DEPARTMENT OF CHEMISTRY

M.Sc CHEMISTRY (TWO-YEAR)

Programme Code: SCHE21

Regulations, Curricula and Syllabus
2019-2020
M.Sc. CHEMISTRY (TWO YEAR)

Programme Code: SCHE21

These regulations are common to all the students admitted to the Two Year Master Programme in the Faculty of Science from the Academic Year 2019 – 2020.

1 Definitions and Nomenclature

1.1 University refers to Annamalai University.

1.2 Department means any of the academic departments and academic centers at the University.

1.3 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.

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

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

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

1.7 Syllabus is an academic document that contains the 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.

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

1.9 Semester is a half-year term that lasts for a minimum duration of 90 days.

1.10 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.

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

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

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

1.14 Credit refers to the quantum of course work in terms of 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.

1.15 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.

1.16 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.

1.17 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.

1.18 Learning Objectives are statements that define the expected goal of a course in
Course Objectives in terms of demonstrable skills or knowledge that will be acquired by a student.

1.19 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.

1.20 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

1.21 Cumulative Grade Point Average (CGPA) is a measure of overall cumulative performance of a student over all the semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters to the sum of the total credits of all courses in all the semesters is given in section 11.4.

1.22 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, RA, and W.

2 Programme Offered and Eligibility Criteria:

<table>
<thead>
<tr>
<th>Faculty of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.Sc. Chemistry</td>
</tr>
<tr>
<td>A pass in B.Sc. Chemistry, B.Sc. Applied Chemistry or B.Sc. Industrial Chemistry with not less than 50% of marks in Part–III.</td>
</tr>
</tbody>
</table>

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

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

4.1 The Two Year Master’s Programme consists of two academic years.

4.2 Each academic year is divided into two semesters, the first being from July to November and the second from December to April.

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

5 Programme Structure

5.1 The Two Year Master’s Programme consists of Core Courses, Elective Courses (Departmental & Interdepartmental), Value Added Course and Project.

5.2 Core courses

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

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

5.3 Elective courses

5.3.1 Departmental Electives (DEs) are the Electives that students can choose from a range of Electives offered within the Department.

5.3.2 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. IDEs are listed in the Hand Book which is available in the University website.

5.4 Experiential Learning

5.4.1 Experiential learning provides opportunities to students to connect principles of the discipline with real-life situations.
5.4.2 In-plant training/field trips/internships/industrial visits fall under this category.

5.5 Project

5.5.1 Each student shall undertake a Project and submit a dissertation as per guidelines in the final semester.

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

5.5.3 The Research Supervisor shall assign a topic for research and monitor the progress of the student periodically.

5.5.4 Students who wish to undertake project work in recognized institutions/industry shall obtain prior permission from the University. The Research Supervisor will be from the host institute.

5.6 Value added Courses (VACs)

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

5.6.2 These courses impart employable and life skills.

5.6.3 Each VAC carries 2 credits with 30 hours of instruction. Classes for a VAC are conducted beyond the regular class hours and preferably in the II and III Semester.

5.7 Online Courses

5.7.1 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.

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

5.8 Credit Distribution: The credit distribution is organized as follows:

<table>
<thead>
<tr>
<th>SEMESTER I to IV</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td>72</td>
</tr>
<tr>
<td>Elective Courses</td>
<td>15</td>
</tr>
<tr>
<td>Project</td>
<td>06</td>
</tr>
<tr>
<td>Constitution of India</td>
<td>02*</td>
</tr>
<tr>
<td>Total</td>
<td>93</td>
</tr>
</tbody>
</table>

5.9 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 duration per week over a semester

1 Practical/Project period of two hours duration per week over a semester.

6 Attendance

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

6.2 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 organization of lesson plan of the Course teacher.

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

6.4 At the end of the semester, the record shall be placed in safe custody for any future verification.
6.5 The Course teacher 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.

6.6 Each student shall have a minimum of 75% attendance in all 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.

6.7 Relaxation of attendance requirement up to 10% may be granted for valid reasons such as illness, representing the University in extracurricular activities and participation in NCC/NSS/YRC/RRC.

7 Mentor-Mentee System

7.1 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 certain number of students to a member of the faculty who shall function as a Mentor throughout their period of study.

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

7.3 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

8.1 The examination system of the University is designed to systematically test the student’s progress in class, laboratory and field work through Continuous Internal Assessment (CIA) Tests and End-Semester Examination (ESE).

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

8.3 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.

8.4 Continuous Internal Assessment Tests

8.4.1 The CIA Tests shall be a combination of a variety of tools such as class tests, assignments and seminars. This requires an element of openness.

8.4.2 The students will be informed in advance about the assessment procedures.

8.4.3 The question paper will be set by the respective course teacher using Bloom Taxonomy.

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

8.4.5 CIA Tests will be for one or two hours duration depending on the quantum of syllabus.

8.4.6 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 course teacher in consultation with the Head of the Department.

8.5 End Semester Examinations (ESE)

8.5.1 The ESE for the first and third semester will be conducted in November and for the second and fourth semester in May.

8.5.2 Candidates who failed in any course will be permitted to reappear in failed course in the subsequent examinations.

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

9 Evaluation

9.1 Marks Distribution

9.1.1 For each course, the Theory, Practical and project shall be evaluated for a maximum of 100 marks.
9.1.2 For the theory courses and project work, CIA Tests will carry 25% and the ESE 75% of the marks.
9.1.3 For the Practical courses, the CIA Tests will carry 40% and the ESE 60% of the marks.

9.2 Assessment of CIA Tests
9.2.1 For the CIA Tests, the assessment will be done by the Course Teacher.
9.2.2 For the Theory Courses, the break-up of marks shall be as follows:

<table>
<thead>
<tr>
<th>Marks</th>
<th></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>Total</td>
<td>25</td>
</tr>
</tbody>
</table>

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

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

9.3 Assessment of End-Semester Examinations
9.3.1 Evaluation for the ESE is done by Internal examiners.

9.4 Assessment of Project/Dissertation
9.4.1 The Project Report/Dissertation shall be submitted as per the guidelines.
9.4.2 The Project Work/Dissertation shall carry a maximum of 100 marks.
9.4.3 CIA for Project work will consist of a Review of literature survey, experimentation/field work, attendance etc.
9.4.4 The Project Report evaluation and viva-voce will be conducted by a committee constituted by the Head of the Department.
9.4.5 The Project Evaluation Committee will comprise the Head of the Department, Project Supervisor and a senior faculty.
9.4.6 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>Project / Dissertation Evaluation</td>
<td>Viva-voce</td>
</tr>
<tr>
<td>Review- I: 10</td>
<td>Review- II: 15</td>
</tr>
<tr>
<td></td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>
9.5 Assessment of Value-added Courses
9.5.1 Assessment of VACs shall be internal. Two CIA Tests shall be conducted by the Department(s) offering VAC.
9.5.2 The grades obtained in VACs will not be included for calculating the GPA/CGPA.

9.6 Passing Minimum
9.6.1 A student is declared to have passed in each course if he/she secures not less than 50% marks in the ESE and not less than 50% marks in aggregate taking CIA and ESE marks together.
9.6.2 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
11.1 The performance of students in each course is evaluated in terms Grade Point (GP).
11.2 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.
11.3 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.

11.4 CGPA is the Weighted average Grade Point of all the Courses passed starting from the first semester to the current semester,

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

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, \( m \) is the number of semesters.
11.5 Evaluation:
11.5.1 Performance of the student for each course will be rated as shown in the Table.

<table>
<thead>
<tr>
<th>Range of Marks</th>
<th>Grade Points</th>
<th>Letter Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 and above</td>
<td>10</td>
<td>S</td>
</tr>
<tr>
<td>80-89</td>
<td>9</td>
<td>A</td>
</tr>
<tr>
<td>70-79</td>
<td>8</td>
<td>B</td>
</tr>
<tr>
<td>60-69</td>
<td>7</td>
<td>C</td>
</tr>
<tr>
<td>55-59</td>
<td>6</td>
<td>D</td>
</tr>
<tr>
<td>50-54</td>
<td>5</td>
<td>E</td>
</tr>
<tr>
<td>Less than 50</td>
<td>0</td>
<td>RA</td>
</tr>
<tr>
<td>Withdrawn from the examination</td>
<td>0</td>
<td>W</td>
</tr>
</tbody>
</table>

11.5.2 A ten point rating scale is used for evaluation of the performance of the student to provide overall grade for the Master’s Programme.

<table>
<thead>
<tr>
<th>CGPA</th>
<th>Classification of Final Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.25 and above</td>
<td>First Class with Distinction</td>
</tr>
<tr>
<td>6.5 and above but below 8.25</td>
<td>First Class</td>
</tr>
<tr>
<td>5.0 and above but below 6.5</td>
<td>Second Class</td>
</tr>
<tr>
<td>0 and above but below 5.0</td>
<td>Re-appear</td>
</tr>
</tbody>
</table>

11.6 Classification of Results. The successful candidates are classified as follows:

11.6.1 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 and 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).

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

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

11.6.4 Candidates who obtain overall highest CGPA in all examinations in the First Appearance Itself are eligible for University Rank.

11.7 Course-Wise Letter Grades
11.7.1 The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

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

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

11.7.4 A letter grade RA indicates that the candidate shall reappear for that course. The RA Grade once awarded stays in the grade sheet 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 candidate has appeared for clearance of the arrears.

11.7.5 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**

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

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

12.3 Permission for withdrawal from the examination shall be granted only once during the entire duration of the programme.

12.4 Application for withdrawal shall be considered only if the student has registered for the course(s), and fulfilled the requirements for attendance and CIA tests.

12.5 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.

12.6 Withdrawal will not be granted for arrear examinations of courses in previous semesters and for the final semester examinations.

12.7 Candidates who have been granted permission to withdraw from the examination shall reappear for the course(s) when the course(s) are offered next.

12.8 Withdrawal shall not be taken into account as an appearance for the examination when considering the eligibility of the candidate 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 library or computer resources, stealing other students’ notes/assignments, and 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 sensitized 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 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 Two Year 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.
# M.Sc. Chemistry (Two Year) Programme

**Programme Code: SCHE21**

Curricula and Scheme of Examination
(For students admitted from the academic year 2019-2020)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>L</th>
<th>P</th>
<th>C</th>
<th>CIA</th>
<th>ESE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FIRST SEMESTER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19CHEC101</td>
<td>Core 1: Organic Reaction Mechanisms</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEC102</td>
<td>Core 2: Coordination Chemistry and Inorganic Reaction Mechanisms</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEC103</td>
<td>Core 3: Chemical Thermodynamics, Photochemistry and Group Theory</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEP104</td>
<td>Core 4: Organic Chemistry Practical- I</td>
<td>6</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEP105</td>
<td>Core 5: Physical Chemistry Practical- I</td>
<td>6</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Elective 1: Interdepartmental Elective</td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
</tr>
<tr>
<td><strong>SECOND SEMESTER</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19CHEC201</td>
<td>Core 1: Organic Photochemistry and Molecular Rearrangements</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEC202</td>
<td>Core 2: Solid State and Organometallic Chemistry</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEC203</td>
<td>Core 3: Chemical Kinetics and Quantum Mechanics</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEP204</td>
<td>Core 4: Organic Chemistry Practical- II</td>
<td>6</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEP205</td>
<td>Core 5: Inorganic Chemistry Practical- I</td>
<td>6</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Elective 2: Interdepartmental Elective</td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19CHEE20X</td>
<td>Elective 3: Department Elective</td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24</td>
</tr>
<tr>
<td><strong>THIRD SEMESTER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19CHEC301</td>
<td>Core 1: Synthetic Organic Chemistry</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEC302</td>
<td>Core 2: Green Chemistry, Computational Chemistry, Drug Design and Spectroscopy</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEC303</td>
<td>Core 3: Spectral and Analytical Techniques</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEC304</td>
<td>Core 4: Electrochemistry and Spectroscopy</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19CHEP305</td>
<td>Core 5: Inorganic Chemistry Practical - II</td>
<td>6</td>
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FOURTH SEMESTER

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**TOTAL CREDITS**

|         | 93 |

Value Added Courses

L- Lectures; P- Practicals; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination.

*19PSCI300 = NON-CREDIT COMPULSORY COURSE*

**Note:**

1. Students shall take both Department Electives (DEs) and Interdepartmental Electives (IDEs) from a range of choices available. The details of interdepartmental electives are given in the "Handbook of Interdepartmental Electives-Two Year Programme" and listed in the University website.

2. Students may opt for any Value-added Courses listed in the University website. The details of Value Added Courses are given in the "Handbook of Value Added Courses" and listed in the University website.

3. Guidance/ Discussion on course specific Experiential Learning to students will be provided wherever feasible to apply the knowledge, skills and attitude taught in the course, either within the classroom, within the community, or within the workplace, to learn by experience which would improve their employability skills.
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L- Lectures; P- Practicals; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination.
ANNAMALAI UNIVERSITY
Department of Chemistry
Pattern of question paper for END semester examinations
(Based on Revised Bloom’s Taxonomy)

Year: I
Programme: M.Sc Two Year PG Programme
Course Code: 
Course Name: 
Max. Marks: 100

Time: 3 Hrs

Part-A (Level-K1/ Level-K2) Marks: (10x2=20)
(Answer ALL of the questions)

1. Define……
2. Multiple Choices a. b. c. d.
3. Multiple Choices a. b. c. d.
4. Match the following i - a ii - b iii - c iv -d v - ..... 
5. Match the following i - a ii - b iii - c iv -d v - ..... 
6. Explain......
7. Select.....
8. Describe......
9. Classify....
10. Elucidate....

Part-B (Level-K3/ Level-K4) Marks: (8x5=40)
(Answer any EIGHT of the questions)

11. Prepare.....
12. Solve.....
13. Apply......
14. Show.....
15. Categorize...
16. Analyze...
17. Distinguish....
18. Infer....
19. Compare....
20. Compute

Part-C (Level-K5) Marks: (3x10=30)
(Answer any THREE of the questions)

21. Discuss...
22. Summarize....
23. Evaluate.....
24. Disprove....

Part-D (Level-K6) Marks: (1x10=10)
(Answer any ONE of the questions)

25. Design....
26. Develop...
ANNAMALAI UNIVERSITY
Department of Chemistry
Pattern of question paper for END semester examinations
Year: II

Programme: M.Sc Two Year PG Programme
Semester: III / IV

Course Code: Course Name: Max.Marks:100
Time: 3 Hrs

Part-A (Level-K1/ Level-K2) Marks: (10x2=20)

(Answer ALL of the questions)

1. Define……
2. Multiple Choices  a. b. c. d.
3. Multiple Choices  a. b. c. d.
4. Match the following i - a  ii - b  iii - c  iv -d  v - ..... 
5. Match the following i - a  ii - b  iii - c  iv -d  v - ..... 
6. Explain........
7. Select......
8. Describe.....
9. Classify....
10. Elucidate....

Part-B (Level-K3/ Level-K4) Marks: (6x5=30)

(Answer any SIX of the questions)

11. Apply........
12. Show.....
13. Prepare
14. Make use of....
15. Categorize...
16. Analyze...
17. Distinguish....
18. Simplify.....

Part-C (Level-K5) Marks: (3x10=30)

(Answer any THREE of the questions)

19. Discuss...
20. Recommend with
21. Evaluate.....
22. Justify....
23. Optimize...

Part-D (Level-K6) Marks: (2x10=20)

(Answer any TWO of the questions)

24. Design....
25. Formulate ...
26. Modify .....
M.Sc Chemistry (TWO YEAR) PROGRAMME

[End Semester Examinations]
Bloom's Taxonomy - Questions Conforming to Levels K1 to K6

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ANNAMALAI UNIVERSITY

Department of Chemistry

[Question Paper Pattern - INTERNAL TESTS I & II (CIA)]

(Based on Revised Bloom's Taxonomy)

Programme: M.Sc : Two Year PG
Semester: All

Time: 2 Hrs
Max.Marks: 50

Part-A (Level-K1) Marks: (6x2=12)
(Answer ALL of the questions)

1. Define /Choose/ Relate……
2. What / Why / How?
3. Multiple Choices a. b. c. d.
4. Multiple Choices a. b. c. d.
5. Match the following i - a ii - b iii - c iv - d v - ..... 
6. Match the following i - a ii - b iii - c iv - d v - ..... 

Part-B (Level-K2) Marks: (3x5=15)
(Answer any THREE of the questions)

7. Explain.....
8. Describe.....
9. Select......
10. Compare

Part-C (Level-K3/ Level-K4) Marks: (2x7=14)
(Answer any TWO of the questions)

11. Apply....
12. Calculate....
13. Categorize...

Part-D (Level-K5/ Level-K6) Marks: (1x9=9)
(Answer any ONE of the questions)

14. Discuss....
15. Summarize....
PROGRAMME OUTCOMES (POs)

After the successful completion of the M.Sc Chemistry (2 year) Degree Programme, the graduates will be able to know about:

<table>
<thead>
<tr>
<th>PO</th>
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<tbody>
<tr>
<td>PO1</td>
<td>Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.</td>
</tr>
<tr>
<td>PO2</td>
<td>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.</td>
</tr>
<tr>
<td>PO3</td>
<td>Analytical and Technical Skills: Ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects/limitations.</td>
</tr>
<tr>
<td>PO4</td>
<td>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.</td>
</tr>
<tr>
<td>PO5</td>
<td>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.</td>
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<tr>
<td>PO6</td>
<td>Individual and team work: Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.</td>
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<tr>
<td>PO7</td>
<td>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.</td>
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<tr>
<td>PO8</td>
<td>Environment and Society: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.</td>
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<tr>
<td>PO9</td>
<td>Ethics: Commitment to professional ethics and responsibilities.</td>
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<td>PO10</td>
<td>Life-long learning: Ability to engage in life-long learning in the context of the rapid developments in the discipline.</td>
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At the end of the programme, the student will be able to

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<tr>
<td>PSO1</td>
<td>Gain complete knowledge about all fundamental aspects of all branches of chemistry.</td>
</tr>
<tr>
<td>PSO2</td>
<td>Understand the basic concepts of organic chemistry like reagents in organic syntheses, stereochemistry, instrumental method of chemical analysis and natural products etc.</td>
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<tr>
<td>PSO3</td>
<td>Identify the importance inorganic chemistry includes coordination chemistry, role of metal ions in biological processes and organometallic chemistry.</td>
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<tr>
<td>PSO4</td>
<td>Gather attention about the physical aspects of molecules like molecular spectroscopy, role of catalysts, polymer chemistry, materials chemistry and biophysical chemistry.</td>
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<tr>
<td>PSO5</td>
<td>Learn 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.</td>
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<tr>
<td>PSO6</td>
<td>Carry out experiments in the area of organic analysis, estimation, separation derivative process, inorganic semi micro analysis, preparation, conductometric and potentiometric analysis.</td>
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<tr>
<td>PSO7</td>
<td>Obtain knowledge in Spectral, Analytical, Qualitative &amp; Quantitative techniques and contribute new scientific insights or innovative applications of chemical research to the next generation.</td>
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</table>
Learning Objective (LO):

LO1 To learn the fundamental mechanisms underlying different chemical reactions, basic aspects of stereochemistry and conformational analysis of six membered ring systems.

Course Outcomes (CO)
At the end of the course, the student 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.

Unit – 1: 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 - $S_N1$, $S_N2$ and $S_Ni$ mechanisms with examples. - structure and solvent effect on nucleophilic substitution reactions. Aromatic nucleophilic substitution: Unimolecular, bimolecular and benzyn mechanisms.

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

Unit – 2: 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 - $S_e1$, $S_e2$ and $S_ei$ 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 – 3: Organic Stereochemistry- I


Walden inversion, asymmetric transformation and asymmetric induction - enantio and diastere 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 – 4: Organic Photochemistry – I


Unit – 5: Natural Products – I


Unit – 6 (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:

Outcome Mapping:

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*1-Low  *2-Medium  *3-Strong
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**Learning Objective (LO):**

| LO1       | To learn the fundamental mechanisms underlying Coordination Chemistry, reaction mechanism and photoinorganic chemistry. |

**Course Outcomes (CO):**

At the end of the course, the student 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. |

**Unit – 1: 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 - 2: 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 – 3: Reaction Mechanism-I**


- Racemisation and isomerisation: Twist mechanisms for isomerisation – Intramolecular mechanisms for racemisation.
Unit – 4: Reaction Mechanism-II


Electron transfer reactions-Electron tunneling hypothesis-Marcus-Hush theory. Atom transfer reaction-one electron and two electron transfer-inner sphere and outer sphere mechanism.

Unit – 5: 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-photosubstitution, photooxidation and photoreduction- Photochemical reactions involving Ruthenium(II) bipyridyl complex. Application to photovoltaics-water photolysis- carbon dioxide reduction.

Unit – 6 (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.

Text books:

Supplementary reading:

Outcome Mapping:

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*1-Low   *2-Medium   *3-Strong
Learning Objective (LO):

LO1 To learn the fundamentals of thermodynamics, photochemistry and group theory.

Course Outcomes (CO):

At the end of the course, the student 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.

Unit – 1: 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 – 2: 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 – 3: Statistical Thermodynamics

Thermodynamic probability and entropy. Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics.


Unit – 4: Photochemistry and Radiation Chemistry


Radiation Chemistry-linear energy transfer, G-value, dosimeters, radiolysis of water, solvated electrons.
Unit – 5: Principles and Applications of Group Theory

Symmetry elements and symmetry operations, point groups, group multiplication table of \( C_{2v} \) and \( C_{3v} \), 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 \( \text{H}_2\text{O} \) and \( \text{NH}_3 \) molecules - hybrid orbitals in \( \text{BF}_3 \), \( \text{CH}_4 \) and \( \text{NH}_3 \).

Unit – 6 (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 - SALC 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


Outcome Mapping:

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*1-Low  2-Medium  3-Strong
Learning Objective (LO):

LO1 To learn different types of organic reactions and its mechanisms and to undertake experiments on organic reactions.

Course Outcomes (CO)

At the end of the course, the student 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. |

Preparation of organic compounds involving two step reactions.

Text books:


Supplementary reading:


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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

| LO1 | To learn the principles and verification of electrochemistry and binary solutions and to perform experiments in studying the important concepts electrochemistry and binary systems. |

Course Outcomes (CO):

At the end of the course, the student 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 the analytical problems. |

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) CH$_3$COOH vs NaOH,
6) Displacement titrations (NH$_4$Cl vs NaOH)
7) Precipitation titrations
   i) CuSO$_4$ vs NaOH, ii) BaCl$_2$ vs Na$_2$CO$_3$, iii) KCl vs AgNO$_3$
8) Titration of mixtures
   i) HCl + CH$_3$COOH vs NaOH, ii) HCl + CuSO$_4$ vs NaOH iii) HCl + NH$_4$Cl 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 + I$_2$ $\rightleftharpoons$ KI$_3$
3) Estimation of iodide ions using partition experiments
4) Distribution of ammonia between water and chloroform
5) Determination of formula of cuprammonium complex

Text Books:


**Outcome Mapping:**

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*1-Low   *2-Medium   *3-Strong
### Learning Objective (LO):

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<td>LO1</td>
<td>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.</td>
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### Course Outcomes (CO):

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

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<td>CO1</td>
<td>Understand the theoretical basis and mechanisms underlying additions and elimination reactions.</td>
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<td>Appreciate reaction mechanisms involved in rearrangements.</td>
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<td>CO3</td>
<td>Evaluate the chemistry of dyes and their synthetic utilities.</td>
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<td>Differentiate the various types of heterocyclic molecules.</td>
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<td>Understand the relationship between the structure and function of various classes of natural compounds.</td>
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### Unit – 1: Organic Photochemistry – II


### Molecular Rearrangements.


### Unit – 2: 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 Sawhoarse 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 – 3: 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 – 4: Small Ring and Higher Ring Heterocycles

Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiranes, 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, dioxcines and dithiocines.

Unit – 5: 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 importants of cholesterol, cholic acid, estrone, estradiol, testosterone and androstrone.

Unit – 6 (Not for Final Examination)

Problems in each type of photochemical reactions and molecular rearrangements. Aromatic transition state-general rule for pericyclic reactions. Structural elucidation of tetracyclins, streptomycin, penicillins, Estriol and progesterone.

Text books:

Supplementary Reading:

**Outcome Mapping:**

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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

LO1 To learn the principles of solid state, polymeric inorganics and organometallic Chemistry.

Course Outcomes (CO):

At the end of the course, the student 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.

Unit - 1: 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 - 2: Polymeric Inorganic Compounds

Structures and classification of higher boranes - carboranes - metallocarboranes- silicates- silicones - Phosphazenes - Linear and cyclic phosphazenes -Sulfur - nitrogen compounds- \( \text{S}_n \text{N}_m \)- one dimensional conductor \([\text{SN}]_x \)-Metal clusters-binuclear metal halide clusters- structure and bonding in octachlorodirhenate(III). Isopoly and heteropolyacids- structure and bonding of isopoly & 6- and 12- heteropoly anions.

UNIT – 3: Phase Transitions


Unit - 4: 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- Metallocenes: preparation, properties, structure and bonding in ferrocene.
Unit - 5: Organometallic Chemistry –II (Catalysts and Reaction Mechanisms)


Unit – 6 (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 MS₂ compounds and intercalations.

Organosilicon compounds – organometallic compounds of arsenic, antimony and bismuth – catenated and multiply bonded compounds.

Text books:

Supplementary Reading:

Outcome Mapping:

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*1-Low *2-Medium *3-Strong
Learning Objective (LO):

LO1  To acquire knowledge on the basic concepts in chemical kinetics and to learn quantum theory.

Course Outcomes (CO):

At the end of the course, the student 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.

Unit – 1: Chemical Kinetics and Catalysis


General features of fast reactions – Study of fast reactions by flow methods.

Unit – 2: 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 – Hammet equation, Taft equation, separation of polar, resonance and steric effects.

Unit – 3: Quantum Mechanics of Simple System -I

Planck’s quantum theory, wave particle duality, uncertainty principle, operators and commutation relations-Postulates of quantum mechanics – derivation of Schrodinger's time- independent wave equation and its application to particle in a one-dimensional 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 – 4: Applications of Quantum Chemistry - II

Covalent bonding – Born-Oppenheimer approximation-Hydrogen molecule ion, LCAO – MO and VB treatments of the hydrogen molecule. Antisymmetry and Pauli’s
exclusion principle. Slater determinantal wave function, term symbols and spectroscopic states – Russell-Saunders coupling.

Unit – 5: 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, sp² and sp³ 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 - 6 (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 I/T plot to get Arrhenius parameters. 04. Determination of Anharmonicity constant and dissociation energy calculation.

Text books:

Supplementary Reading:

Outcome Mapping:

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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

LO1 To undertake separation and analysis of organic mixtures using two component system.

Course Outcomes (CO):

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

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<th>CO1</th>
<th>Acquire the necessary practical skills to independently analyse organic compounds.</th>
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<td>Gain expertise in the separation of two component mixtures of organic compounds.</td>
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<td>Systematically evaluate organic compounds.</td>
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<tr>
<td>CO4</td>
<td>Apply the knowledge in industries.</td>
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Qualitative Analysis: Analysis of two component mixture. Separation and systematic analysis of the separated two individual components.

Textbooks:


Supplementary reading:


Outcome Mapping:

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| CO4 | 3   | 3   |     |     |     | 3   | 3   | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3    |

*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

| LO1 | 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. |

Course Outcomes (CO):

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

| CO1 | Acquire the necessary practical skills to independently analyze inorganic compounds |
| CO2 | Gain expertise in the systematic analysis of inorganic compounds. |
| CO3 | Apply the knowledge in industries. |

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:


Outcome Mapping:

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*1-Low  2-Medium  3-Strong*
**Learning Objective (LO):**

| LO1 | To learn the new techniques in planning an organic synthesis and to acquire knowledge about polymers and its industrial importance. |

**Course Outcomes (CO):**

At the end of the course, the student 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. |

**Unit – 1: 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 – 2: 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, Trimethyl silyl iodide, dicyclohexylcarbodiimide, OsO₄, DDQ, SeO₂, PCC. Phase Transfer Catalysts - Benzyltriethylammonium halides - Crown ethers.

**Oxidation and reduction:**

- **Oxidation** - Swern and Dess-Martin oxidations, Corey-Kim oxidation, PCC and KMnO₄ oxidations.
- **Reduction** using hydride reagents, LiAlH₄, NaBH₄ and other organoboranes: chemoselectivity, catalytic hydrogenation (homogenous and heterogeneous catalysts).

**Unit – 3: Organic Reactions and Advanced Mechanisms**

**Formation of C-C single bond:** Aldol condensation, Claisen ester reaction, Stobbe condensation, Knoevenagel reaction, Michael addition, Dieckmaan 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.

Unit – 4: 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 organo boranes - application in hydroboration, reduction and allylation reactions, epoxidation catalyst, semicorin catalyst, Jacobson catalyst - Uses of Champhor derived auxiliaries and menthol derived auxiliaries in asymmetric synthesis.

Unit – 5: 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 polythiophenes.

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

Unit – 6 (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.

Text books:

Supplementary reading:


**Outcome Mapping:**

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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

| LO1 | To understand the basic aspects of Green Chemistry and spectroscopy of organic compounds. |

Course Outcomes (CO):

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

| CO1 | Correlate the mass spectra and molecular structure. |
| CO2 | Understand Drug Design and Synthesis. |
| CO3 | Interpret the $^1$H as well as $^{13}$C NMR spectra of organic compounds. |
| CO4 | Learn the principles of multidimensional NMR. |
| CO5 | Analyze the unknown compounds by spectroscopy. |

Unit – 1: Green Chemistry

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

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

Unit – 2: 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) softwares.

Drug Design and Synthesis


Synthesis of Benzodiazepene, Sulfonyl urea and Diclofenac drugs.

Unit – 3: Mass Spectrometry

spectra of hydrocarbons, alcohols, phenols, aldehydes, ketones, carboxylic acids, amines and their derivatives - MALDI-TOF and its applications.

**Unit – 4: 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 – 5: Multidimensional NMR Spectroscopy**

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


**Unit – 6 (Not for Final Examination)**


**Text books:**


**Supplementary Reading:**


**Outcome Mapping:**

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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

LO1 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.

Course Outcomes (CO):

At the end of the course, the student will be 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.

Unit - 1: Spectral and Magnetic Properties of Complexes

Ground state Terms for d^{1}-d^{6} 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}]^{3+}, trans – [Cr(en)_{2} F_{2 }]^{+} [Ni(en)_{3}]^{2+}, [CoF_{6}]^{3+}, [Co(ox)_{3}]^{3+}, [Cu(H_{2}O)_{3}]^{2+}.


Unit – 2: 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 - 3: NQR and Mossbauer Spectroscopies


Unit - 4: 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 – 5: Chromatography and ORD


Unit – 6 (Not for Final Examination)

$^1$H, $^{12}$C, $^{19}$F, $^{17}$O, $^{31}$P and $^{119}$Sn NMR spectra of coordination compounds – IR and Mass spectra of complexes – Hirshfeld surface analysis.

Text books:


Outcome Mapping:

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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

LO1  To learn the theories electrochemistry and to learn the fundamental concepts of molecular, UV and IR spectroscopy.

Course Outcomes (CO):

At the end of the course, the student 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.

Unit – 1: 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 – 2: Electrochemistry- Electrode Reactions, Battery and Fuel Cell


Unit – 3: Electroanalytical Methods


Unit – 4: Molecular Spectroscopy


Comparison of Raman and IR spectra – structural determination from Raman and IR spectroscopy, rule of mutual exclusion

**Unit - 5: UV – Visible and IR -Spectroscopy**


**Unit – 6 (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:**


**Outcome Mapping:**

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*1-Low  2-Medium  3-Strong*
Learning Objective (LO):

**LO1** To develop skills in the determination of a metal ion in presence of another by appropriate techniques.

Course Outcomes (CO):

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

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<td>CO2</td>
<td>Gain expertise in the systematic analysis of inorganic compounds.</td>
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<tr>
<td>CO3</td>
<td>Apply the knowledge in industries.</td>
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Quantitative analysis

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

Text Book:


Outcome Mapping:

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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

LO1: To learn the principles and verification of basic electrochemistry and Kinetics

Course Outcomes (CO):
At the end of the course, the student will be able to

CO1: Understand the necessary practical skills in instrumental analysis.
CO2: Gain expertise in the systematic calculations and graphical representation.
CO3: Apply the knowledge in industries.

I. Potentiometry Experiments
1) Single electrode potentials
2) Solubility of sparingly soluble salt
3) Redox titrations
   a) Ferrous iron (II) vs. dichromate (Fe^{2+} vs. Cr_{2}O_{7}^{2-})
   b) Iodide ion (I^-) vs. KMnO_{4}
   c) Ferrous iron (II) vs. Cerium (IV) ion (Fe^{2+} vs. Ce^{4+})
4) Precipitation titrations
   a) Chloride vs. Silver ion
   b) Iodide vs. Silver ion
   c) Mixture of chloride and iodide ion vs. Silver ion
5) Potentiometric titrations (by quinhydrone electrode)
   a) Strong acid vs. Strong base
   b) Dissociation constant of a weak acid vs. NaOH
   c) 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:

Outcome Mapping:

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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

| LO1 | To understand the basic features of Indian Constitution. |
| LO2 | To grasp about the basic Rights and Duties of Indian Citizens. |
| LO3 | To ponder over the form of Indian Political System. |
| LO4 | To have broad understanding about the pivotal provisions related with liberty, equality and fraternity. |

Course Outcomes (CO):
At the end of the course, the student will be able to

| CO1 | Imbibe with the basic features of Indian Political System. |
| CO2 | Enlighten themselves with the rights and duties of Indian Citizens. |
| CO3 | Understand the significance of rule of law. |
| CO4 | Inculcate with basic liberties. |

Unit I : Constitution of India – Basic Features and Fundamental Principles

Unit II : Fundamental Rights and Duties

Unit III : Legislative and Financial Powers of States
Federal Structure and Distribution of Legislative and Financial powers between the Union and the States-Parliamentary form of Government of India- The Constitution powers and States of the President of India.

Unit IV : Constitutional Amendments in India

Unit V : Fundamental Rights
Recent Amendments in Constitution of India
Faculty member will impart the knowledge on Recent Amendments in Constitution of India to the students and these components will not cover in the examination.

Text Books

Supplementary Readings

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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

LO1 To understand theory of radioactivity and applications of radioisotopes, bioinorganics and materials.

Course Outcomes (CO):

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

CO1 Get a clear understanding about radioactivity and its application for peaceful purposes.
CO2 Get familiar with chemical reactions in physiological systems.
CO3 Understand lanthanides and actinides.
CO4 Appreciate bioinorganic chemistry.
CO5 Learn preparative techniques in inorganic chemistry.

Unit - 1: 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 - 2: 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 - 3: Bioinorganic Chemistry-I


Unit - 4: Bioinorganic Chemistry-II


**Unit - 5: Preparative techniques of inorganic materials**


**Unit – 6 (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:**


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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

LO1 To learn about the synthesis and characterization techniques of nanomaterials and to learn the principle of various adsorption isotherms.

Course Outcomes (CO):

At the end of the course, the student 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.

Unit - 1: 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.


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

Unit - 2: Characterization of Nanomaterials


Unit – 3: 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 - 4: 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, thermofoming, 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 – 5: Surface Chemistry**


**Unit – 6 (Not For Final Examination)**


**Text Books:**


**Supplementary Reading:**


**Outcome Mapping:**

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*1-Low   2-Medium  3-Strong*
Learning Objective (LO):

LO1 To understand the basic aspects of quantitative experiments in Organic Chemistry and to estimate the organic compounds.

Course Outcomes (CO):

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

| CO1 | Critically examine quantitative analysis of organic compounds. |
| CO2 | Understand the quantitative methods. |
| CO3 | Perform the estimation of phenol. |
| CO4 | Analyze glucose and ketones. |
| CO5 | Apply the knowledge in industries. |

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

Text Books:


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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

| LO1 | To know the colorimetric estimation of metal ions and to understand the complexometric titrations. |

Course Outcomes (CO):

At the end of the course, the student 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 sample. |

Colorimetric analysis:

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

Complexometric Titrations:

a) Standardization of EDTA.
b) Determination of Mg$^{2+}$, Zn$^{2+}$, Ni$^{2+}$ and Ca$^{2+}$

Water analysis:

a) Estimation of total alkalinity of water sample
b) Estimation of dissolved oxygen in waste water
c) Estimation of chloride content in water sample
d) Estimation of hardness in water sample by EDTA method
e) Chemical oxygen demand (COD)

Preparation of the followings:

1) Tris(thiourea)copper(I) chloride
2) Potassium trioxalatoferrate
3) Tetraamminecopper(II) sulphate
4) Microcosmic salt
5) Chrome alum
6) Trans-Diaquadoxalatochromate(III)
**Text Books:**

**Outcome Mapping:**

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*1-Low  2-Medium  3-Strong*
Learning Objective (LO):

| LO1 | To learn the principles and verification of Kinetics, Electrochemistry and Phase diagrams. |

Course Outcomes (CO):
At the end of the course, the student will be able to

| 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. |

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)

pH Metry:
4. Dissociation constant of monobasic acid
5. Dissociation constant of dibasic acid
6. Dissociation constant of tribasic acid

Chemical Kinetics:
7. Study the influence of Cu²⁺ and Fe²⁺ on the reaction between persulfate and iodide ions
8. Determination of energy of activation (Eₘ) for an acid catalyzed hydrolysis of an ester.

Adsorption:
9. Study of adsorption of acetic acid/oxalic acid on charcoal

Phase Rule:
10. Two component system-simple Eutectic
11. Three component system.

Text Books:

Outcome Mapping:

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*1-Low  *2-Medium  *3-Strong
Learning Objective (LO):

**LO1** To learn the basics of research work by carrying out selective academic and applied projects.

Course Outcomes (CO):

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

**CO1** Acquire the practical knowledge of understanding research problems.
**CO2** Gain knowledge about basic principles of various components of research.
**CO3** Apply the principles of chemistry in various fields.

Project Work: Selective academic and applied projects.

1. The students will be allotted under the guidance of On-Campus Teachers as PROJECT GUIDES by the Head of the Department.
2. The Project Students have to discuss with the respective project guide about their area of interest for selection of the Project Topic and submit the written PROJECT TOPICS to the Head of the Department which is certified by the research guide.
3. The students have to prepare the Project Report/Dissertation (not less than 50 pages) and Submission of the same at least one month before the last working day of the IV Semester through their Research Guide.

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*1-Low  *2-Medium  *3-Strong
DEPARTMENTAL ELECTIVE COURSES

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<th>Semester II</th>
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**Learning Objective (LO):**

| LO1         | To learn the advanced materials, basics of important instruments and study the aspects of pollution |

**Course Outcomes (CO):**

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

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<th>CO1</th>
<th>Demonstrate knowledge of materials and chemical and biochemical principles of fundamental environmental processes in air, water, and soil.</th>
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<td>Develop an understanding of chemicals and their effects on the environment.</td>
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<td>Develop an understanding of some basic principles of chemistry and apply these principles to current environmental issues.</td>
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<td>CO4</td>
<td>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.</td>
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**Unit - 1: Chemistry of Selective Materials**


**Unit - 2: 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 - 3: 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 metal as pollutants – thermal pollution – chemical pollution.
Unit – 4: Soil and radioactive pollutions


Unit - 5: Environmental Toxicology

Chemical solution to environmental problems, biodegradability, principles of decomposition, better industrial processes. Bhopal gas tragedy, Chernobyl, 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., radionuclide analysis, disposal of wastes and their management.

Current Streams of Thought: The Faculty will impart the current developments in the subject during the semester to the students and this component will not be a part of Examinations.

Text Books:


Outcome Mapping:

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*1-Low  *2-Medium  *3-Strong
DEPARTMENTAL ELECTIVE COURSES

Semester II 19CHEE207: Applied Chemistry

Learning Objective (LO):

LO1 To learn the basics of applied chemistry

Course Outcomes (CO):

At the end of the course, the student 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. |

Unit - 1: High Polymers


Unit - 2: Analysis of Water Pollution


Unit - 3: Applied Photochemistry

Photographic sensitizers — cyanins — pinacyanine, Kryptocyanine — ultraviolet screening agents — Uvinol, Tinuvin — Fluorescent whitening agent — Blankophor— β calcofluor — SD color photography. Additive and subtractive processes. Chemistry of color
Developers Flash photolysis. Chemistry of vision – organic transistors - Introduction examples, organic light emitting diodes – Applications

**Unit - 4: 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 - 5: Organic Nanomaterials**

Fullerenes – synthesis and purification – magnetic and optical properties. Carbon nanotubes – synthesis purification and functionalization.


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**Current Streams of Thought:** The Faculty will impart the current developments in the subject during the semester to the students and this component will not be a part of Examinations.

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**Text Books:**

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*1-Low  *2-Medium  *3-Strong
DEPARTMENTAL ELECTIVE COURSES

Semester III

19CHEE307: Scientific Research Methodology

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Learning Objective (LO):

LO1 To introduce the purpose and importance of research for future development.

Course Outcomes (CO):

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

CO1 Understand the basics of research.
CO2 Appreciate the tools of research.
CO3 Get exposure to research problems.

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, end notes, referencing styles, bibliography-journal abbreviations (CASSI), abbreviations used in scientific writing.

UNIT - 5: Computer Searches of Literature


**Current Streams of Thought:** The Faculty will impart the current developments in the subject during the semester to the students and this component will not be a part of Examinations.

**Text books:**
5. Kanare,H.M.,(1985) *Writing the Laboratory Notebook*; American Chemical Society: Washington, DC.

**Outcome Mapping:**

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*1-Low  *2-Medium  *3-Strong
DEPARTMENTAL ELECTIVE COURSES

Semester III

19CHEE308: Organic Chemical Technology

Learning Objective (LO):

LO1 To understand the elements of chemical engineering in organic synthesis and to know the unit processes in organic chemical technology.

Course Outcomes (CO):

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

CO1 Understand the basics of chemical technology.
CO2 Appreciate principle of chemical engineering.
CO3 Get idea about applications of chemistry in industries.

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 vapoour 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.

**Current Streams of Thought:** The Faculty will impart the current developments in the subject during the semester to the students and this component will not be a part of Examinations.

**Text books:**


**Supplementary reading:**

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

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*1-Low  *2-Medium  *3-Strong