voce</td>
</tr>
<tr>
<td></td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

**Assessment of Value Added Courses**

VACs shall be evaluated completely by Internal Examiners.

Two CIA Tests shall be conducted during the semester by the Department(s) offering VAC.

A committee consisting of the Head of the Department, faculty handling the course and a senior faculty member shall monitor the evaluation process.
The grades obtained in VACs will not be included for calculating the GPA.

**Passing Minimum**

A candidate is declared to have passed in each course if he/she secures not less than 40% marks in the ESE and not less than 50% marks in aggregate taking CIA and ESE marks together.

9.6.4 A candidate who has not secured a minimum of 50% of marks in a course (CIA + ESE) shall reappear for the course in the next semester/year.

**10. Conferment of the Master’s Degree**

A candidate who has secured a minimum of 50% marks in all courses prescribed in the programme and earned the minimum required credits shall be considered to have passed the Master’s Programme.

**11. Marks and Grading**

The performance of students in each course is evaluated in terms of Grade Point (GP).

The sum total performance in each semester is rated by Grade Point Average (GPA) while Cumulative Grade Point Average (CGPA) indicates the Average Grade Point obtained for all the courses completed from the first semester to the current semester.

The GPA is calculated by the formula

\[
GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}
\]

where \( C_i \) is the Credit earned for the Course \( i \) in any semester; \( G_i \) is the Grade Point obtained by the student for the Course \( i \) and \( n \) is the number of Courses passed in that semester.

\[
CGPA = \frac{\sum_{i=1}^{m} \sum_{j=1}^{n} C_i G_{ij}}{\sum_{i=1}^{m} \sum_{j=1}^{n} C_i}
\]

where \( C_i \) is the Credit earned for the Course \( i \) in any semester; \( G_{ij} \) is the Grade Point obtained by the student for the Course \( i \) and \( n \) is the number of Courses passed in the current semester. \( m \) is the number of semesters.

Evaluation of the performance of the student will be rated as shown in the Table.

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Points</th>
<th>Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>10</td>
<td>90 and above</td>
</tr>
<tr>
<td>A</td>
<td>9</td>
<td>80-89</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>70-79</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>60-69</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>55-59</td>
</tr>
</tbody>
</table>
Classification of Results. The successful candidates are classified as follows:

For **First Class with Distinction**: Candidates who have passed all the courses prescribed in the Programme *in the first attempt* with a CGPA of 8.25 or above within the programme duration. Candidates who have withdrawn from the End Semester Examinations are still eligible for First Class with Distinction (See Section 12 for details).

For **First Class**: Candidates who have passed all the courses with a CGPA of 6.5 or above.

For **Second Class**: Candidates who have passed all the courses with a CGPA between 5.0 to less than 6.5.

Candidates who obtain highest marks in all examinations at the first appearance alone will be considered for University Rank.

**Course-Wise Letter Grades**

The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

A candidate is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than RA.

A course completed successfully, cannot be repeated for the purpose of improving the Grade Point.

A letter grade RA indicates that the candidate shall reappear for that course. The RA Grade once awarded stays in the grade card of the student and is not deleted even when he/she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the Odd/Even semester in which the student has re-appeared.

If a student secures RA grade in the Project Work/Field Work/Practical Work/Dissertation, he/she shall improve it and resubmit if it involves only rewriting/incorporating the clarifications suggested by the evaluators or he/she can re-register and carry out the same in the subsequent semesters for evaluation.

12. **Provision for Withdrawal from the End Semester Examination**

The letter grade W indicates that a candidate has withdrawn from the examination.

A candidate is permitted to withdraw from appearing in the ESE for one or more courses in ANY ONE of the semesters ONLY for exigencies deemed valid by the University authorities.

Permission for withdrawal from the examination shall be granted only once during the entire duration of the programme.
Application for withdrawal shall be considered **only** if the student has registered for the course(s), fulfilled the requirements for attendance and CIA tests.

The application for withdrawal shall be made ten days prior to the commencement of the examination and duly approved by the Controller of Examinations. Notwithstanding the mandatory prerequisite of ten days notice, due consideration will be given under extraordinary circumstances.

Withdrawal is **not** granted for arrear examinations of courses in previous semesters (for which the student has secured RA Grade) and for the final semester examinations.

Candidates who have been granted permission to withdraw from the examination shall reappear for the course(s) in the subsequent semester.

Withdrawal shall not be taken into account as an appearance for the examination when considering the eligibility of the student to qualify for First Class with Distinction.

13. **Academic misconduct**
Any action that results in an unfair academic advantage/interference with the functioning of the academic community constitutes academic misconduct. This includes but is not limited to cheating, plagiarism, altering academic documents, fabrication/falsification of data, submitting the work of another student, interfering with other students’ work, removing/defacing department library or computer resources, stealing other students’ notes/assignments, electronically interfering with other students’/ University's intellectual property. Since many of these acts may be committed unintentionally due to lack of awareness, students shall be sensitised on issues of academic integrity and ethics.

14. **Transitory Regulations**
Wherever there has been a change of syllabi, examinations based on the existing syllabus will be conducted for two consecutive years after the implementation of the new syllabus in order to enable the students to clear the arrears. Beyond that, the students will have to take up their examinations in equivalent subjects, as per the new syllabus, on the recommendation of the Head of the Department concerned.

15. **Notwithstanding anything contained in the above pages as Rules and Regulations governing the Five Year Integrated Master’s Programmes at Annamalai University, the Syndicate is vested with the powers to revise them from time to time on the recommendations of the Academic Council.**
PROGRAMME OUTCOMES

PO1. Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.

PO2. Resource Utilisation: Cultivate the skills to acquire and use appropriate learning resources including library, e-learning resources, ICT tools to enhance knowledge-base and stay abreast of recent developments.

PO3. Analytical and Technical Skills: Ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects/limitations.

PO4. Critical thinking and Problem solving: Identify and critically analyse pertinent problems in the relevant discipline using appropriate tools and techniques as well as approaches to arrive at viable conclusions/solutions.

PO5. Project Management: Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyse and interpret data and provide solutions. Exhibit organisational skills and the ability to manage time and resources.

PO6. Individual and teamwork: Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.

PO7. Effective Communication: Communicate effectively in spoken and written form as well as through electronic media with the scientific community as well as with society at large. Demonstrate the ability to write dissertations, reports, make effective presentations and documentation.

PO8. Environment and Society: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.

PO9. Ethics: Commitment to professional ethics and responsibilities.

PO10. Life-long learning: Ability to engage in life-long learning in the context of the rapid developments in the discipline.

PROGRAMME SPECIFIC OUTCOMES

PSO1 Gains complete knowledge about all fundamental aspects of all branches of chemistry.

PSO2 Understands the basic concepts of organic chemistry like reagents in organic syntheses, stereochemistry, instrumental method of chemical analysis and natural products etc.

PSO3 Identify the importance inorganic chemistry includes coordination chemistry, role of metal ions in biological processes and organometallic chemistry.

PSO4 Gathers attention about the physical aspects of molecules like molecular spectroscopy, role of catalysts, polymer chemistry, materials chemistry and bio-physical chemistry.

PSO5 Learns about the potential uses of analytical industrial chemistry, medicinal chemistry, and environment oriented chemistry. Apply the various analytical techniques like IR, mass, NMR, NQR, EPR, XRD to structural characterization of unknown compounds.

PSO6 Carry out experiments in the area of organic analysis, estimation, separation derivative process, inorganic semi microanalysis, preparation, conductometric and potentiometric analysis.

PSO7 Obtain knowledge in Spectral, Analytical, Qualitative & Quantitative techniques and contribute new scientific insights or innovative applications of chemical research to the next generation.
## M. Sc. Chemistry (5-Year Integrated) Programme

**PROGRAMME CODE: SCHE51**

Programme Structure

(For students admitted from the academic year 2019 - 2020)

**Total Credits: 228**

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**TOTAL CREDITS** 237

- L- Lectures; P- Practical; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination
**Note:**

1. Students shall take both Department Electives (DEs) and Interdepartmental Electives (IDEs) from a range of choices available.

2. Students may opt for any Value-added Courses listed in the University website.

### DEPARTMENT ELECTIVE COURSES

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## ANCILLARY COURSES OFFERED TO OTHER DEPARTMENTS

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19ICHT14 - Inorganic, Organic and Physical Chemistry – I

Learning Objectives:
To learn the basic principles of atomic structure, bonding and the concepts of gaseous and liquid states

Unit–I: Atomic Structure and Periodic Properties

Unit–II: Study of s block elements I – Hydrogen and alkali metals
Alkali metals – Electronic structure, sizes of atoms and ions. Chemical properties: Oxides, hydroxides, peroxides and superoxides, hydrides and halides of alkali metals.
Compounds of Li, Na and K - preparation, properties and uses of LiCl, Li$_2$CO$_3$, washing soda, baking soda, sodium nitrite, sodamide, KI and KCN.

Unit–III: Formation and Characters of Covalent Bond Involving Carbon

Unit–IV: Alkanes, Alkenes and Alkynes
Oxidation, reduction and polymerization.Uses of ethylene and propene. Cumulative, conjugated and isolated double bonds. 1,3 Butadiene, 1,4-addition. Diels – Alder reaction, polymerization reactions of butadiene.

Unit–V: Gaseous and Liquid States

Text Books

Supplementary Reading

**Course Outcomes:**

- **CO1** Students will know the important basics of chemistry
- **CO2** Students will start the basic building of chemistry principles in inorganic, organic and physical chemistry.

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19ICHT24 - Inorganic, Organic and Physical Chemistry – II

Learning Objectives:

To learn the basic principles of periodic classification, organic functional groups and thermodynamics

Unit – I: Study of s block elements II - Alkaline Earth Metals

Electronic structure – sizes of atoms and ions. Chemical properties – Oxides, hydroxides, peroxides, nitriles, carbides, hydrides and halides of alkaline earth metals comparison of Be and Mg with other alkaline earth metals – Comparison of alkaline earth metals with alkali metals - Plaster of Paris, Portland cement – Hardness of water.

Unit – II: Arene, Alkyl Halides and Aryl Halides


Preparation, physical properties and chemical reactions of alkyl halides. SN1 and SN2 mechanisms. Manufacture, properties, reactions and uses of CHCl3 and CCl4, vinyl chloride, allyl chloride and chlorobenzene. Relative reactivities of alkyl, aryl, vinyl and allyl halides.

Unit – III: Alcohols and Phenols


Dihydric alcohols – nomenclature, methods of formation, chemical reactions of vicinal diols, oxidative cleavage by Pb(OAc)4 and HIO4 and pinacol-pinacolone rearrangement. Glycerol – manufacture, properties, reactions and uses.


Unit – IV: Chemical Kinetics and Catalysis


Unit – V: Thermodynamics - I

Definition of system and surroundings. Types of systems, thermodynamic properties - intensive and extensive properties. State and path functions - Concept of heat and work – thermodynamic equilibrium – reversible and irreversible processes.

First law of thermodynamics: statement - heat capacities at constant volume and constant pressure, relationship between Cv and Cp.

Joule’s law – Joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

**Text Books**


**Supplementary Reading**

10) S. Glasstone, Thermodynamics for Chemists; Affiliated East West Press, 2008.

**Course Outcomes:**

**CO1** Students will know the important basics of chemistry

**CO2** Students will start the basic building of chemistry principles in inorganic, organic and physical chemistry.

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19ICHP25: Practical – I: Volumetric Analysis

Learning Objectives

To learn the basic principles of acid base titrations, important concepts of redox, precipitation titrations.

1. Acid-base Titrations:
   a) Determination of NaOH and Na₂CO₃ in a mixture by double titration.
   b) Estimation of barium chloride
   c) Determination of ammonium ion

2. Redox Titrations:
   a) Permanganametry – Estimation of ferrous and ferric ions in a mixture
   b) Estimation of oxalic acid and oxalate ion.
   c) Dichromatory – Estimation of Fe²⁺ and Fe³⁺ ions
   d) Iodometry – Estimation of copper

3. Precipitation Titration: Determination of chloride

Text Book:


Course outcomes:

**CO1** Students will know the important basics of practical chemistry

**CO2** Students will understand the principles involved in practical physical chemistry

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Learning Objectives:
To learn the basic principles of chemical bonding, classifications of organic compounds and the concepts of electrochemistry

Unit – I: Chemical Bonding

Unit – II: Acids, Bases and Non Aqueous Solvents
Bronsted definition, Lewis definition, Lux-Flood definition – Usanovich’s generalized definition – Ka, Kb for Bronsted acids and bases. Relative strengths of Bronsted acids and bases- pH of Buffer solution- Henderson’s equation. Theory of acid base indicators. Non-aqueous solvents, liquid NH₃, liq.SO₂ and HF.

Unit – III: Ethers, Epoxides, Aldehydes and Ketones

Unit – IV: Carboxylic Acids and their Derivatives

Unit – V: Electrochemistry - I

Text Books

Course Outcomes:

CO1 Students will understand the important basics of chemical bonding
CO2 Students will gain knowledge in various organic functional groups
CO3 Students will appreciate the fundamentals of electrochemistry

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19ICHP34: Practical II - Inorganic Qualitative Analysis

Learning Objectives:

To analyze the inorganic mixture containing two cations and two anions
Analysis of mixture containing two cations and two anions of which one will be an interfering ion. Semi micro methods using the conventional scheme with hydrogen sulphide may be adopted.

Cations to be studied: Lead, Copper, Bismuth, Cadmium, Iron, Aluminium, Zinc, Manganese, Cobalt, Nickel, Barium, Calcium, Strontium, Magnesium and Ammonium.

Anions to be studied: Carbonate, Sulphide, Sulphate, Nitrate, Chloride, Bromide, Fluoride, Borate, Oxalate and Phosphate.


Course Outcomes:

CO1 Students will able to perform inorganic analysis systematically and independently

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Learning Objectives:

To learn the basic principles of metallurgy, important classifications of organic compounds and stereochemistry and to learn the concepts of Thermodynamics.

Unit – I: Metallurgy

Occurrence of metals. Extraction and concentration of ore. Various methods of concentration of ore. Various processes involved in metallurgy such as calcination, roasting, smelting, zone refining and froth flotation. Various types of reductions of metallic oxides into metals. Types of furnaces used in metallurgy. Reverberatory furnaces and blast furnace. Extraction of titanium, vanadium, chromium, iron and copper from their ores. Refining of metals-Electrolytic refining, Zone refining. Important physical and chemical properties of Ti, Th, U, Pb, Zn, Al, Fe and Cu. Important alloys of Ti, V, Cr, Pb, Zn, Al, Fe and Cu with special reference to steel and alloy steels.

Unit – II: Organic Compounds of Nitrogen


Unit – III: Stereochemistry of Organic Compounds


Unit – IV: Thermodynamics - II

Second law of thermodynamics: Need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature. Concept of entropy: Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change during physical change, Clausius inequality, entropy as criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases. Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities. A and G as criteria for the thermodynamic equilibrium and spontaneity Variation of G and A with P, V and T.

Unit – V: Colloidal State and Adsorption

Definition and classification of colloids.

Text Books:


Supplementary Reading

Course Outcomes:
CO1 Students will know the important basics of metalurgy
CO2 Students will understand various organic compounds and stereochemistry
CO3 Students will appreciate the fundamentals of physical chemistry particularly thermodynamics

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19ICHP44: Practical III - Preparation and Analysis of Organic Compounds

Course Objectives:

To understand single step preparations of organic compounds

Preparations: Single step preparation involving reactions such as nitration, bromination, hydrolysis and acetylation.

Qualitative Analysis

a) Detection of N, S and Cl in organic compounds
b) Characterization of organic compounds as acidic, basic and neutral
c) Differentiation of organic compounds as saturated, unsaturated and aromatic and non-aromatic
d) Finding the presence of the following functional groups in organic compounds containing only one such functional group – phenolic, carboxyl, dicarboxyl, ester, nitro, amide, ketone, aldehyde
e) Analysis of carbohydrates (reducing and non-reducing)

Course Outcomes:

CO1 Students will able to perform single step preparations independently
Learning Objectives:
To learn the basic concepts of analytical Chemistry, basic principles error analysis and the important concept of separation methods

Unit – I: Basic concepts of analytical chemistry

Unit – II: Errors and their Evaluation
Definition of terms mean and median. Precision-standard deviation, relative standard deviation. Accuracy-absolute error, relative error. Types of errors in experimental data-determinate (systematic), indeterminate (or random) and gross. Sources of errors and the effects upon the analytical results. Methods for reporting analytical data. Statistical evaluation of data-indeterminate errors. The uses of statistics.

Unit – III: Titrimetric Analysis
Complexometric titration, EDTA titrations, EBT and murexide indicator. Titrations in non-aqueous solvents – solvents for non-aqueous titrations - Indicators for non-aqueous titrations.

Unit – IV : Gravimetric Analysis
Thermal analytical methods – Principle involved in thermogravimetric analysis and differential thermal analysis.

Unit – V : Separation Methods
Solvent extraction: Principles and process of solvent extraction – Distribution law and the partition coefficient – Batch extraction – Continuous extraction.

Text Books:

**Supplementary Reading:**


**Course Outcomes:**

CO1 Students will know the advanced basics of analytical chemistry

| PO and PSO/Course outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
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19ICHT51 - Organic Chemistry – I

Learning Objectives

To learn the important classifications and nomenclature of organic compounds and to learn the concepts of conformational analysis.

Unit – I: Nomenclature – Electron Displacements

Rules of IUPAC nomenclature – nomenclature of condensed carbocyclic and aromatic systems – heterocyclic rings (containing one, two and three hetero atoms) - Fused ring systems.

Unit – II: Preparation and Synthetic uses of Malonic Esters, Ethyl acetoacetate and Grignard Reagents


Unit – III: Conformational Analysis

Conformations of ethane, n-butane, 1,2-dichloroethane and 1,2-ethanediol - relative stabilities of gauche and anti conformations – Representation of conformations of 1,2-disubstituted ethanes, meso- and dl-tartaric acids, erythro- and threo-1,2-dibromo-1-phenylpropane by Newman projection and Sawhorse formulae. Conformation of cyclohexane and its monosubstituted derivatives, conformational energy of a substituent, OH, CH₃, CH₂CH₃, CH(CH₃)₂ and C(CH₃)₃.

Unit – IV: Heterocyclic Compounds


Unit – V: Alkaloids and Terpenoids


Structure and synthesis of citral, geraniol and α-terpineol.

Text Books :


Supplementary Reading


**Course Outcomes**

**CO1** Students will know the important basics conformational analysis

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19ICHT52 - Inorganic Chemistry – I

Learning Objectives:
To learn the basic principles of chemical bonding, classifications of inorganic compounds and the concepts of nuclear chemistry.

Unit – I: Nature of Bonding of Main Group Elements

Unit – II: Metallic Bonding

Unit – III: Study of p- Block Elements
Nitrogen family, comparative study of N, P, As, Sb and Bi elements- oxides, oxyacids, halides, hydrides. Structure and uses of hydrazine, hydroxylamine, hydrazoic acids- Preparation and uses of NaBiO₃ - Nitrogen fertilizers.
Properties of Halogens - Halogen oxides-Oxoacids - Interhalogen compounds.
Noble gases: Electronic configuration - reason for placing in zero group position in the periodic table - Chemical inertness of noble gases – reasons - applications - Clathrates and compounds of Xenon.

Unit – IV: Chemistry of d and f Block Elements
Chemistry of f-block elements – comparative account of lanthanides and actinides, occurrence, elements oxidation states, magnetic properties colour and spectra – lanthanide contraction – causes, consequences and uses – comparison between 3d and 4f block elements.

Unit – V: Nuclear Chemistry – I
Modes of radioactive decay: α and β decay, Radioactive decay constant. Radioactive equilibrium, Orbital electron capture, nuclear isomerism, internal conversion – Detection and determination of radioactivity – Cloud chamber, Nuclear emulsion, Bubble chamber, Proportional counter, Geiger – Muller counter, scintillation and Cherenkov counters - particle accelerators: linear, cyclotron, synchrotron, betatron and bevatron.

Text Books:
Supplementary Reading


Course Outcomes

**CO1** Students will know the important basics of chemical bonding

**CO2** Students will understand various Inorganic compounds

**CO3** Students will appreciate the fundamentals of nuclear chemistry

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Learning Objectives

To learn the advanced concepts of electrochemistry, basic principles Phase equilibria and important concepts of molecular structure

Unit – I: Electrochemistry - II


Unit – II : Phase Equilibrium

Equilibrium between two phases of one component, Clapeyron equation and Clausius-Clapeyron equation - applications.

Statement and meaning of the terms – phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system – water, CO₂ and sulphur systems.

Phase equilibrium of two component system – simple eutectic Bi-Cd and Pb - Ag systems, compound formation and formation of solid solution, phase diagram for Fe-C system.

Unit – III: Binary Systems

Solution, concentration units - molarity, molality and normality – ideal solution ΔH, ΔV, ΔS thermodynamics of ideal solution ΔH_{mix}, ΔV_{mix} and ΔS_{mix}.

Binary liquid systems, Raoult’s law, vapour pressure of ideal solution, deviations from ideal behaviour – vapour pressure – composition curves and temperature – composition curves.

Fractional distillation of binary liquid solution, azeotropic distillation.

Partially miscible liquid pairs – phenol – water, triethylamine-water and nicotine-water systems CST and effect of impurities on CST – Immiscible liquids.

Theory and application of steam distillation – Solution of gases in liquids – factors influencing the solubility of gas in a liquid, Henry’s law.

Unit – IV: Colligative Properties

Theory of dilute solutions – colligative properties – lowering of vapour pressure, osmotic pressure, elevation of boiling point and depression of freezing point - basic explanation - Thermodynamic derivation of elevation of boiling point and depression in freezing point – determination of molecular mass from boiling point measurements, freezing point measurements and osmotic pressure measurements – abnormal molar mass and van ’t Hoff factor – distribution law – distribution coefficient – condition for the validity of the distribution law and thermodynamic derivation – association and dissociation of the solute in one of the solvents.

Unit – V: Group theory


Text Books:


**Supplementary Reading:**

**Course Outcomes**
- **CO1** Students will know the advanced basics of electrochemistry
- **CO2** Students will appreciate the fundamentals of physical chemistry like phase equilibria and molecular structure.

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SEMESTER - V
Credits: 6
Hours: 12

19ICHP55 - Practical IV - Gravimetric Analysis

Learning Objectives:

To learn the gravimetric analysis of various anions and cations

1. Estimation of sulphate as barium sulphate
2. Estimation of barium as barium sulphate
3. Estimation of barium as barium chromate
4. Estimation of lead as lead chromate
5. Estimation of silver as silver chloride
6. Estimation of calcium as calcium oxalate monohydrate
7. Estimation of calcium as calcium carbonate
8. Estimation of nickel as Ni-DMG complex
9. Estimation of zinc as zinc oxinate
10. Estimation of magnesium as magnesium oxinate.

Text Book:


Course Outcomes:

CO1 Students will understand the gravimetric analysis of various anions and cations

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19 ICHT61 - Organic Chemistry – II

Learning Objectives:

To learn the carbohydrates, amino acids, polymers, basic principles dyes and the important concept of spectroscopy

Unit – I: Carbohydrates


Unit – II: Amino Acids and Proteins


Unit – III: Polymers


Unit – IV: Synthetic Dyes, Fats, Oils and Detergents

Classification of dyes and synthesis of methyl orange, congo red, crystal violet, phenolphthalein.

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerols, hydrogenation of unsaturated oils, Saponification value, iodine value, acid value soaps, synthetic detergents, alkyl and aryl sulphonates.

Unit V: Organosulphur compounds


Text Books:


Supplementary Reading

Course Outcomes:

**CO1** Students will know the basics of natural products

**CO2** Students will appreciate the fundamentals of organic spectroscopy and molecular structure

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Learning Objectives:
To learn the concepts of coordination compounds, basic principles nanophase materials and the important concept of environmental chemistry

Unit – I: Coordination Compounds
Werner’s coordination theory, Effective atomic number rule, Nomenclature of coordination compounds, Isomerism in coordination compounds, Chelates. Applications of coordination compounds, Complexometric titrations using EDTA, Application of valance bond theory to coordination compounds.

Unit - II: Nanophase Materials

Unit – III: Thermodynamics of Inorganic Reactions

Unit – IV: Analytical Applications of Chemical Equilibria
Acid-base equilibria – Common ion effect, Buffer solution, Solubility equilibria, Distribution equilibria, Complex ion equilibria, Factors influencing equilibria.
Principle of inorganic qualitative analysis: Reactions involved in the separation and identification of cations and anion in the analysis- Spot test reagents: Aluminon, Cupferon, DMG, thiourea, Magneson, Alizarin and Nessler's reagent-Semi micro techniques

Unit – V: Environmental Chemistry
Pollution and its control: Sources of air pollution CO₂, Pb, CO, oxides of nitrogen and sulphur, Freons, smog, greenhouse effect, global warming, methods of control.
Pollution of soil: Fertilizers, insecticides, solid waste and acid rain, methods to control.
Pollution of water: Industrial and domestic waste, effluents, sewage waste, Fertilizer, insecticides oil, toxic metal, COD and BOD. Consequences, methods to control, Rainwater harvesting – its need, methods and advantages.
Noise pollution and radioactive pollution, health hazards.

Text Books:

Supplementary Reading:

**Course Outcomes**

**CO1** Students will know the basics of coordination compounds

**CO2** Students will appreciate the fundamentals of nanophase materials

**CO3** Students are enable to understand the chemistry of environment

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Learning Objectives:
To learn the advanced concepts of spectroscopy, the basic principles of photochemistry and the important concept of quantum chemistry

Unit – I: Spectroscopy - I
Electromagnetic radiation, concept of frequency, wavelength, wavenumber, energy, energy levels, quantization, interaction of electromagnetic energy into matter, basic aspects of atomic and molecular spectroscopy.

Types of molecular spectra, microwave spectroscopy – rotational spectra of diatomic molecule, conditions for a molecule to be active in microwave region, origin of molecular spectra - rotational spectra - rigid rotor and non-rigid rotor, rotational constants (B), selection rule for rotational transition -Intensity of spectral lines – Effect of isotopic substitution.

Unit – II: Photochemistry - I

Unit – III: Solid State
Classification of solids – isotropic and anisotropic crystals, laws of crystallography, representation of planes, miller indices, space lattice, crystal systems, seven primitive unit–cells. X-ray diffraction, derivation of Bragg’s equation, determination of structure of NaCl by Debye Scherrer (powder) method and rotating crystal method, determination of Avagadro’s number, discussion of structures of KCl & CsCl. Defects in crystals – stoichiometric and nonstoichiometric. Packing of ions in crystals – radius ratio rule and its limitations.

Unit – IV: Quantum Mechanics - I
Black body radiation, Planck's radiation law, photoelectric effect, Compton effect, Bohr’s model of hydrogen atom (no derivation), its demerits, wave-particle duality, de Broglie equation, Heisenberg uncertainty principle, wave nature of electron, Schrodinger's time – independent wave equation (no derivation), wave function and its physical interpretation, Normalization and orthogonal function.

Unit – V: Polymer Science
Polymerization reaction, types of polymerization reactions, addition polymerization and condensation polymerization, mechanism of polymerization, kinetics of polymerization, molecular mass of polymers, number average and mass average molecular mass, determination of molecular mass by osmotic pressure measurement and sedimentation method – important physical properties of polymers.

Text Books

Supplementary Reading

**Course Outcomes:**

CO1 Students will know the basics of spectroscopy and quantum Chemistry

CO2 Students will appreciate the fundamentals of physical chemistry like solid state and polymers

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Learning Objectives:
To learn the advanced concepts of pharmaceutical Chemistry, basic principles of drugs and the important concept of vitamins and enzymes

Unit – I Basic Pharmaceutical Chemistry
Definition of the following terms: drug, pharmacophore, pharmacology, Pharmacopeia, bacteria, virus and vaccine. Causes, symptoms and drug for anaemia, jaundice, cholera, malaria and filarial. Indian Medicinal plants and uses – Tulasi, Neem, Kizhanelli, Mango, Semparuthi, Adadodai and Thoothvelai.

Unit – II Antibacterials
Sulpha drugs-examples and actions-prontosil, sulphathiazole, sulphafurazole. Antibiotics-definition and action of penicillin, streptomycin, chloramphenicol, erythromycin-tetracyclin – SAR of chloramphenicol only. Antiseptics and disinfectants – definition and distinction – phenolic compounds, chlorocompounds and cationic surfactant.

Unit – III Analgesics and CNS stimulants

Unit – IV Anesthetics and Drugs for Chronic diseases

Blood: Grouping, composition, Rh factor, blood pressure, hypertension and hypotension.

Unit – V Vitamins, Harmones and Enzymes
Vitamins – fat soluble vitamins – (i) vitamin A, (ii) vitamin D, (iii) vitamin B complex, (iv) vitamin C, (V) vitamin E, (vi) vitamin K, (vii) vitamin P.

Hormones – Introduction, properties and function of hormones, chemical nature of hormones. Physiological function of some hormones: Adrenaline, thyroxin, oxytocin, insulin, the sex hormones.


Text Books:

Course Outcomes
CO1 Students will know the advanced basics of pharmaceutical chemistry
CO2 Students will appreciate the fundamentals of drugs, vitamin, hormone and enzymes
Learning Objectives

To learn the basic concepts of experimental physical chemistry, basic principles of electrochemistry and the important concept of distribution law and kinetics

1. Critical Solution Temperature
2. Effect of impurity on Critical Solution Temperature
3. Transition Temperature - Determination of molecular weight by depression of freezing point method
4. Rast Method - Determination of molecular weight by depression of freezing point methods
5. Phase Diagram (Simple eutectic system)
6. Kinetics of Ester Hydrolysis
7. Partition Co-efficient of iodine between water and organic solvents.
8. Association factor of benzoic acid / acetic acid between benzene and water
9. Conductometric Acid-Base Titration
10. Potentiometric Redox Titration
11. Determination of cell constant

Text Books:


Course outcome:

CO1 Acquire the necessary practical skills to perform physical chemistry practicals.
CO2 Gain expertise in the instrumental analysis.
CO3 Systematically evaluate calculations involving in physical chemistry
CO4 Apply the gained knowledge in industries
Learning Objectives:

To learn the fundamental mechanisms underlying different chemical reactions, basic aspects of stereochemistry and conformational analysis of six member ring systems

Unit – I: Organic Reaction Mechanisms – I

Aromaticity - Electronic Effects - Types of organic reactions - Reaction intermediates - formation, structure and stability of carbocations, carbanions, radicals, carbenes and nitrenes.

Aliphatic nucleophilic substitution - $S_N^1$, $S_N^2$ and $S_N^{ii}$ mechanisms with examples. Aromatic nucleophilic substitution: Unimolecular, bimolecular and benzyne mechanisms.

Esterification and transesterification - Ester hydrolysis - acid catalysed acyl oxygen and alkyl oxygen fission mechanisms - explanation of the principle of microscopic reversibility.

Unit – II: Organic Reaction Mechanisms – II

Addition to carbon-carbon and carbon-oxygen multiple bonds - electrophilic and nucleophilic addition - addition to conjugated system. Hydration of olefins - Hydroboration

Elimination reactions: E1, E2, E1cB & E2C mechanisms - Pyrolytic eliminations - cis elimination - orientation of double bond - Bredt’s rule, Hofmann and Saytzeff rules.

Aliphatic electrophilic substitution - $S^1_E$, $S^2_E$ and $S^{ii}_E$ mechanisms with examples. Aromatic electrophilic substitution - mechanisms of nitration, halogenation and sulphonation reactions. Friedel-Crafts reaction and its modifications. Influence of substituents on reactivity and orientation. Electrophilic substitution of naphthalene - formation of two isomers - explanation of kinetic and thermodynamic controls by sulphonation of naphthalene.

Unit – III: Organic Stereochemistry- I


Walden inversion, asymmetric transformation and asymmetric induction - enantio and diastereo selective synthesis - enantiomeric excess and diastereomeric excess.

Atropisomerism of biphenyls, allenes and spiranes. Geometrical isomerism about C=C bond - E-Z notation - determination of configuration of geometrical isomers - geometrical isomerism in acyclic oximes.

Unit – IV: Organic Photochemistry – I

Unit – V: Natural Products – I


Unit – VI (Not for final examination)

Nomenclature of alicyclic, bicyclic and tricyclic compounds (basic skeletal structure only with or without one substituent). Biogenesis- The building blocks and construction mechanism of 1. Terpeniods – Mono Sesqui, Di and Triterpeniods. 2. Alkaloids derived from ornithine, lysine, nicotinic acid, tyrosine and tryptophan.

Text Books:


Supplementary reading:


Course outcomes:

At the end of the course, the students will be able to
**CO1:** Understand various types of reaction mechanisms involved in synthetic organic transformation.

**CO2:** Appreciate various types of reaction mechanisms involved in synthetic organic transformation

**CO3:** Analyse basic stereochemistry concepts in a proper perspective.

**CO4:** Evaluate the principles of Photochemistry

**CO5:** Apply the concepts of asymmetric synthesis

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SEMESTER - VII

Credits: 4
Hours: 4

19 ICHT72: Coordination Chemistry and Inorganic Reaction Mechanisms

Learning Objectives:
To learn the fundamental mechanisms underlying Coordination Chemistry, reaction mechanism and photoinorganic chemistry

Unit-I Coordination Chemistry of Transition Metal ions
Nomenclature of coordination compounds - Stability constants of complexes and their determination (pH metric and spectrophotometric methods). Factors influencing stability, stabilization of unusual oxidation states by complex formation.

Pearson’s HSAB concept, acid-base strength and hardness and softness, symbiosis, theoretical basis of hardness and softness. Electronegativity and hardness and softness.
Stereoisomerism of coordination complexes.

Unit-II Theories of Coordination Compounds
VB theory-Crystal field theory- splitting of d-orbitals under various geometries- CFSE-factors affecting the magnitude of 10Dq-Evidences for CFSE- Spectrochemical series-Distortions in octahedral complexes- Jahn-Teller theorem, Jahn-Teller effect, Molecular orbital theory-MO concepts of octahedral and tetrahedral complexes- MO energy level diagrams of sigma and pi bonding in octahedral complexes, nature of metal-ligand pi bonds- Evidences for pi back bonding

Unit-III Reaction Mechanism-I
Racemisation and isomerisation: Twist mechanisms for isomerisation – Intramolecular mechanisms for racemisation.

Unit-IV Reaction Mechanism-II
Electron transfer reactions-Electron tunnelling hypothesis-Marcus-Hush theory. Atom transfer reaction-one electron and two electron transfer-inner sphere and outer sphere mechanism.

Unit-V Photoinorganic Chemistry
Excited states of metal complexes-Energy transfer under conditions of weak interaction and strong interaction-exciplex formation. Conditions of the excited states to be useful as redox reactants-photostabilization, photooxidation and photoreduction- Photochemical reactions involving Ruthenium(II) bipyridyl complex. Application to photovoltaics-water photolysis-carbon dioxide reduction.

Unit – VI (Not for final examination)

Applications of coordination compounds: Metal complexes in analytical chemistry, medicinal chemistry, industrial process, water suffering process and agriculture.

Photochemistry of Cr(III), Co(III), Pt(II) and Pt(IV) complexes.

Textbooks:
Supplementary reading

Course outcomes:
At the end of the course, the students will be able to

CO1: Understand the basics of coordination Chemistry.

CO2: Appreciate various theories of inorganic complexes

CO3: Evaluate inorganic reaction mechanisms

CO4: Analyse substitution reaction mechanisms and electron transfers

CO5: Apply the concepts of energy transfer to photovoltaics.

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19ICHT73: Chemical Thermodynamics, Photochemistry and Group Theory

Learning Objectives:
To learn the fundamental of thermodynamics, photochemistry and group theory.

Unit – I: Classical Thermodynamics
Calculation of adiabatic flame temperature, Maxwell's relations, thermodynamic equation of state, thermodynamics of open systems, partial molar quantities, chemical potential, Gibbs-Duhem equation, variation of chemical potential with temperature and pressure, third law of thermodynamics-Determination of absolute entropies of solids, liquids and gases –residual entropy. Nernst heat theorem, chemical equilibrium-Van't Hoff isotherm, standard free energy change of reactions, variation of equilibrium constant with temperature and pressure.

Unit – II: Thermodynamics of Non-Ideal and Irreversible Systems

Non-equilibrium thermodynamics - conservation of energy and mass, entropy production in chemical reactions – Microscopic reversibility and Onsager reciprocal relation. General application of non-equilibrium thermodynamics.

Unit – III: Statistical Thermodynamics
Thermodynamic probability and entropy. Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics.


Unit – IV: Photochemistry and Radiation Chemistry

Radiation Chemistry-linear energy transfer, G-value, dosimeters, radiolysis of water, solvated electrons.

Unit – V: Principles and Applications of Group Theory
Reducible and irreducible representations, properties of irreducible representations orthogonality theorem. Construction of character tables of $C_{2v}$ and $C_{3v}$. Selection rules for IR and Raman spectra, procedure for determining symmetry of normal modes of vibration of $H_2O$ and $NH_3$ molecules - hybrid orbitals in $BF_3$, $CH_4$ and $NH_3$.

Unit – VI (Not For Final Examination)
Application of Bose-Einstein statistics to photon gas and superfluidity of liquid helium
Application of Fermi-Dirac statistics to electron gas and thermionic emission.

Applications of Group theory to IR, Raman and Electronic spectra - SALT procedure - evaluation of energies and MO's for systems like ethylene, butadiene.

Metal Oxide Semiconductors and Doped Metal Oxide Semiconductors and its applications.
Mechanism of photocatalysis and its applications.
Text Books:

Supplementary Reading

Course outcomes:
At the end of the course, the students will be able to

CO1: Understand basics of Thermodynamics
CO2: Evaluate basic reaction mechanisms involved in Photochemistry
CO3: Understand the fundamentals of statistical thermodynamics
CO4: Appreciate the fundamentals of photochemistry and radiation Chemistry
CO5: Apply the principles of Group theory

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19ICHT74: Organic Chemistry Practical – I

Learning Objectives:
To learn different types of organic reactions and its mechanisms and to undertake experiments on organic reactions.

Preparations:
Preparation of organic compounds involving two step reactions.

Textbook:

Supplementary reading:

Course outcomes:
At the end of the course, the students will be able to

CO1 Acquire basic laboratory skills required to carry out organic reactions
CO2 Independently perform two step organic preparations
CO3 Analyse the mechanisms of reactions.
CO4 Gain the expertise to apply it to specific research problems.

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Learning Objectives:

To learn the principles and verification of electrochemistry and binary solutions and to perform experiments in study the important concepts electrochemistry and binary systems.

I. Conductivity Experiments

1) Determination of cell constant
2) Determination of the solubility of sparingly soluble salt
3) Verification of DHO equation – Equivalent conductance of strong electrolyte
4) Dissociation constant of weak electrolyte (verification of Ostwald’s dilution law)

II. Conductometric titrations

5) Acid-base titrations
   i) HCl vs NaOH, ii) CH₃COOH vs NaOH,
6) Displacement titrations (NH₄Cl vs NaOH)
7) Precipitation titrations
   i) CuSO₄ vs NaOH, ii) BaCl₂ vs Na₂CO₃, iii) KCl vs AgNO₃
8) Titration of mixtures
   i) HCl + CH₃COOH vs NaOH, ii) HCl + CuSO₄ vs NaOH iii) HCl + NH₄Cl vs NaOH

III. Distribution Law Experiments

1) Partition coefficient of iodine between two immiscible solvents
2) Study of the equilibrium constant of the reaction: KI + I₂ ⇌ KI₃
3) Distribution of ammonia between water and chloroform
4) Determination of formula of cuprammonium complex

Text Books:

Course outcomes:

At the end of the course, the students will be able to

CO1 acquire practical knowledge on important equations in thermodynamics
CO2 acquire the practical knowledge of understanding important equations in distribution experiments
CO3 perform conductometric experiments
CO4 acquire the practical knowledge of understanding important equations in distribution experiments
CO5 evaluate their knowledge to analyze analytical problems.
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Note: The table represents the correlation between PO (Program Outcomes) and PO10 (Program Specific Outcome) with their respective weights.
19ICHT81: ORGANIC PHOTOCHEMISTRY AND MOLECULAR REARRANGEMENTS

Learning Objectives:

To understand addition, elimination, rearrangement and name reactions along with their mechanism and synthetic utility and to understand various types of oxidation and reduction reactions.

Unit – I: Organic Photochemistry – II


Molecular Rearrangements.


Unit – II: Organic Stereochemistry- II

Conformational analysis of 1,2-disubstituted ethanes - relative stabilities of gauche and anti conformations. Representations of the conformations of diastereomers with two asymmetric carbons using Newmann and Sawhorse projections - relative stabilities of diastereomers.

Conformational analysis of cyclohexane, mono and disubstituted derivatives – reactivity of cyclohexane derivatives - Conformation and stereochemistry of cis and trans decalin and 9 - methyldecalin.

Unit – III: Synthetic Dyes and Supramolecular Chemistry

Colour and constitution (Electronic concept). Classification of dyes, Chemistry and Synthesis of methyl orange, congo red, malachite green, crystal violet, fluorescein, alizarin and indigo.


Unit – IV: Small Ring and Higher Ring Heterocycles

Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiranines, azetidines, oxetanes and thietanes. Benzo-Fused Five-Membered Heterocycles -Synthesis and reactions of benzopyrroles, bezofurans and benzothiophenes.

Six membered Heterocycles with two or more Heteroatoms. Synthesis and reactions of diazones, triazines, tetrazines and thiazines. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Seven-and Large-membered Heterocycles - Synthesis and applications of azepines, oxepines, thiepines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines.
Unit – V: Natural Products – II

**Antibiotics:** classification, structure and uses of penicillins, fluoroquinolones, chloramphenicol, and streptomycin - Structural elucidation and synthesis of chloramphenicol.

**Vitamins:** Classification, structure and uses of vitamins A, B1, B6, C, D, E and K.

**Steroids:** Occurrence - Diel's hydrocarbon - nomenclature of Steroids - Structure and biological importance of cholesterol, cholic acid, estrone, estradiol, testosterone and androsterone.

Unit – VI (Not for final examination)


Textbooks:


Supplementary Reading


Course outcomes:

At the end of the course, the students will be able to

**CO1** Understand the theoretical basis and mechanisms underlying additions and elimination reactions.

**CO2** Appreciate reaction mechanisms involved in rearrangements
**CO3** Evaluate the chemistry of dyes and their synthetic utilities.

**CO4** Differentiate the various types of heterocyclic molecules.

**CO5** Understand the relationship between the structure and function of various classes of natural compounds

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19ICHT82: Solid State and Organometallic Chemistry

Learning Objectives:

To learn the principles of solid state, polymeric inorganics and organometallic Chemistry.

Unit-I: Solid State Structures and Structural Defects

Ionic bonding, Lattice energy, Born equation and its derivation, Limiting radius ratio rules, Radius ratio for trigonal, tetrahedral, octahedral and cubic sites.

Structures of some ionic crystals (sodium chloride, caesium chloride, rutile, wurtzite, fluorite).

Crystal defects: Stoichiometric defects-Schottky and Frenkel defects – colour centres in alkali halide crystals – Nonstoichiometric defects- metal excess and metal deficiency defects – extended defects – line and plane defects.

Unit-II: Polymeric Inorganic Compounds


UNIT – III: Phase Transitions


Unit-IV: Organometallic Chemistry I

Types of ligands- Concept of haptacity-18 electron rule and its limitations- bonding in metal carbonyls- Polynuclear carbonyls with and without bridging groups-Applications of IR spectra in the study of structure of metal carbonyls-structure and bonding in metal nitrosyls and dinitrogen complexes-Preparation, structure and bonding in metal alkenes (Zeise’s salt), alkynes and allyl complexes- Metalloenes: preparation, properties, structure and bonding in ferrocene.

Unit-V: Organometallic Chemistry –II (Catalysts and Reaction Mechanisms)


Unit – VI (Not for final examination)

Structure and properties of solid – prototypical oxides, fluorides, sulfides and related compounds. Monoxides of 3d metals, higher oxides and glasses – layered MS$_2$ compounds and intercalations.

Organo-silicon compounds – organometallic compounds of arsenic, antimony and bismuth – catenated and multiply bonded compounds.

Textbooks

3. Lee, J.D., Concise inorganic chemistry, Wiley India, 2006

**Supplementary Reading**

**Course outcomes:**

At the end of the course, the students will be able to

**CO1** Correlate the structure of solids with their applications

**CO2** Understand the various classes of polymeric inorganic compounds

**CO3** Appreciate the classification and factors influencing phase transitions

**CO4** Evaluate the structure and applications of organometallic compounds

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19ICT83: Chemical Kinetics and Quantum Mechanics

Learning Objectives:
To acquire knowledge on the basic concepts in chemical kinetics and to learn quantum theory.

Unit – I: Chemical Kinetics and Catalysis
General features of fast reactions – Study of fast reactions by flow methods.

Unit – II: Chemical Dynamics
Potential energy surfaces, Kinetic isotopic effects - Dynamics of unimolecular reactions – Lindemann-Hinshelwood – Rice Ramsperger Kassel (RRK) theory and Rice Ramsperger Kassel – Marcus (RRKM) theory.
Study of fast reactions by laser, relaxation, flash Photolysis and nuclear magnetic resonance methods.
LFERs – Hammett equation, Taft equation, separation of polar, resonance and steric effects.

Unit – III: Quantum Mechanics of Simple System - I
Operators and commutation relations-Postulates of quantum mechanics – derivation of Schrodinger’s time-independent wave equation and its application to particle in a onedimensional box, particle in a three-dimensional box, harmonic oscillator, rigid rotor and Schrodinger equation for hydrogen atom-separation of variables-energy levels-radial factors of the hydrogen atom wave functions.

Unit – IV: Applications of Quantum Chemistry - II

Unit – V: Applications of Quantum Chemistry - III
The variation Theorem, linear variation principle, perturbation theory (first order and non degenerate). Applications of variation method and perturbation theory to the helium atom. Hybridization-determination of bond angles of sp, sp$^2$ and sp$^3$ hybridizations. Huckel pi-electron (HMO) theory and its applications to ethylene, butadiene and benzene. HMO orbital construction, calculation of properties –delocalization energy, electron density and bond order. A brief idea of self consistent field theory.

Unit - VI (Not For Final Examination)
Computer Applications in Chemistry Introduction to computers and computing - Block diagram of a PC and the functions of the various units of computer - High and low level languages - Introduction to net working - LAN, WAN, Internet and Intranet - WorldWideWeb - ChemWeb - E-journals - search engines for chemistry. Introduction to C language - Structure of C program - Control statements.

Examples of simple chemistry Programmes. 01. Conversion of Celsius temperature to Kelvin temperature 02. Applications of Beer-Lambert Law. 03. Linear least square - Fit log k vs 1/T plot to get Arhenius parameters. 04. Determination of Anharmonicity constant and dissociation energy calculation.

Textbooks:


**Supplementary Reading**


**Course outcomes:**

At the end of the course, the students will be able to

**CO1** Understand the theoretical basis underlying the kinetics of different chemical reactions

**CO2** Appreciate the theories of molecular dynamics

**CO3** Comprehend the quantum mechanics of simple systems

**CO4** Evaluate the applications of quantum chemistry

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**Learning Objectives:**

To undertake separation and analysis of organic mixtures using two compound system.

**Qualitative Analysis:** Analysis of two component mixture. Separation and systematic analysis of the separated two individual components.

**Textbook**


**Supplementary reading**


**Course outcomes:**

At the end of the course, the students will be able to

- **CO1** acquire the necessary practical skills to independently analyse organic compounds.
- **CO2** gain expertise in the separation of two component mixtures of organic compounds.
- **CO3** systematically evaluate organic compounds
- **CO4** apply the knowledge in industries.

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19ICHP85: Inorganic Chemistry Practical – I

Learning Objective:

To get the skill in the identification of cations including rare earth metals and to develop the skill in the estimation of metal ions by complexometric titrations

Semi Micro Qualitative Analysis

Mixture containing two common cations and two of the following less familiar cations. Se, Te, W, Mo, Be, Ti, Ce, Th, Zr, U, V, Tl and Li.

Text Books:

Course outcomes:

At the end of the course, the students will be able to

CO1 acquire the necessary practical skills to independently analyse Inorganic compounds.

CO2 gain expertise in the systematic analysis if inorganic compounds.

CO3 apply the knowledge in industries

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Learning Objectives:

To learn the new techniques in planning an organic synthesis and to acquire knowledge about polymers and its industrial importance.

Unit – I: Planning Organic Synthesis

An introduction to retrosynthesis - Synthon, Synthetic equivalent, Target molecule, Functional group interconversion - Disconnection approach - One group disconnection - Disconnection of alcohols, olefins and ketones - Logical and illogical disconnections. Two group disconnection - 1,2-, 1,3-, 1,4-, 1,5- and 1,6-dioxygenated skeletons and dicarbonyls. Retro Diels - Alder reaction - Pericyclic reactions – Retrosynthesis of some heterocycles containing two nitrogen atoms. Retrosynthetic analysis of Camphor, Longifiline and Reserpine.

Unit – II: Reagents in Organic Chemistry:

Uses of the following reagents in organic synthesis and functional group transformations. Sodium borohydride, Lithium aluminium hydride, tri-n-butyltin hydride, Lithium dimethyl cuprate, Lithium diisopropyl amide, Trimethylsilyl iodide, dicyclohexylcarbodiimide, OsO$_4$, DDQ, SeO$_2$, PCC. Phase Transfer Catalysts - Benzyltriethylammonium halides - Crown ethers.

Oxidation and reduction:


Unit – III: Organic Reactions and Advanced Mechanisms

Formation of C-C single bond: Aldol condensation, Claisen ester reaction, Stobbe condensation, Knoevenagel reaction, Michael addition, Dieckmann condensation - Stork enamine reaction - Mannich reaction. Formation of C=C double bond: Wittig reaction, Claisen-Schmidt condensation and Peterson’s synthesis.

Cannizaro and cross Cannizaro reactions, Benzoin condensation, Wolff-Kishner reduction, Clemmenson reduction, Birch reduction and Chichibabin reaction.

General methods of investigation of organic reaction mechanisms - kinetic and non-kinetic methods - Baldwin rules - cross over experiments - isotopic labeling primary and secondary kinetic isotopic effects - solvent kinetic isotopic effects. SN1’, SN2’ and SNi’ mechanisms - Neighbouring group participation - non-classical carbocation and memory effect - structure and solvent effect on nucleophilic substitution reactions.

Unit – IV: Selective Synthetic Methods

Need for protection of functional groups during chemical reactions - protection of hydroxyl, mercapto, amino, carbonyl and carboxylic groups.

Asymmetric synthesis with chiral substrate: Nucleophilic addition to α-chiral carbonyl compounds, Electrophilic addition to α-chiral olefins - epoxidation, cyclopropanation, hydroboration. Asymmetric synthesis using chiral reagents and catalysts: Chiral organoboranes - application in hydroboration, reduction and allylation reactions, epoxidation catalyst,
semicorin catalyst, Jacobson catalyst - Uses of Camphor derived auxiliaries and menthol derived auxiliaries in asymmetric synthesis.

**Unit – V: Polymers**

Chemistry of polymerisation, Kinetics of polymerisation, Chemical and geometrical structure of polymer molecules, Glass transition temperature, Crystallinity in polymers - Copolymerisation. Polymer stereochemistry.

Industrial polymers - Synthesis, structure and applications of industrially important polymers like PVC, nylon 6,6, buna-S rubber and Polytetrafluoroethylene (Teflon). Conducting polymers - Synthesis and applications of polyacetylenes, polyanilines, polypyrroles and polythiophines.

Polymers as aids in organic synthesis - Polymeric reagents, catalysts and substrates. Polymers in Optical lithography - Drug delivery - Drug carriers.

**Unit – VI (Not for final examination)**

Uses of following reagents in organic synthesis and functional group transformation. Synthesis and uses of drugs- anxiolytics, neuroleptics, hypnotics, sedatives, local anaesthetics, anti-coagulants, hypoglycaemic agents, antihistaminic agents, antimalarials, analgesics, antipyretics and anti-inflammatory.

**Textbooks:**


**Supplementary reading:**


**Course outcomes:**

At the end of the course, the students will be able to

**CO1** understand the concepts of retrosynthetic analysis

**CO2** learn about various organic reagents used in synthetic organic chemistry

**CO3** evaluate the various organic reactions and its mechanisms

**CO4** understand about selective synthetic methods

**CO5** gain knowledge about polymers
SEMESTER - IX

Credits: 4
Hours: 4

19ICHT92: GREEN CHEMISTRY, COMPUTATIONAL CHEMISTRY, DRUG DESIGN AND SPECTROSCOPY

Learning Objective:

To understand the basic aspects of Green Chemistry and spectroscopy of organic compounds.

Unit – I: Green Chemistry

Introduction and principle of green chemistry - Environmental friendly green techniques - solvent supported catalysts and reagents, heterogeneous reactions, Examples of organic reactions involving green chemistry techniques.

Techniques in Organic Synthesis - Use of microwave, ultrasound, ionic liquids, supercritical fluid extraction in organic synthesis – Heterogenized reactions

Unit – II: Computational Chemistry

An introduction to concepts of potential energy surface, Basic principles of molecular mechanics, Ab initio method, Semiempirical calculations (SE) and Density functional theory (DFT) software.

Drug Design and Synthesis


Synthesis of Benzodiazepene, Sulfonyl urea and Diclofenac drugs.

Unit – III: Mass Spectrometry

Unit – IV: NMR Spectroscopy

Nuclear spin and magnetic moment of a nucleus – nuclear energy levels in the presence of magnetic field - basic principles of NMR experiments – CW and FT NMR – $^1$H NMR chemical shift - factors influencing proton chemical shifts - coupling constants – factors influencing coupling constants – $^1$H NMR spectra of simple organic molecules such as: CH$_3$CH$_2$Cl, CH$_3$CHO, etc., AX, AB and AMX spin system – spin decoupling – nuclear overhauser effect – chemical exchange.

Introduction to $^{13}$C NMR - chemical shifts – additivity principle – factors affecting $^{13}$C NMR chemical shifts - proton decoupled, off-resonance, INEPT and DEPT $^{13}$C NMR spectra – $^{13}$C NMR spectra of simple organic molecules.

Unit – V: Multidimensional NMR Spectroscopy:

Basic principles of 2D NMR spectroscopy – HOMOCOSY, HSQC, HMBC, TOCSY and NOESY spectra and their applications.


Unit – VI (Not for final examination)


Textbooks:


Supplementary Reading

Course outcomes:

At the end of the course, the students will be able to

CO1 correlate the UV absorption and molecular structure

CO2 understand IR stretching frequencies of organic compounds with their functional groups.

CO3 interpret the $^1$H and $^{13}$C NMR spectra of organic compounds

CO4 learn the principles of multidimensional NMR

CO5 analyze the unknown compounds by spectroscopy.

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Learning Objectives

To study the electronic and magnetic properties of complexes, applications of diffraction methods and to know the characterization of inorganic compounds using ESR, NQR and Mossbauer spectroscopies.

Unit-I: Spectral and Magnetic Properties of Complexes

Ground state Terms for d^{1}-d^{9} ions- Derivation of terms for p^{2} and d^{1} configurations. Characteristics of d-d transitions. Energy level diagrams – Orgel diagrams of d^{1}-d^{9} - Tanabe-Sugano diagram of d^{6}. Effect of Jahn-Teller distortion, Nephelauxetic effect. Selected examples of d-d spectra – [Ti(H_{2}O)_{6}]^{2+}, trans – [Cr(en) F]^{+}, [Ni(en)_{3}]^{2+}, [CoF_{6}]^{3-}, [Co(ox)_{3}]^{3-}, [Cu(H_{2}O)_{6}]^{2+}.


Unit – II: Photoelectron and ESR Spectroscopies

Valence and core binding energies – Measurement technique – Koopman’s theorem – Chemical shifts in X-ray photoelectron spectroscopy – Auger spectroscopy – Applications of ESCA in chemistry.

Electron spin Resonance Spectroscopy – Origin of the spectrum – method of recording - hyperfine splitting – g value and hyperfine splitting constant - ESR spectra of simple organic radicals - application of ESR spectra to transition metal complexes

Unit - III: NQR and Mossbauer Spectroscopies


Unit-IV: Diffraction Methods

Crystal systems and lattice types. Miller indices and Bravais lattices. Unit cells and its identification from systematic absence - the concept of reciprocal lattice – Structure factor and its relation with electron density –Analysis by powder X-ray diffraction and single crystal photography and its applications.


Unit – V: Chromatography and ORD


Unit – VI (Not for final examination)

^{1}H, ^{13}C, ^{19}F, ^{17}O, ^{31}P and ^{119}Sn NMR spectra of coordination compounds – IR and Mass spectra of complexes – Hirshfeld surface analysis.

Textbooks

2. Lee, J.D., Concise inorganic chemistry, Wiley India, 5th edition, 2012

**Course Outcomes:**

After completion of this course, students are able to

- **CO1** evaluate the spectral and magnetic properties of complexes.
- **CO2** analyse the spectral techniques like PES and ESR
- **CO3** understand the theory of NQR
- **CO4** appreciate the diffraction methods
- **CO5** gain knowledge on ORD and CD

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19ICHT94: Electrochemistry and Spectroscopy

Learning Objectives:
To learn the theories electrochemistry and to learn the fundamental concepts of molecular, UV and IR spectroscopy.

Unit – I: Electrochemistry - Theories of Strong Electrolytes and Electrochemical Cells
Debye-Huckel-Onsager equation and its verification, conductance at high field and high frequency, Debye-Huckel limiting law.
Electrochemical cell reactions, Nernst equation – electrochemical series. electrode-electrolyte interface, electrical double layer- Helmholtz-Perrin, Gouy-Chapmann and Stern theories – electro kinetic phenomena- Lipmann equation, corrosion and passivity –Pourbaix and Evans diagrams-methods of protection of metals from corrosion

Unit – II: Electrochemistry- Electrode Reactions, Battery and Fuel Cell

Unit – III: Electroanalytical Methods

Unit – IV: Molecular Spectroscopy
Comparison of Raman and IR spectra – structural determination from Raman and IR spectroscopy, rule of mutual exclusion.

Unit-V: UV – Visible and IR -Spectroscopy

Unit – VI (Not For Final Examination)
Advanced Spectral Techniques
Raman Micro spectrometry applied to the Study of Electrode Materials-(Coherent Anti Stokes Raman spectroscopy (CARS), Resonance Raman, Time Resolved Raman Spectroscopy and Surface enhanced Raman spectroscopy and its applications. 2D IR Spectroscopy and Single photon Fluorescence spectroscopy and its applications - Single molecule spectroscopy and its applications.

Text Books:

**Supplementary Reading**

**Course outcomes:**

At the end of the course, the students will be able to

**CO1** understand the theories of strong electrolytes.

**CO2** acquire the knowledge about various electro analytical techniques

**CO3** solve the numerical and analytical problems related to electrochemistry and surface chemistry.

**CO4** appreciate the theories of molecular spectroscopies like UV and IR.

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19ICHP95: Inorganic Chemistry Practical – II

Learning Objectives:

To develop skills in the determination of a metal ion in presence of another by appropriate techniques.

Quantitative analysis

1) Determination of \( \text{Ba}^{2+} \) and \( \text{Ca}^{2+} \) ions
2) Determination of \( \text{Cu}^{2+} \) and \( \text{Ni}^{2+} \) ions
3) Determination of \( \text{Cu}^{2+} \) and \( \text{Zn}^{2+} \) ions
4) Determination of \( \text{Cu}^{2+} \) and \( \text{SO}_4^{2-} \) ions
5) Determination of \( \text{Ca}^{2+} \) and \( \text{Mg}^{2+} \) ions
6) Analysis of pyrolusite

Text Book:


Course outcomes:

At the end of the course, the students will be able to

**CO1** acquire the necessary practical skills to independently determine inorganic ions.

**CO2** gain expertise in the systematic analysis of inorganic compounds.

**CO3** apply the knowledge in industries.

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Learning Objectives:
To learn the principles and verification of basic electrochemistry and Kinetics

I. Potentiometry Experiments
   1) Single electrode potentials
   2) Solubility of sparingly soluble salt
   3) Redox titrations
      a) Ferrous iron (II) vs dichromate ($\text{Fe}^{2+}$ vs $\text{CrO}_4^{2-}$)
      b) Iodide ion (I\textsuperscript{-}) vs KMnO\textsubscript{4}
      c) Ferrous iron (II) vs Cerium (IV) ion ($\text{Fe}^{2+}$ vs $\text{Ce}^{4+}$)
   4) Precipitation titrations
      a) Chloride Vs Silver ion
      b) Iodide Vs Silver ion
      c) Mixture of chloride and iodide ions Vs Silver ion
   5) Potentiometric titrations (by quinhydrone electrode)
      a) Strong acid vs Strong base
      b) Mixture of acids (HCl + weak acid) vs NaOH

II. Chemical Kinetics
   1) Acid catalysed hydrolysis of an ester.
   2) Comparison of acid strengths.
   3) Persulphate – iodide kinetics – clock reaction – Primary salt effects
   4) Saponification of an ester
   5) Iodination of acetone

Text Books:

Course outcomes:
After the completion of this course, students will be able to
   CO1 understand the necessary practical skills in instrumental analysis.
   CO2 gain expertise in systematic calculations and graphical representation.
   CO3 apply the knowledge in industries
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19ICHT101: Nuclear, Bioinorganic and Materials Chemistry

Learning Objectives:
To understand theory of radioactivity and applications of radioisotopes, bioinorganics and materials.

Unit-I: Nuclear Chemistry
Radioactive decay and equilibrium, Nuclear Q – value and nuclear cross sections, different types of nuclear reactions, fission and fusion. Theories of fission. Fissile and Fertile isotopes.-Nuclear fusion – stellar energy, Theories of α- and β- decay, orbital electron capture, nuclear isomerism, internal conversion. Hot atom chemistry. Radio isotopes and their Applications: Activation analysis, Isotopic dilution technique-radiometric titration- tracer technique. Counting techniques such as G. M. counter and proportional counter. Applications of nuclear science in industry, agriculture and biology.

Unit-II: Chemistry of Lanthanides and actinides
Correlation of electronic structures, occurrence and isolation, separation - Chemistry of separation of Np, Pu & Am from U & fission products. Oxidation states and general properties – Comparison with ‘d’ block elements, Lanthanide contraction and its significance, Coordination compounds of lanthanides - Spectral and magnetic characteristics of lanthanides and actinides - Position in the periodic table. Similarities between the actinides and lanthanides.

Unit-III: Bioinorganic Chemistry-I

Unit-IV: Bioinorganic Chemistry-II

Unit-V: Preparative techniques of inorganic materials
Principle of solid state reactions with reference to MgO and Al_{2}O_{3} - Reaction conditions – Structural considerations – reaction rates – Wagner mechanism – nucleation and diffusion – surface structure and reactivity. Synthesis of MgAl_{2}O_{4} (a spinel) – experimental procedure. Synthesis of a Zeolite - (Na_{x}(AlO_{2})_{y}(SiO_{2})_{z})mH_{2}O - Preparation of thin films – cathode sputtering – Preparation of metastable phase by sol-gel technique – Hydrothermal technique – Zone melting – Melts – vapour phase transport methods.

Unit – VI (Not for final examination)
Uses of nuclear radiations: Radiation sterilization – Radiation energy for chemical synthesis – Radioisotopes as a source of electricity.

Biological role of some trace non-metals: boron, silicon, sulphur, selenium, arsenic, fluorine, chlorine, bromine, iodine – role of metal complexes in conventional drug resistant to malaria.

Text Books:
Course outcomes:

At the end of the course, the students will be able to

- **CO1** understand about radioactivity and its application for peaceful purposes
- **CO2** get familiarise with chemical reactions in physiological systems
- **CO3** understand lanthanides and actinides
- **CO4** appreciate bioinorganic chemistry
- **CO5** learn preparative techniques in inorganic chemistry

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19ICHT102: Nano Materials, Macromolecular and Surface Chemistry

Learning Objectives:
To learn about the synthesis and characterization techniques of nanomaterials and to learn the principle of various adsorption isotherms.

Unit - I: Synthesis and Applications of Nanomaterials
Preparation of nanomaterials – sol-gel synthesis, Chemical Vapour Deposition (CVD), electrodeposition, ball milling, plasma arcing, uses of natural nanoparticles. Synthesis and applications of carbon nanotubes.


Semiconductor quantum dots – synthesis – electronic structure & spectral properties

Sensors – Classification, Types of sensors, properties, chemical sensor, electrochemical sensors, optical sensors, biosensors, nanosensors, nanobiosensors, Applications of Nanosensors.

Unit - II: Characterization of Nanomaterials

Unit - III Material Science
Band theory - insulators, semiconductors and conductors and their applications - superconductors and their applications – A study of conducting polymers, liquid crystals, NLO, LCD, LED and photochromic materials and their applications. Principle, properties and applications of ferroelectric, piezoelectric and pyroelectric materials.

Unit IV: Properties of Polymers
Polymer Processing: Plastics elastomers and fibres. Compounding processing techniques: calendaring, die casting, rotational casting, film casting, injection moulding, blow moulding extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

Polymer structure and physical properties –crystalline melting point $T_m$. Determination of $T_g$. Relationship between $T_m$ and $T_g$.

Biopolymers – biomaterials. Polymers in medical field - High temperature and fire – resistant polymers.

Unit – V: Surface Chemistry

Unit – VI (Not For Final Examination)

Text Books
2. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Nanotechnology, Overseas Press, 2005

Supplementary Reading

Course outcomes:
At the end of the course, the students will be able to

CO1 know various methods of preparations of nanomaterial and its characterization using various microscopic techniques.

CO2 evaluate the principle and applications of industrially important materials

CO3 understand concepts of polymers, mechanism, kinetics and applications

CO4 understand about polymer chemistry

CO5 understand the basic surface chemistry

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19ICHP103: Organic Chemistry Practical – III

Learning Objectives:
To understand the basic aspects of quantitative experiments in Organic Chemistry and to estimate the organic compounds.

Quantitative analysis and Estimation of phenol, aniline, methyl ketone and glucose by volumetric analysis.

Text Books:

Course outcomes:
At the end of the course, the students will be able to

CO1 examine quantitative analysis of organic compounds

CO2 understand the quantitative methods

CO3 perform the estimation of phenol

CO4 analyse glucose and ketones

CO5 apply the knowledge in industries

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19ICHP104: Inorganic Chemistry Practical – III

Learning Objectives:
To know the colorimetric estimation of metal ions and to understand the complexometric titrations.

Colorimetric analysis:
Colorimetric estimations of copper, nickel, iron and chromium using photoelectric colorimeter.

Complexometric Titrations:
- Standardization of EDTA.
- Determination of Mg^{2+}, Zn^{2+}, Ni^{2+} and Ca^{2+}

Water analysis:
- Estimation of total alkalinity of water
- Estimation of dissolved oxygen in waste water
- Estimation of chloride content in water
- Estimation of hardness in water by EDTA
- Chemical oxygen demand (COD)

Preparation of the followings:
1) Tris (thiourea) copper(I) chloride
2) Potassium trioxalatoferrate
3) Tetraammine copper(II) sulphate
4) Microcosmic salt
5) Chrome alum
6) Trans-Diaquadioxalatochromate(III)

Text Books:

Course outcomes:
At the end of the course, the students will be able to
- CO1 understand the colorimetric estimations of metal ions
- CO2 gain knowledge on the preparation of complexes
- CO3 evaluate the water quality that will be useful in environmental aspect
- CO4 understand the complexometric titrations
- CO5 calculate the hardness of water
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SEMESTER - X

19ICHP105: Physical Chemistry Practical – III

Learning Objectives:

To learn the principles and verification of Kinetics, electrochemistry and Phase diagrams.

Electrochemistry:

1. Kinetics of saponification of ester by conductometric method.
2. Determination of activity, activity coefficient of ions.
3. Determination of pH of a Buffer solution (potentiometer).
4. Determination of dissociation constant of weak acid by Potentiometer.

pH Metry:

5. Dissociation constant of monobasic acid.
6. Dissociation constant of dibasic acid.
7. Dissociation constant of tribasic acid.
8. Study the influence of Cu$^{2+}$ and Fe$^{2+}$ on the reaction between persulfate and iodide ions.
9. Study of adsorption of acetic acid/oxalic acid on charcoal.

Phase Rule:

10. Two component system-simple Eutectic
11. Three component system.

Kinetics:

12. Determination of energy of activation (Ea) for acid catalyzed hydrolysis of an ester.

Text Books:


Course outcome:

At the end of the course, the students will be able to

CO1 acquire the necessary practical skills to perform physical chemistry practicals.
CO2 gain expertise in the instrumental analysis.
CO3 evaluate calculations involving in physical chemistry.
CO4 apply the gained knowledge in industries.
### SEMESTER - X

**Credits: 6**

**Hours: 10**

19ICHPJ106: Project Work / Inplant training

**Learning Objectives:**
To learn the basics of research work by carrying out selective academic and applied projects.

**Course outcomes:**
At the end of the course, the students will

- **CO1** acquire the practical knowledge of understanding research problems.
- **CO2** gain knowledge basic principles of various components of research
- **CO3** apply the principles of chemistry in various fields

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19ICHE15A: ELECTIVE I: APPLIED CHEMISTRY

Learning objectives:
To study about basic chemistry of water technology, fuels and corrosion.

UNIT-I: Water Technology-I

UNIT-II: Water Technology-II
Water for industrial purposes - Boiler feed water (Water for steam making) - Boiler troubles - carry over - priming - foaming - scales and sludges - water treatment - external treatment (lime soda process and ion exchange process, RO process) - Internal treatment (colloidal, phosphate, calgon, carbonate conditioning).

UNIT-III: Corrosion
Definition - Theories of corrosion - dry corrosion (direct chemical attack), wet corrosion (electrochemical theory) - methods of prevention of corrosion - modifying metal properties by alloying - surface coatings: Galvanization - electroplating and anodization - cathodic protection: sacrificial anode method - impressed voltage method. Modifying the environment - use of inhibitors.

UNIT-IV: Fuels
Fuels: classification - combustion and chemical principles, units of heat - calorific value: gross and net calorific values and their determination by bomb calorimeter. Solid fuels: proximate and ultimate analysis of coal and their importance - high and low temperature combustion, coke: Petroleum - Chemical composition and fractional distillation, cracking of heavy oil residues - thermal and catalytic cracking, knocking and chemical structure, octane number and cetane number and their significance.

UNIT-V: Inorganic cementing materials

REFERENCE


Course outcomes:
At the end of the course, students will be able to
CO1: understand the concept of water technology
CO2: understand the mechanism of Corrosion
CO3: understand about fuels and cementing materials

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SEMESTER -III

Credits: 3
Hours: 3

19ICHE15B: Elective 2: Industrial Chemistry

Learning Objectives:

The objective of the course is to enable the student to understand the concepts of fuels and energy resources.

Unit I: Fuels and Energy Resources

Petroleum - origin of petroleum, composition, refining of petroleum fractionation composition of various fractions, cracking - catalytic and thermal cracking, synthetic petrol, knocking, octane and cetane numbers, anti knocking agents, coal gas, producer gas, Methane production from biomass, alcohol as fuel.

Unit II: Cement and Fertilizers


Unit III: Iron, Steel and Alloys


Unit IV: Glass, Ceramics and Refractories

Glass, raw materials and colouring agents - chemical reaction involved in glass manufacture - some special glasses (borosilicate, alkali silicate, optical glass, soda lime glass, their properties and applications). Ceramics - various classes of ceramics, general properties, porous and non-porous wares, raw materials for ceramics, uses. Refractories - manufacture of refractories - properties and uses of common refractory bricks - silica bricks - fire clay bricks, magnesite bricks and dolomite bricks.

Unit V: Surface Coatings

Pre-treatment of the surface, metallic coating, galvanizing, tinning - Inorganic coatings

Course outcomes:

At the end of the course, students will be able to

CO1: categorize fuels and energy sources

CO2: describe the types of polymerization methods as well as preparation and uses of few well-known polymers
CO3: describe the composition and manufacturing process of cements and fertilizers

CO4: demonstrate the manufacturing process and applications of iron, steel, alloys, glass, ceramics and refractories

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SEMESTER - V

Credits: 3
Hours: 3

19ICHE35A: Elective 3: Chemistry for Mankind

Learning Objectives:

The objective of the course is to develop an understanding of food components such as carbohydrates, amino acids, proteins, to obtain preliminary knowledge on dyes, leathers, fibers, to provide comprehensive introduction to sulpha drugs, antibiotics, fuels and to know synthesis and applications of polymers.

Unit I - Carbohydrates

Introduction - classification-preparation and properties of glucose and fructose structure of glucose (configuration-not expected) mutarotation- interconversion of aldose and ketose. Increasing and decreasing the length of the carbon chain in sugars - polysaccharides- preliminary study of starch and cellulose. Industrial applications of starch and cellulose.

Unit II - Amino Acids and Proteins

Classification-preparation and properties of amino acids, isoelectronic point-tests for amino acids-polypeptides, peptide linkage, proteins - classification-denaturation of proteins, colour reactions, biological significance of proteins, structure of proteins, primary structure of proteins, end group analysis, preliminary study of secondary structure, introduction to DNA and RNA.

Unit III - Dyes, Leather and Fibers

Introduction-structural features of a dye-classification of dyes, preparation of methyl orange, fluorescein, malachite green, alizarin and uses (both textile and non-textile).

Leather: Basic principles in tanning and dyeing of leather, types of tanning (chrome and vegetable tanning) Fibers: Synthetic fibers derived from cellulose, nylon and terylene.

Unit IV - Sulpha Drugs, Antibiotics and Fuels

Introduction to sulpha drugs - sulphanilamide, sulphameracine, sulphaguanidine - preparation, mode of action of sulpha drugs. Antibiotics: very brief study of chloramphenicol, penicillin and tetracycline-their uses (detailed chemistry not required).


Unit V - Polymers

Different types of polymerization-addition, condensation, ionic and free radical polymerization-mechanisms, synthesis and applications of the following polymers-PVC, polyester, polythene, Teflon, and polystyrene - rubber-natural rubber, vulcanization of rubber- synthetic rubber-neoprene.
Course outcomes:

After successful completion of the course, students will be able to

CO1 Describe the chemistry of carbohydrates

CO2 Determine the structures of selected alkaloids and terpenes

CO3 Classify protein and demonstrate the primary and secondary structure of proteins

Text Books:

Learning Objectives:

The objective of the course is to learn about the food laws and general composition and quality criteria of the food products, to know the importance of toxicology and also the analysis of common adulterants.

UNIT – I: Food Laws and regulations


UNIT - II

General Composition and quality -Dairy products -Oil and Fats-Spices and condiments -Food Grains-Flours-Canned Foods-Fruit and Vegetables products-Meat and poultry-Sugar- Beverages-Alcoholic and Non Alcoholic drinks

UNIT - III

Importance of food toxicology -naturally occurring toxins in various foods -microbial and parasitic-food poisoning and food infections or foodborne illness-mycotoxins - aflatoxin- bacterial toxin-residual chemical contaminants-pesticides-heavy metals, hormones in food.

UNIT - IV

Comparison of adulterants and additives-food additives-antioxidants-Natural oxidants-synthetic oxidants-colour-stabilizer-surface active agents-artificial sweetener-flavor enhancers-Intentional adulterants-Incidental adulterants

UNIT - V

Analysis of adulterants- morphological and anatomical characterization-physical techniques-chemical/biochemical techniques-electrophoresis and immunology based techniques-molecular techniques-PCR and sequencing based techniques.
Course outcomes:
After successful completion of the course, student will be able to
CO1 Describe the food laws
CO2 Discuss the general composition and quality of food
CO3 Determine the toxins and adulterants of food
CO4 Describe the food additives

Text Books:

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Learning Objectives:
To understand the basics of human organ functions and to impart knowledge on clinical biochemistry and laboratory practices

Unit I - Basics of Human Metabolism

Unit II - Laboratory Techniques

Unit III - Renal Function

Unit IV - Urine Analysis
Identification of Pathological Physical and Chemical Urine Constituents & Microscopic examination of Urine, Quantitative Determination of Urine Protein Proteinuria & Microalbuminuria Quantitative Determination of Urine Uric Acid Quantitative Determination of Urine Creatinine.

Unit V - Blood Analysis

Course outcome:
At the end of the course,
CO1: the student able to understand the concepts of clinical chemistry

Textbook:

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Learning Objectives:

The objective of the course is to know the importance of agricultural chemistry and an exposure to analyze and find a suitable method to cultivate and to promote agricultural methods.

Unit I - Chemistry of soil


Unit II - Plant Nutrients and Fertilizers

Plant nutrients - Sources and roles of macro and micronutrients in plant growth - Nutritional deficiency in plants - symptoms, corrective measures - Fertilizers - classification of NPK fertilizers - natural and synthetic.

Unit III - Pesticides

Definition - Classification - organic and inorganic pesticides and its mechanism of action - Safe handling of pesticides, Fungicides - definition - classification - mechanism of action - sulfur, copper and mercury compounds.

Unit IV - Herbicides

Definition - classification - mechanism of action - Arsenic and boron compounds - urea compounds, nitro compounds and chlorocompounds.

Unit V - Plant Growth Regulators

Definition - Classification - Structure and functions of - Abscisic acid - Auxins - Cytokinins - Ethylene - Gibberellins.

Course outcomes:

After successful completion of the course, students will be able to

CO1: describe the basics of soil
CO2: classify and explain plant nutrients and fertilizers
CO3: predict the mechanism of pesticides and herbicides
CO4: describe the structure and functions of plant growth regulators
Text Book:


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SEMESTER – VIII

19ICHE74A: Elective 7: SELECTIVE MATERIALS, TECHNIQUES AND ENVIRONMENTAL CHEMISTRY

SELECTIVE MATERIALS, TECHNIQUES AND ENVIRONMENTAL CHEMISTRY

Learning Objectives:
To learn the advanced materials, basics of important instruments and study the aspects of pollution

Unit I: Chemistry of Selective Materials

Unit II: Spectral and thermal techniques
Instrumentation of AAS, AES, Spectrofluorimetry, types of optical instruments components, sample preparation application in quantitative analysis - IR spectroscopy-instrumentation- detectors- various types of sources- monochromators- sample cell considerations - sample preparations - Principle of TGA,DTA and DSC – applications.

Unit III: Air and water pollution
Air Pollution: Sources of pollutants - SO₂,NO₂,CO₂, hydrocarbons and lead-pollutant particle size – aerosols and particulates – photochemical and industrial smogs - Air pollution - upper atmosphere – greenhouse effect - biochemical effect of heavy metals, PAN and cyanide
Water Pollution: Dissolved oxygen - BOD, COD - heavy metals as pollutants - thermal pollution – Chemical pollution.

Unit IV: Soil and radioactive pollutions

Unit-V: Environmental Toxicology
Chemical solution to environmental problems, biodegradability, principles of decomposition, better industrial processes. Bhopal gas tragedy , Three Mile Island, Sewazo and Minamata disasters. Industrial Pollution: Cement, sugar, distillery, drug paper and pulp, thermal power plants, nuclear power plants, metallurgy polymers drugs etc., radio nuclide analysis, disposal of wastes and their management.

Text Books:

1. Environmental Chemistry, S.E.Manahan, Lewispublishers.
2. Environmental Chemistry, Sharma&Kaur, Krishnapublishers

Course Outcomes:
After the completion of this course, students will be able to
CO1 Demonstrate knowledge of materials and chemical and biochemical principles of fundamental environmental processes in air, water, and soil.

CO2 Develop an understanding of chemicals and their effects on the environment.

CO3 Develop an understanding of some basic principles of chemistry and apply these principles to current environmental issues.

CO4 Acquire broad knowledge of the field of environmental toxicology and chemistry including basic principles, target organ toxicity and the toxicity of a select group of chemical compounds.

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Learning Objectives:
To learn the basics of applied chemistry.

Unit - I: High Polymers

Unit - II: Analysis of Water Pollution

Unit - III: Applied Photochemistry

Unit - IV: Fuel Analysis and Agricultural Chemistry
Analysis of soil: moisture, pH, total nitrogen, phosphorous, silica, lime, magnesia, manganese, sulphur and alkali salts.
Fertilizers: Fertilizer industries in India, manufacture of ammonia, ammonium salts, urea, nitrates, phosphates and superphosphates – mixed fertilizers – nitrogen fixation.

Unit - V: Organic Nanomaterials
Fullerenes – synthesis and purification – magnetic and optical properties. Carbon nanotubes – synthesis purification and functionalization.

Text Books:
Course Outcomes:
After the completion of this course, students will be able to

CO1 Demonstrate knowledge of polymers

CO2 Develop an understanding of chemicals and their effects on the environment.

CO3 Develop an understanding of some basic principles of Photochemistry and apply these principles to current environmental issues

CO4 Acquire broad knowledge of the field of fuel analysis

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Learning Objectives:
To introduce the purpose and importance of research for future development.

UNIT - 1: Meaning of Research
The search for knowledge, purpose of research, scientific method, role of theory, characteristics of research - Types of research: fundamental or pure research, applied research, action research, historical research, experimental research.

UNIT - 2: Chemical Literature
Sources of chemical information: primary, secondary and tertiary sources - Indexes and abstracts in science and technology: applied science and technology index, biological abstracts, chemical abstracts, chemical titles, current chemical reactions, current contents, engineering index, index chemicus, index medicus, physics abstracts, science citation index - Classical and comprehensive reference works in chemistry. Beilstein, compilations of data, synthetic methods and techniques, treatises, reviews.

UNIT - 3: Chemical Abstracts
Current awareness searching: CA weekly issues, CA issue indexes - Retrospective searching: CA volume indexes - general subject index, chemical substance index, formula index, index of ring systems, author index, patent index - 3CA Collective indexes: Collective index (CI), decennial index (DI) - Access points for searching CA indexes: index guide, general subject terms, chemical substance names, molecular formulas, ring systems, author names, patent numbers - Locating the reference: finding the abstract, finding the original document, chemical abstract service source index.

UNIT - 4: Scientific Writing
Scientific writings: research reports, theses, journal articles, and books - requirement of technical communications: eliminating wordiness and jargon-tautology, redundancy, imprecise words, superfluous phrases - Steps to publishing a scientific article in a journal: types of publications - communications, articles, reviews; when to publish, where to publish, specific format required for submission, organization of the material - Documenting: abstracts - indicative or descriptive abstract, informative abstract, footnotes, endnotes, referencing styles, bibliography - journal abbreviations (CASSI), abbreviations used in scientific writing.

UNIT - 5: Computer Searches of Literature

Textbooks:
5. H. M. Kanare, Writing the Laboratory Notebook; American Chemical Society: Washington, DC, 1985.

Course outcomes:
After successful completion, students
  CO1: will be able to understand the basics of research
  CO2: will appreciate the tools of research
  CO3: will get exposure to research problems
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SEMESTER - IX

19ICHE94B: Elective 10: Organic Chemical Technology

Organic Chemical Technology

Learning objectives:
To understand the elements of chemical engineering in organic synthesis and to know the unit processes in organic chemical technology.

UNIT - 1: Elements of Chemical Engineering

UNIT - 2: Applications of Thermodynamics in Organic Unit Processes
Energy balance over a flow system, heat of reaction, effect of temperature upon heat of reaction - Chemical equilibrium, calculation of equilibrium conversion, entropy changes, simultaneous reactions.

UNIT - 3: Organic Chemical Process Kinetics
Factors vapour phase and liquid phase catalytic reactions affecting chemical processes - Type and shape of reactors used, the method of operation, temperature control - Batch or flow process, batch mixing, fixed or fluidized bed.

UNIT - 4: Unit Process in Industrial Organic Synthesis
Study of Organic reactions as they apply to industrial processes. Process parameters of importance in scaling up of these reactions from laboratory to pilot plant to main plant - Selection of suitable plant equipment, especially the shape and size of the reactor stirrer, condenser etc. choice of material of construction - Study of industrial scale nitration, sulphonation, homogeneous and heterogeneous hydrogenation, oxidation and halogenations reactions.

UNIT-5: Study of Detailed Technologies of Manufacture – a dye, a drug and a pigment
Three specific chemicals, one each from the above category will be discussed, illustrating the chemical engineering principles used in proper selection of equipment - The logic involved in the layout of the plant, the control tests for the process itself and isolation methods of the product and its standardization - Importance of quality control and technical service to customers will be pointed out.

Textbooks:


Supplementary reading:

2. BIOS, CIOS and FIAT technical reports on the German chemical industry.

**Course outcomes:**

After successful completion, students

CO1: will be able to understand the basics of chemical technology

CO2: will appreciate principle of chemical engineering

CO3: will get idea about applications of chemistry in industries

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