# AVS

# COLLEGE OF ARTS & SCIENCE

# (AUTONOMOUS)

**Attur Main Road, Ramalingapuram, Salem - 106.**

**(Recognized under section 2(f) & 12(B) of UGC Act 1956 and**

**Accredited by NAAC with 'A' Grade)**

**(Co - Educational Institution | Affiliated to Periyar University, Salem**

**ISO 9001 : 2015 Certified Institution)**

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**Syllabus for**

## M.Sc. CHEMISTRY

**CHOICE BASED CREDIT SYSTEM –**

**LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK**

**(CBCS – LOCF)**

**(Applicable to the Candidates admitted from 2023-24 onwards)**

# VISION

- To attain excellence in the field of education by creating competent scholars with a touch of human values.

# MISSION

- To accomplish eminence in the academic domain.
- To provide updated infrastructure.
- To educate value based education.
- To impart skills through efficient training programs.
- To cultivate culture and tradition with discipline and determination.

## REGULATIONS

**1. Eligibility for Admission:**

A candidate who has passed the B.Sc., Degree Examination with Chemistry as the main subject of an end semester examination of universities accepted by the Syndicate as equivalent there to is eligible for admission to the Programme.

**2. Duration:**

The course of study shall be on Semester System. The two year post graduate programme in M.Sc., Chemistry consists of four semesters under Choice Based Credit System (CBCS).

**3. Eligibility for award of degree:**

The degree of Master in Science will be awarded to any student who has completed the appropriate programme of study and passed examinations as a student at the College in accordance with such other Regulations for Students of the College as may be applicable.

**4. Course of Study:**

The course of study for the M.Sc., degree in the Chemistry shall comprise of the following subjects according to the syllabus and books prescribed from time to time. The Syllabus for various subjects shall be demarcated into five units in each subject.

**(i) Core Courses (Illustrative)**

1. Organic Reaction mechanism I & II
2. Structure and bonding in Inorganic compounds
3. Organic Chemistry Practical
4. Physical Chemistry-I &II
5. Inorganic Chemistry Practical
6. Organic synthesis and Photochemistry
7. Coordination Chemistry-I &II
8. Physical Chemistry Practical
9. Analytical Instrumentation technique practical
10. Industry Module Core-I

**(ii) Elective Courses (ED within the Department Experts) (Illustrative)**

1. Nanomaterials and Nanotechnology.
2. Electrochemistry.
3. Medicinal Chemistry.
4. Biomolecules and Heterocyclic compounds.
5. Bioinorganic Chemistry.
6. Analytical Instrumentation technique Practical.

**(iii) Elective Courses (ED from other Department Experts)**

**5. Scheme of Examination:**

There shall be four examinations - two in the first year and two in the second year. Candidates at failing in any subject / subjects will be permitted to appear for such failed subject / subjects Subsequent examinations.

The syllabus has been divided into four semesters. Examinations (theory and practical) for I and III semesters will be held in November / December and Examinations (theory and practical) for II and IV semesters will be held in April / May.

**6. Passing Rules:**

Theory Course: For theory courses there shall be three tests conducted by the faculty concerned and the average of the best two can be taken as the Continuous Internal Assessment (CIA) for a maximum of 25 marks.

**i) Theory**

A candidate who secures not less than 50% in the end semester (external) examination and 50% marks in the continuous internal assessment put together in any course shall be declared to have passed the examination in the subject (theory or practical).

**ii) Practical**

For practical, the minimum for a pass includes the record notebook marks also. There is no passing minimum for the record note book. However, submission of a record note book is a must.

| **Programme Outcomes (POs)**<br>On successful completion of the **M.Sc. Chemistry** | |
|---|---|
| **PO1** | Apply the knowledge of chemical science to find solutions to various academic and research problems. |
| **PO2** | Identify a research problem, review research literature, and design innovative solutions for scientific problems. |
| **PO3** | Recognize and practice the required skill- sets to enhance them for future employability. |
| **PO4** | Adopt appropriate modern techniques, resources, and tools to execute the experiments and analyze and interpret the data. |
| **PO5** | Implement contextual knowledge and ethical principles to assess various societal issues related to common scientific and industrial practices. |
| **PO6** | Assess the impact of scientific approaches in environment with special emphasis on the need for sustainable development. |
| **PO7** | Function as an individual or as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO8** | Communicate effectively, write reports and design documentation, make effective presentations, and give and receive clear instructions. |
| **PO9** | Utilize knowledge and understanding of the chemical principles to manage projects of various magnitudes in multidisciplinary environments. |
| **PO10** | Identify the important aspects of Chemistry and other allied subjects for independent and life-long learning in the broader context of scientific and technological development. |

| **Program Specific Outcomes (PSOs)**<br>After the successful completion of **M.Sc. Chemistry** programme the students are expected to | |
|---|---|
| **PSO1** | To help students acquire advanced theoretical and practical knowledge in various fields of Chemical Sciences and allied subjects. |
| **PSO2** | To provide support to the students to become ethically and psychologically strong, socially conscious, expert professionals with independent thinking ability, leadership quality and excellent communication skills. |
| **PSO3** | To train the students to adapt in to competitive work culture and flourish in industrial or academic environments. |

| | |
|---|---|
| **PSO4** | To address issues of environment, health and development from a chemical perspective. |
| **PSO5** | To function effectively as a member/leader in diverse teams/groups. |

| **Programme Educational Objectives (PEOs)** | |
|---|---|
| The **M.Sc. Chemistry** programme describes accomplishments that graduates are expected to attain within five to seven years after graduation. | |
| **PEO1** | To mold a generation of youth this can apply the subject knowledge in their life and careers. |
| **PEO2** | To inculcate scientific attitude enriched with a multidisciplinary perspective in the students. |
| **PEO3** | To update the students with the needs of the industry and society. |
| **PEO4** | To develop a generation this feels responsible towards the society and the nation. |
| **PEO5** | To provide academically feasible and sustainable solutions for real-life problems. |

## CREDIT DISTRIBUTION FOR 2 YEARS M.Sc. CHEMISTRY PROGRAMME

| Part | Course Type | Credits per Course | No. of Papers | Total Credits |
|---|---|---|---|---|
| Part I | Core Courses | 5 | 8 | 40 |
| | Core Extra Disciplinary | 2 | 1 | 2 |
| | Core Courses Practical | 4 | 2 | 8 |
| | Core Courses Practical | 5 | 1 | 5 |
| | Elective Courses | 3 | 5 | 15 |
| | Elective Courses Practical | 3 | 1 | 3 |
| | Core Project with VIVA-VOCE | 7 | 1 | 7 |
| | | | **Total** | **80** |
| Part II | Skill Enhancement Courses | 2 | 2 | 4 |
| | Professional Competency Skill Enhancement Course | 2 | 1 | 2 |
| | Internship | 2 | 1 | 2 |
| | Human Rights | 1 | 1 | 1 |
| | MOOC/ SWAYAM/ NPTEL Courses | 2 | 1 | 2 |
| | | | **Total** | **11** |
| Part III | Extension Activity (NSS/NCC/Physical Education) | 1 | 1 | 1 |
| | | | **Total Credits** | **92** |

## CONSOLIDATED SEMESTER WISE AND COMPONENT WISE CREDIT DISTRIBUTION FOR 2 YEARS M.Sc. CHEMISTRY PROGRAMME

| Parts | Semester I | Semester II | Semester III | Semester IV | Total Credits |
|---|---|---|---|---|---|
| **Part I** | **20** | **20** | **22** | **20** | **82** |
| **Part II** | **-** | **3** | **2** | **2** | **7** |
| **Part III** | **-** | **-** | **2** | **1** | **3** |
| **Total** | **20** | **23** | **26** | **23** | **92** |

*Part I and II components will be separately taken into account for CGPA calculation and classification for the post graduate programmes and the other components part III have to complete during the duration of the programmes as per the norms, to be eligible for obtaining the PG degree.

## METHOD OF EVALUATION

| Evaluation | Components | | Marks |
|---|---|---|---|
| Internal Evaluation | Continuous Internal Assessment Test | 15 | 25 Marks |
| | Assignments | 3 | |
| | Class Participation | 2 | |
| | Distribution of marks for Attendance (in percentage)<br>96 – 100: 5 Marks<br>91 – 95: 4 Marks<br>86 – 90: 3 Marks<br>81 – 85: 2 Marks | 5 | |
| External Evaluation | End Semester Examination | | 75 Marks |
| **Total** | | | **100 Marks** |

**Note:** PG Programmes- A candidate must score minimum 13 marks in Internal and 38 marks in External Evaluation.

## CONTINUOUS INTERNAL ASSESSMENT

Categorizing Outcome Assessment Levels Using Bloom's Taxonomy

| level | Cognitive Domain | Description |
|---|---|---|
| K1 | Remember | It is the ability to remember the previously learned concepts or ideas. |
| K2 | Understand | The learner explains concepts or ideas. |
| K3 | Apply | The learner uses existing knowledge in new contexts. |
| K4 | Analyze | The learner is expected to draw relations among ideas and to compare and contrast. |
| K5 | Evaluate | The learner makes judgments based on sound analysis. |
| K6 | Create | The learner creates something unique or original. |

## Question Paper Blue Print for Continuous Internal Assessment – I & II

| Duration: 2 Hours | | | | | | | Maximum: 50 marks |
|---|---|---|---|---|---|---|---|
| Section | K level | | | | | | Marks |
| | K1 | K2 | K3 | K4 | K5 | K6 | |
| A (no choice) | 10 | | | | | | 10 X 1 =10 |
| B (no choice) | | 1 | 1 | | | | 2 X 5 =10 |
| C (either or choice) | | | | 3 | | | 3 x 10 = 30 |
| Total | | | | | | | 50 marks |

*Note: K4 and K5 levels will be assessed in the Model Examination whereas K5 and K6 Levels will be assessed in the End Semester Examinations.*

## Question Paper Blue Print for Continuous Internal Assessment - I

Time: 2 Hours Total Marks: 50 Marks Minimum Pass: 20 Marks

| Unit | Section - A | Section - B | Section - C |
|---|---|---|---|
| I | Q.N. 1, 2, 3, 4, 5 | Q.N. 11 | Q.N. 13 A, 13 B |
| I or II | - | - | Q.N. 14 A, 14 B |
| II | Q.N. 6, 7, 8, 9, 10 | Q.N. 12 | Q.N. 15 A, 15 B |

**SECTION – A (10 X 1 = 10 Marks)**

ANSWER ALL THE QUESTIONS

**SECTION – B (2 X 5 = 10 Marks)**

ANSWER ALL THE QUESTIONS

**SECTION – C (3 X 10 = 30 Marks)**

ANSWER ALL THE QUESTIONS (Either or Choice)

## Question Paper Blue Print for Continuous Internal Assessment - II

Time: 2 Hours Total Marks: 50 Marks Minimum Pass: 20 Marks

| Unit | Section - A | Section - B | Section - C |
|---|---|---|---|
| III | Q.N. 1, 2, 3, 4, 5 | Q.N. 11 | Q.N. 13 A, 13 B |
| III or IV | - | - | Q.N. 14 A, 14 B |
| IV | Q.N. 6, 7, 8, 9, 10 | Q.N. 12 | Q.N. 15 A, 15 B |

**SECTION – A (10 X 1 = 10 Marks)**

ANSWER ALL THE QUESTIONS

**SECTION – B (2 X 5 = 10 Marks)**

ANSWER ALL THE QUESTIONS

**SECTION – C (3 X 10 = 30 Marks)**

ANSWER ALL THE QUESTIONS (Either or Choice)

## Question Paper Blue Print for Model Examination & End Semester Examination

| Duration: 3 Hours | | | | | | | | Maximum: 75 marks |
|---|---|---|---|---|---|---|---|---|
| Section | | K level | | | | | | Marks |
| | | K1 | K2 | K3 | K4 | K5 | K6 | |
| A (no choice, three questions from each unit) | | 15 | | | | | | 15 X 1 =15 |
| B (choice, one question from each unit) | | | 1 | 1 | | | | 2 X 5 =10 |
| C (either or choice & two questions from each unit) | *Courses with K4 as the highest cognitive level* | | | | 4 | 1 | | 5 x 10 = 50 |
| | *Course with K5 as the highest cognitive level wherein three K4 questions and two K5 questions are compulsory.* | | | | 3 | 2 | | |
| | *Course with K6 as the highest cognitive level wherein two questions each on K4, K5 and one question on K6 are compulsory.* | | | | 2 | 2 | 1 | |
| Total | | | | | | | | 75 marks |

## Question Paper Blue Print for Model Examination & End Semester Examination

Time: 2 Hours  Total Marks: 75 Marks  Minimum Pass: 30 Marks

| Unit | Section - A | Section - B | Section - C |
|---|---|---|---|
| I | Q.N. 1, 2, 3 | Q.N. 16 | Q.N. 21 A, 21 B |
| II | Q.N. 4, 5, 6 | Q.N. 17 | Q.N. 22 A, 22 B |
| III | Q.N. 7, 8, 9 | Q.N. 18 | Q.N. 23 A, 23 B |
| IV | Q.N. 10, 11, 12 | Q.N. 19 | Q.N. 24 A, 24 B |
| V | Q.N. 13, 14, 15 | Q.N. 20 | Q.N. 25 A, 25 B |

**SECTION – A (15 X 1 = 15 Marks)**

ANSWER ALL THE QUESTIONS

**SECTION – B (2 X 5 = 10 Marks)**

ANSWER ANY TWO QUESTIONS

**SECTION – C (5 X 10 = 50 Marks)**

ANSWER ALL THE QUESTIONS (Either or Choice)

## Question Paper Blue Print for Model Practical Examination & End Semester Examination (Practical)

Time: 3 Hours  Total Marks: 60 Marks  Minimum Pass: 24 Marks

| Practical Marks | Maximum Mark | Minimum Mark |
|---|---|---|
| Internal | 40 | 16 |
| External | 60 | 24 |
| Total | 100 | 40 |

## Evaluation for End Semester Examinations (Practical)

| | |
|---|---|
| Record | 10 marks |
| Formula with expansion | 05 marks |
| Observation with data | 20 marks |
| Viva-voce | 05 marks |
| Calculation | 15 marks |
| Result with units | 05 marks |
| **TOTAL** | **60 MARKS** |

*Submission of record with due certification is a must for external practical examinations.

**A student should complete all requires experiments to get 10 marks for the record.

# Scheme of Examination for M.Sc. Chemistry

## First Year – Semester - I

| Part | Course Code | Course Title | Ins. Hrs. | Credit | CIA | ESE | Total |
|---|---|---|---|---|---|---|---|
| I | 23PCHCC01 | Core Course - I Organic Reaction Mechanism - I | 5 | 5 | 25 | 75 | 100 |
| | 23PCHCC02 | Core Course - II Structure and Bonding in Inorganic Compounds | 5 | 5 | 25 | 75 | 100 |
| | 23PCHCCP01 | Core Course - I Organic Chemistry Practical | 5 | 4 | 40 | 60 | 100 |
| | 23PCHEC01 | Elective - I Nanomaterials and Nanotechnology | 5 | 3 | 25 | 75 | 100 |
| | 23PCHEC02 | Elective - II Electrochemistry | 5 | 3 | 25 | 75 | 100 |
| **Total** | | | **25** | **20** | **140** | **360** | **500** |

## First Year – Semester - II

| Part | Course Code | Course Title | Ins. Hrs. | Credit | CIA | ESE | Total |
|---|---|---|---|---|---|---|---|
| I | 23PCHCC03 | Core Course - III Organic reaction mechanism - II | 5 | 5 | 25 | 75 | 100 |
| I | 23PCHCC04 | Core Course - IV Physical Chemistry - I | 5 | 5 | 25 | 75 | 100 |
| I | 23PCHCCP02 | Core Course - II Inorganic Chemistry Practical | 5 | 4 | 40 | 60 | 100 |
| I | 23PCHEC03 | Elective - III Medicinal Chemistry | 3 | 3 | 25 | 75 | 100 |
| I | 23PCHEC04 | Elective - IV Bio Inorganic Chemistry | 3 | 3 | 25 | 75 | 100 |
| II | 23PCHSEC01 | Skill Enhancement Course - I Industrial Chemistry | 3 | 2 | 25 | 75 | 100 |
| II | 23PSOCCC01 | Fundamentals of Human Rights | 1 | 1 | 25 | 75 | 100 |
| **Total** | | | **25** | **23** | **190** | **510** | **700** |

## Second Year – Semester - III

| Part | Course Code | Course Title | Ins. Hrs. | Credit | CIA | ESE | Total |
|---|---|---|---|---|---|---|---|
| I | 23PCHCC05 | Core Course - V Organic synthesis and Photochemistry | 5 | 5 | 25 | 75 | 100 |
| I | 23PCHCC06 | Core Course - VI Coordination Chemistry - I | 5 | 5 | 25 | 75 | 100 |
| I | 23PCHCCP03 | Core Course - III Physical Chemistry Practical | 5 | 5 | 40 | 60 | 100 |
| I | 23PCHEC05 | Elective - V Biomolecules and Hetero Cyclic Compounds | 4 | 3 | 25 | 75 | 100 |
| I | 23PBTNME2 | Non Major Elective Course - Tissue Engineering | 3 | 2 | 25 | 75 | 100 |
| II | 23PCHI01 | Internship | - | 2 | 25 | 75 | 100 |
| II | 23PCHSEC02 | Skill Enhancement Course - II Preparation of Consumer Products | 3 | 2 | 25 | 75 | 100 |
| III | | MOOC/ SWAYAM/ NPTEL Courses | - | 2 | - | - | 100 |
| **Total** | | | **25** | **26** | **190** | **510** | **800** |

## Second Year – Semester - IV

| Part | Course Code | Course Title | Ins. Hrs. | Credit | CIA | ESE | Total |
|---|---|---|---|---|---|---|---|
| I | 23PCHCC07 | Core Course - VII Coordination Chemistry - II | 5 | 5 | 25 | 75 | 100 |
| I | 23PCHCC08 | Core Course - VIII Physical Chemistry - II | 5 | 5 | 25 | 75 | 100 |
| I | 23PCHPV01 | Core Course Project with viva voce | 5 | 7 | 25 | 75 | 100 |
| I | 23PCHECP01 | Elective Practical - I Analytical Instrumentation technique Practical | 5 | 3 | 40 | 60 | 100 |
| II | 23PCHPCSE01 | Professional Competency Skill Enhancement Course Training for Competitive Examinations Chemistry for Advanced Research Studies | 5 | 2 | 25 | 75 | 100 |
| III | | Extension Activity | - | 1 | 25 | 75 | 100 |
| **Total** | | | **25** | **23** | **165** | **435** | **600** |

****Ins. Hrs.** – Instructional Hours**, CIA**- Continuous Internal Assessment**, ESE**- End Semester Examination

| Semester: I | Course Code: 23PCHCC01 | Hours/Week: 5 | Credit: 5 |
|---|---|---|---|

## COURSE TITLE: CORE COURSE - I ORGANIC REACTION MECHANISM - I

**Course Overview:**

1. This course appreciates the differences involved in the various types of organic reaction mechanisms.
2. These courses generally provide the mechanism of various organic reactions.
3. In this course covers the techniques in the determination of reaction mechanisms.
4. This course provides design feasible synthetic routes for the preparation of organic compounds.

**Learning Objectives:**

1. To understand the feasibility and the mechanism of various organic reactions.
2. To comprehend the techniques in the determination of reaction mechanisms.
3. To understand the concept of stereochemistry involved in organic compounds.
4. To correlate and appreciate the differences involved in the various types of organic reaction mechanisms.
5. To design feasible synthetic routes for the preparation of organic compounds.

| Unit - I | Methods of Determination of Reaction Mechanism | 10 Hours |
|---|---|---|

Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and **kinetic requirements of reactions:** Hammond postulate. Methods of determining, **mechanism:** non-kinetic methods - product analysis, determination of intermediates - isolation, detection, and trapping. Cross-over experiments, isotopic labeling, isotope effects and stereo Chemical evidences. Kinetic methods - relation of rate and mechanism. Effect of structure on **Reactivity:** Hammett and Taft equations. Linear free energy relationship, partial rate factor, Substituent and reaction.

| Unit - II | Aromaticity, Aromatic and Aliphatic Electrophilic Substitution | 10 Hours |
|---|---|---|

Aromaticity in benzenoid, non - benzenoid, heterocyclic compounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di-and poly substituted phenol, Nitrobenzene and halo benzene. Reactions involving nitrogen electrophiles: nitration, nitration and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: Chlorination and bromination; Carbon electrophiles: Friedel - Crafts alkylation Acylation and arylation reactions. Aliphatic electrophilic Substitution Mechanisms: SE2 and SEi, SE1-Mechanism and evidences.

| Unit - III | Aromatic and Aliphatic Nucleophile Substitution | 10 Hours |
|---|---|---|

Aromatic nucleophile substitution: Mechanisms - SNAr, SN1 and Benzene mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attacking nucleophile. Reactions: Oxygen and Sulphur - nucleophiles, Bucherer and Rosemont reactions, von Richter, Somme let - Hauser and Smiles rearrangements. SN1, ion pair, SN2 mechanisms and evidences. Aliphatic nucleophile substitutions at an allelic carbon, aliphatic trigonal carbon and vinyl carbon. SN1, SN2, SNi, and SE1mechanism and evidences, Swain - Scott, Grunwald - Winstein Relationship - Ambient nucleophiles.

| Unit - IV | Stereochemistry - I | 09 Hours |
|---|---|---|

Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. Optical purity, prochirality, enantiotropy and diastereotopic atoms, groups, faces, Axial and planar chirality, chirality due to helical shape, methods of determining, The configuration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation.D, L system, Cram's and Prelog's rules: R, S - notations, Cahn – Ingold - Prelog rules, absolute and relative configurations. Configurations of alleges, spiranes, biphenyls, - cycloalkanes. Topicity and prostereo isomerism, chiral shift reagents and chiral solvating reagents. Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, Stereo selective and stereo specific synthesis.

| Unit - V | Stereochemistry - II | 09 Hours |
|---|---|---|

Conformation and reactivity of acyclic systems, intermolecular rearrangements, neighboring group participation, chemical consequence of conformational equilibrium – Curtin - Hammett Principle. Stability of five and six-membered rings: mono-di - and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly Cyclic systems, decaling and Brett's rule. Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, octant rule, configuration and conformation, Cotton Effect, axial, Halo ketone rule and determination of configuration.

**Text Book(s):**

1. J. March and M. Smith, Advanced Organic Chemistry, 5th edition, John-Wiley and Sons.2001.

2. E.S.Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.
3. P.S.Kalsi, Stereochemistry of carbon compounds, 8th edition, New Age International Publishers, 2015.
4. P.Y.Bruice, Organic Chemistry, 7th end, Prentice Hall, 2013.
5. J.Clayden, N.Greeves, S.Warren, Organic Compounds, 2nd edition, Oxford University Press, 2014.

**Reference Books:**

1. F.A. Carey and R.J. Sandburg, Advanced Organic Chemistry Part-A and B, 5thedition, Kluwer Academic / Plenum Publishers, 2007.
2. D.G.Morris, Stereochemistry, RSC Tutorial Chemistry Text1, 2001.
3. N.S.Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987.
4. E.L.Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.
5. I.L.Finar, Organic Chemistry, Vol-1&2,6thedition, Pearson Education Asia, 2004.

**Web Resources:**

1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic
2. https://www.organic-chemistry.org/

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To recall the basic principles of organic chemistry. | K1 |
| CO2 | To understand the formation and detection of reaction intermediates of organic reactions. | K2 |
| CO3 | To predict there action mechanism of organic reactions and stereochemistry of organic compounds. | K3 |
| CO4 | To apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions. | K4 |
| CO5 | To design and synthesize new organic compounds by correlating the stereochemistry of organic compounds. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L - Low**

| Semester: I | Course Code: 23PCHCC02 | Hours/Week: 5 | Credit: 5 |
|---|---|---|---|

## COURSE TITLE: CORE COURSE - II STRUCTURE AND BONDING IN INORGANIC COMPOUNDS

**Course Overview:**

1. This course covers the structural properties of compounds.
2. These courses generally provide the structural aspects of ionic crystals.
3. In this course covers the various diffraction and microscopic techniques.
4. This course provides information about the defects.

**Learning Objectives:**

1. To determine the structural properties of main group compounds and clusters.
2. To gain fundamental knowledge on the structural aspects of ionic crystals.
3. To familiarize various diffraction and microscopic techniques.
4. To study the effect of point defects and line defects in ionic crystals. To evaluate the structural aspects of solids.
5. To determine the structural properties of main group compounds and clusters.

| Unit - I | Structure of main group compounds and clusters | 10 Hours |
|---|---|---|

VB theory – Effect of lone pair and electro negativity of atoms (Bent's rule) on the geometry of the molecules; Structure of silicates - applications of Paulings rule of electro valence isomorphous Replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three - dimensional silicates. Structure of silicones, Structural and bonding features of B-N, S-N and P-N compounds; Polyacids – types, examples and structures; Borane cluster: Structural features of close, nido, arachano and klado; carboranes, hetero and metallo boranes; Wade's rule to predict the Structure of borane cluster; main group clusters – zintlions and mno rule.

| Unit - II | Solid state chemistry – I | 09 Hours |
|---|---|---|

Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravis lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group; Solid state energetics: Lattice energy – Born - Land equation - Kapustin ski equation, Made lung constant.

| Unit - III | Solid state chemistry – II | 10 Hours |
|---|---|---|

Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti - fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels - normal and inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.

| Unit - IV | Techniques in solid state chemistry | 10 Hours |
|---|---|---|

X-ray diffraction technique: Bragg's law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data – ICDD files, Phase purity, Scherer formula, lattice constants calculation; Systematic absence of reflections; Electron diffraction technique – principle, instrumentation and application. Electron microscopy – Difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.

| Unit - V | Band theory and defects in solids | 09 Hours |
|---|---|---|

Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Defect sin crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser and phosphors; Linear defects and its effects due to dislocations.

**Text Book(s):**


1. AR West, Solid state Chemistry and its applications, 2nd Edition (Students Edition), John Wiley & Sons Ltd., 2014.
2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.
3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.
4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders company: Philadelphia, 1977.
5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: New York, 1983.


**Reference Books:**


1. D.E. Douglas, D.H. Mc Daniel and J.J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.
2. RJ D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.

3. CNR Rao and J. Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199
4. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982.
5. D.F. Shriver, P.W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford University Press: London, 2001.

**Web Resources:**

1. https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video galleries /lecture-videos/

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Predict the geometry of main group compounds and clusters. | K1 |
| CO2 | Explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of captions. | K2 |
| CO3 | Understand the various types of ionic crystal systems and analyze their structural features. | K3 |
| CO4 | Explain the crystal growth methods. | K4 |
| CO5 | To understand the principles of diffraction techniques and microscopic techniques. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

| Mapping (COs vs POs) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** |
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L - Low**

| **Semester: I** | **Course Code: 23PCHCCP01** | **Hours/Week: 5** | **Credit: 4** |
|---|---|---|---|

## COURSE TITLE: CORE COURSE - I ORGANIC CHEMISTRY PRACTICAL

**Course Overview:**

1. This course covers analyze technique of separated organic components systematically.
2. These courses generally provide the separation, qualitative analysis and preparation of organic compounds.
3. In this course covers the suitable experimental setup for the organic preparations involving two stages.
4. This course gives the experiment different purification and drying techniques.

**Learning Objectives:**

1. To understand the concept of separation, qualitative analysis and preparation of organic compounds.
2. To develop analytical skill in the handling of chemical reagents for separation of binary and ternary organic mixtures.
3. To analyze the separated organic components systematically and derivative them suitably.
4. To construct suitable experimental setup for the organic preparations involving two stages.
5. To experiment different purification and drying techniques for the compound processing.

| Unit - I | Separation and analysis | 20 Hours |
|---|---|---|

A. Two component mixtures.

B. Three component mixtures.

| Unit - II | Estimations | 20 Hours |
|---|---|---|

a) Estimation of Phenol (bromination).

b) Estimation of Aniline (bromination).

c) Estimation of Ethyl methyl ketone (iodimetry).

d) Estimation of Glucose (redox).

e) Estimation of Ascorbic acid (iodimetry).

f) Estimation of Amino group (acetylation).

| Unit - III | Two Stage Preparations | 20 Hours |
|---|---|---|

a) *P*-Brome acetanilide from aniline.

b) *p*-Nitro aniline from acetanilide.

c) 1,3,5-Tribromo benzene from aniline.

d) Acetyl salicylic acid from methyl salicylate.

**Text Book(s):**

1. B.S. Furniss, A.J. Hanna ford, P.W.G. Smith and A.R. Tatchell, Vogel's Practical Organic Chemistry. 5$^{th}$edn. ELBS, 1989.
2. Raj K. Bansal, Laboratory manual of Organic Chemistry, III End., New Age International (P) Ltd. 1996.
3. N. S. Gnana pragasam and G. Ramamurthy, Organic Chemistry Lab Manual, New Ed., SV Publishers 2006.
4. Chemdraw 8.0 to16.0, PerkinElmer-UserGuideVersion16.0, Cambridge Soft Corporation.

**Reference Books:**

1. B.S. Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell, Vogel's Practical Organic Chemistry. 5$^{th}$edn. ELBS, 1989.
2. N.S. Gnanapragasam and Ramamurthy, Organic Chemistry Lab Manual, New Ed., SV Publishers 2006.

3. P. S. Subramanian, R. Gopalan, K. Rangarajan, Elements of Analytical Chemistry, Sultan Chand & Sons, New Delhi,2003.

**Web Resources:**

1. https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To recall the basic principles of organic separation, qualitative analysis and preparation. | K1 |
| CO2 | To explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method. | K2 |
| CO3 | To determine the characteristics of separation of organic compounds by various chemical reactions. | K3 |
| CO4 | To develop strategies to separate, analyze and prepare organic compounds. | K4 |
| CO5 | To formulate a method of separation, analysis of organic mixtures and design suitable procedure for organic preparations. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L - Low**

| Semester: I | Course Code: 23PCHEC01 | Hours/Week: 5 | Credit: 3 |
|---|---|---|---|

## COURSE TITLE: ELECTIVE - I NANO MATERIALS AND NANOTECHNOLOGY

**Course Overview:**

1. This course covers the various types of Nano materials and their properties.
2. These courses generally provide the concept of nanomaterial and nanotechnologies.
3. In this course correlate the characteristics of various nanomaterial's.
4. This course introduces the synthetic routes for synthetically used new nanomaterial.

**Learning Objectives:**

1. To understand the concept of nanomaterial and nanotechnology.
2. To familiarizing the various types of Nano materials and their properties.
3. To outline the applications of synthetically important nanomaterial.
4. To correlate the characteristics of various nanomaterial synthesized by new technologies.
5. To design synthetic routes for synthetically used new nanomaterial.

| Unit - I | Introduction of nanomaterial and nanotechnologies | 07 Hours |
|---|---|---|

Introduction - role of size, classification - 0D, 1D, 2D, 3D. Synthesis - Bottom – Up, Top – Down, consolidation of Nano powders. Features of nanostructures, Background of nanostructures. Techniques of synthesis of nanomaterial, Tools of the Nano science. Applications of Nanomaterial and technologies.

| Unit - II | Bonding and structure of the nanomaterial | 08 Hours |
|---|---|---|

Predicting the type of bonding in a substance crystal structure. Metallic nanoparticles, surfaces of materials, nanoparticle size and properties. Synthesis - physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvothermal and Hydrothermal – CVD - types, metalloorganic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.

| Unit - III | Mechanical properties of materials | 07 Hours |
|---|---|---|

Theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials Nanoparticles: gold and silver, metal oxides: silica, iron oxide andalumina – synthesis and properties.

| Unit - IV | Electrical properties | 07 Hours |
|---|---|---|

Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic Properties, electronic properties of materials. Classification of magnetic phenomena. Semiconductor materials – classification - Ge, Si, Ga As, SiC, GaN, GaP, CdS, PbS. Identification of materials as p and n – type semiconductor - Hall effect - quantum and anomalous, Hall voltage- Interpretation of charge carrier density. Applications of semiconductors: p-injunctions as Transistors and rectifiers, photovoltaic and photo galvanic cell.

| Unit - V | Nano thin films, Nano composites | 07 Hours |
|---|---|---|

Application of nanoparticles in different fields. Core - shell nanoparticles - Types, synthesis, and properties. Nano composites - metal -, ceramic and polymer - matrix Composites - applications. Characterization – SEM, TEM and AFM - principle, instrumentation and Applications.

**Text Book(s):**

1. S. Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016.
2. Arum gam, Materials Science, Amerada Publications, 2007.
3. Giacavazzo et.al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010.
4. Woolf son, An Introduction to Crystallography, Cambridge University Press, 2012.
5. James F.Shackelford and Madanapalli K.Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.

**Reference Books:**

1. G. Schmidt, Nanoparticles: From theory to applications, Wiley Weinheim 2004.
2. E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830-831, Cambridge University Press.
3. G. Ozin, A. Arsenault, Nano chemistry: A Chemical Approach to Nano materials, Royal Society of Chemistry, Cambridge UK 2005.
4. W. Goddard, “Handbook of Nano science, engineering and technology”, CRC Press, 2007.
5. T. Pradeep, “Nano: The essentials, understanding Nano science and Nanotechnology”, Tata McGraw Hill, 2007.

**Web Resources:**

1. http://xrayweb.chem.ou.edu/notes/symmetry.html.
2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.

| |
|---|
| **Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning. |

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To explain methods of fabricating Nano structures. | K1 |
| CO2 | To relate the unique properties of Nano materials to reduced imensionality of the material. | K2 |
| CO3 | To describe tools for properties of Nano structures. | K3 |
| CO4 | To discuss applications of Nano materials. | K4 |
| CO5 | To understand the health and safety related to nanomaterial. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L - Low**

| Semester: I | Course Code: 23PCHEC02 | Hours/Week: 5 | Credit: 3 |
|---|---|---|---|

## COURSE TITLE: ELECTIVE - II ELECTROCHEMISTRY

**Course Overview:**

1. This course covers the electronics of elementary electrode reactions.
2. These courses generally provide the structure of the electrical double layer of different models.
3. In this course covers electronics of multistep multi electron system.
4. This course introduces the concepts in fuel cells.

**Learning Objectives:**

1. To understand the behavior of electrolytes in terms of conductance, ionic atmosphere, interactions.
2. To familiarize the structure of the electrical double layer of different models.
3. To compare electrodes between current density and over potential. To discuss the mechanism of electrochemical reactions.
4. To highlight the different types of over voltages and its applications in electro analytical techniques.
5. To understand the behavior of electrolytes in terms of conductance, ionic atmosphere, interactions.

| Unit - I | Ionics | 08 Hours |
|---|---|---|

Arrhenius theory - limitations, van's Hoff factor and its relation to colligative properties. Deviation from ideal behavior. Ionic activity, mean ionic activity and mean ionic activity coefficient - concept of ionic strength, Debye Hackle theory of strong electrolytes, activity coefficient of strong electrolytes, Determination of activity coefficient ion solvent and ion - Ion interactions. Born equation. Debye - Hackle Bjerrum model. Derivation of Debye - Hackle Limiting law at appreciable concentration of electrolytes modifications and applications. Electrolytic conduction – Debye - Hackle Onsager treatment of strong electrolyte - qualitative and Quantitative verification and limitations. Evidence for ionic atmosphere. Ion association and Triple ion formations.

| Unit - II | Electrode - electrolyte interface | 07 Hours |
|---|---|---|

Interfacial phenomena - Evidences for electrical double layer, polarizable and non - polarizable Interfaces, Electro capillary phenomena - Lippmann equation electro capillary curves. Electro - kinetic phenomena electro - osmosis, electrophoresis, streaming and sedimentation potential, Colloidal and poly electrolytes. Structure of double layer: Helmholtz - Perrin, Guoy - Chapman And Stern models of electrical double layer. Zeta potential and potential at zero charge. Applications and limitations.

| Unit - III | Electronics of Elementary Electrode Reactions | 07 Hours |
|---|---|---|

Behavior of electrodes: Standard electrodes and electrodes at equilibrium. Anodic and Catholic Currents, condition for the discharge of ions. Nernst equation, polarizable and non - polarizable Electrodes. Model of three electrode system, over potential. Rate of electro chemical reactions: Rates of simple elementary reactions. Butler - Volmer equation - significance of exchange current Density, net current density and symmetry factor. Low and high field approximations. Symmetry Factor and transfer coefficient, Tafel equation and Tafel plots.

| Unit - IV | Electronics of Multistep Multi Electron System | 07 Hours |
|---|---|---|

Rates of multi - step electrode reactions, Butler - Volmer equation for a multi - step reaction. Rate Determining step, electrode polarization and depolarization. Transfer coefficients, its significance And determination, Stoichiometric number. Electro - chemical reaction mechanisms - rate Expressions, order, and surface coverage. Overvoltage - Chemical and electro chemical, Phase, activation and concentration over Potentials. Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan’s diagrams.

| Unit - V | Concentration Polarization, Batteries and Fuel cells | 07 Hours |
|---|---|---|

Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes. Polarography - principle and applications. Principle of square Wave polarography. Cyclic voltammetry - anodic and catholic stripping voltammetry and Differential pulse voltammetry. Sodium and lithium - ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. Capacitors - mechanism of energy storage, Charging at constant current and constant voltage. Energy production systems: Fuel Cells: Classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells.

**Text Book(s):**

1. D.R. Crow, Principles and applications of electrochemistry, 4th edition, Chapman & Hall/CRC, 2014.
2. J. Raja ram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011.
3. S. Glasstone, Electrochemistry, Affiliated East-West Press, Pvt., Ltd., New Delhi, 2008.
4. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan, Electrochemistry - Principles and applications, S. Viswanathan Printers, Chennai, 2007.
5. Joseph Wang, Analytical Electrochemistry, 2nd edition, Wiley, 2004.

**Reference Books:**

1. J.O.M. Bockris and A.K.N. Reddy, Modern Electrochemistry, vol.1 and 2B, Springer, Plenum Press, New York, 2008.
2. J.O.M. Bockris, A.K.N. Reddy and M.G. Aldeco Morden Electro chemistry, vol. 2A, Springer, Plenum Press, New York, 2008.
3. Philip H.Rieger, Electrochemistry, 2nd edition, Springer, New York, 2010.
4. L.I. Antropov, Theoretical electrochemistry, Mir Publishers, 1977.
5. K.L. Kapoor, A Text book of Physical chemistry, volume-3, Macmillan, 2001.

**Web Resources:**

1. https://www.pdfdrive.com/modern-electrochemistry-e34333229.

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To understand the behavior of electrolytes in solution and compare the structures of electrical double layer of different models. | K1 |
| CO2 | To predict the kinetics of electrode reactions applying Butler - Volmer and Tafel equations. | K2 |
| CO3 | To study different the urodynamic mechanism of corrosion. | K3 |
| CO4 | To discuss the theories of electrolytes, electrical double layer, electronics and activity coefficient of electrolytes. | K4 |
| CO5 | To have knowledge on storage devices and electro chemical reaction mechanism. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | M | S |
| **CO2** | M | S | S | S | M | S | S | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S |
| **CO4** | S | S | S | S | S | S | S | M | M |
| **CO5** | S | M | S | S | S | S | S | M | M |

**S - Strong, M – Medium, L - Low**

| Semester: II | Course Code: 23PCHCC03 | Hours/Week: 5 | Credit: 5 |
|---|---|---|---|
| **COURSE TITLE: CORE COURSE - III ORGANIC REACTION MECHANISM - II** | | | |

**Course Overview:**

1. This course covers the mechanism involved in various types of organic reactions with evidences.
2. These courses generally provide the concept of mechanism involved in various types of organic reactions with evidences.
3. In this course correlate the reactivity between aliphatic and aromatic compounds.
4. This course introduces the basic concept of aromaticity in benzenoid, non-benzenoid.

**Learning Objectives:**

1. To understand the concept of aromaticity in benzenoid, non-benzenoid, heterocyclic and annulene compounds.
2. To understand the mechanism involved in various types of organic reactions with evidences.
3. To understand the applications of synthetically important reagents.
4. To correlate the reactivity between aliphatic and aromatic compounds. To design synthetic routes for synthetically used organic reactions.
5. To understand the concept of aromaticity in benzenoid, non-benzenoid, heterocyclic and annulene compounds.

| Unit - I | Elimination and Free Radical Reactions and Mechanisms | 10 Hours |
|---|---|---|

E2, E1, and E1cB mechanisms. Sync - and anti - eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Reactivity: Effect of substrate, attacking bases, leaving group and Medium. Stereochemistry of eliminations in acyclic and cyclic systems, pyro lytic elimination. Long lived and short - lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, Reactions of radicals, polymerization, Addition, halogenations, aromatic substitutions, rearrangements. Reactivity: Reactivity on Aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.

| Unit - II | Oxidation and Reduction Reactions and Mechanisms | 10 Hours |
|---|---|---|

Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition - Elimination, oxidative and reductive coupling reactions. Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxide, ferricyanide, mercuric acetate, lead tetra acetate, permanganate, manganese dioxide, osmium tetroxide, oxidation of saturated Hydrocarbons, alkyl groups, alcohols, halides and amines. Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allelic oxidation, oxidation by chromium trioxide - pyridine, DMSO - Oxalyl chloride (Swern oxidation) and Corey - Kim oxidation, dimethyl sulphoxide - dicyclo hexyl carbo diimide (DMSO - DCCD). Mechanism of reduction reactions: Wolff-Kushner, Clemmenson, Rosemont, reduction with Trialkyl and triphenyltin hydrides, McFadden-Steven's reduction, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault - Blanc reduction.

| Unit - III | Rearrangements | 10 Hours |
|---|---|---|

Rearrangements to electron deficient carbon: Pinacol - pinacolone and semi - pinacolone rearrangements - applications and stereochemistry, Wagner - Meerwein, Demjanov, Die none-Phenol, Baker - Venkataraman, Benzilic acid and Wolff rearrangement. Rearrangements to Electron deficient nitrogen: Hofmann, Curtis, Schmidt, Lessen, Beckmann rearrangements. Rearrangements to electron deficient oxygen: Baeyer - Villigero oxidation and Dakin Rearrangement. Rearrangements to electron rich atom: Favorskii, Quasi - Favorskii, Stevens, [1,2] - Wittig and [2,3] - Wittig rearrangements. Fries and Photo Fries rearrangement. Intermolecular rearrangements – Claisen, abnormal Claisen, Cope, oxy - Cope and Benzidine Rearrangements.

| Unit - IV | Addition to Carbon Multiple Bonds and Mechanisms | 09 Hours |
|---|---|---|

(a) Addition to carbon - carbon multiple bonds - Addition reactions involving electrophiles, nucleophiles, free radicals, carbines and cyclic mechanisms - Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen; (b) Addition to carbon - heteroatom multiple bonds: Mannish reaction, Grignard reagent, Wittig reaction, Prinsreaction. Stereo chemical aspects of addition reactions. Addition to Carbon-Hetero atom. Multiple bonds: Addition of Grignard reagents, Organizing and organ lithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates – Strobe reactions. Hydrolysis of esters And amides, Ammonolysis of esters.

| Unit - V | Reagents and Modern Synthetic Reactions | 09 Hours |
|---|---|---|

Aluminum isopropoxide, Diazomethane, 2,3-Dichloro-5,6-dicyano-1, 4-benzoquinone (DDQ), N,N-Dicyclo hexyl carbo diimide (DCC), Lead Tetra acetate (LTA), Lithium aluminum hydride(LAH), Manganese dioxide, Osmium tetroxide, selenium dioxide, sodium borohydride, Wittig reagents, Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium, Cyanoborohydride, ($NaBH_3CN$), meta-Chloroperbenzoic acid (m-CPBA), Dimethyl aminiopyridine (DMAP), n- $Bu_3SnD$, Triethylamine (TEA), Diazobicyclo[5.4.0]undec-7-ene (DBU), *N*-bromosuccinimide (NBS), Trifluoroaceticacid (TFA), Phenyl tri methyl ammonium tri bromide (PTAB). Diethyl maleate, (DEM), Copper diacetyl acetate (Cu (acac) 2), Suzuki coupling, Heckreaction, reaction.

**Text Book(s):**

1. J. March and M. Smith, Advanced Organic Chemistry, 5thed, John-Wiley and Sons. 2001.
2. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.
3. P. S. Kalsi, Stereochemistry of carbon compounds, 8$^{th}$edn, New Age International Publishers, 2015.
4. P.Y. Bruice, Organic Chemistry, 7$^{th}$edn., Prentice Hall, 2013.
5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee Organic Chemistry, 7$^{th}$edn., Pearson Education, 2010.

**Reference Books:**

1. S.H. Pine, Organic Chemistry, 5$^{th}$edn, McGraw Hill International Edition, 1987.
2. L.F. Fieser and M. Fieser, Organic Chemistry, Asia Publishing House, Bombay, 2000.
3. E.S. Gould, Mechanism and Structure inorganic Chemistry, Holt, Rinehart and Winston Inc., 1959.
4. T.L. Gilchrist, Heterocyclic Chemistry, Longman Press, 1989.
5. J.A. Joule and Kills, Heterocyclic Chemistry, 4thed. John-Wiley, 2010.

**Web Resources:**

1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic
2. https://www.organic-chemistry.org/

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To recall the basic principles of aromaticity of organic and heterocyclic compounds. | K1 |
| CO2 | To undress and the mechanism of various types of organic reactions. | K2 |
| CO3 | To predict the suitable reagents for the conversion of selective organic compounds. | K3 |
| CO4 | To correlate the principles of substitution, elimination, and addition reactions. | K4 |
| CO5 | To design new routes to synthesis organic compounds. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L - Low**

| Semester: II | Course Code: 23PCHCC04 | Hours/Week: 5 | Credit: 5 |
|---|---|---|---|

## COURSE TITLE: CORE COURSE - IV PHYSICAL CHEMISTRY - I

**Course Overview:**

1. This course covers the concept of classical thermodynamics.
2. These courses generally provide the fundamental of quantum mechanics.
3. In this course give the information to the composition of partial molar quantities.
4. This course discusses the kinetics of reactions.

**Learning Objectives:**

1. To recall the fundamentals of the rmodynamics and the composition of partial molar quantities.
2. To understand the classical and statistical approach of the functions.
3. To compare the significance of Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein.
4. To correlate the theories of reaction rates for the evaluation of thermodynamic parameters.
5. To study the mechanism and kinetics of reactions.

| Unit - I | Classical Thermodynamics | 10 Hours |
|---|---|---|

Partial molar properties-Chemical potential, Gibb's - Duhem equation - binary and ternary Systems. Determination of partial molar quantities. Thermodynamics of real gases – Fugacity - determination of fugacity by graphical and equation of state methods - dependence of Temperature, pressure and composition. Thermodynamics of ideal and non - ideal binary Mixtures, Duhem - Margulies equation applications of ideal and non - ideal mixtures. Activity and activity coefficients - standard states – determination - vapor pressure and freezing Point methods.

| Unit - II | Statistical thermodynamics | 10 Hours |
|---|---|---|

Introduction of statistical thermodynamics concepts of thermodynamic and mathematical Probabilities-distribution of distinguishable and non- distinguishable particles. Assemblies, Ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics-Comparison and applications. Partition functions-evaluation of translational, vibrational and Rotational partition functions for monoatomic, diatomic and polyatomic ideal gases. Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy,

Gibb's function, Helmholtz function residual entropy, equilibrium constants and equipartition Principle. Heat capacity of mono and diatomic gases - ortho and Para hydrogen. Heat capacity of Solids - Einstein and Debye models.

| Unit - III | Irreversible Thermodynamics | 10 Hours |
|---|---|---|

Theories of conservation of mass and Energy entropy production in open systems by heat, Matter and current flow, force and flux concepts. Onsager theory - validity and verification - Onsager reciprocal relationships. Electro kinetic and thermo mechanical effects - Application of Irreversible thermodynamics to biological systems.

| Unit - IV | Kinetics of Reactions | 09 Hours |
|---|---|---|

Theories of reactions - effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions - Lindeman and Christiansen hypothesis - molecular beams, collision, Cross sections, effectiveness of collisions, Potential energy surfaces. Transition state theory - evaluation of thermodynamic parameters of activation - applications of ARRT to reactions, Between atoms and molecules, time and true order - kinetic parameter evaluation. Factors determine the reaction rates in solution - primary salt effect and secondary salt effect, Homogeneous catalysis – acid - base catalysis - mechanism of acid base catalyzed reactions - Bronzed catalysis law, enzyme catalysis – Michelins - Mentonequation.

| Unit - V | Kinetics of complex and fast reactions | 09 Hours |
|---|---|---|

Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, Chain reactions. Chain reactions - chain length, kinetics of H2 – Br2 reactions (Thermal And Photochemical reactions) - Rice Herzfeld mechanism. Study of fast reactions - relaxation methods - temperature and pressure jump methods electric and magnetic field jump methods - Stopped flow flash photolysis methods and pulse radiolysis. Kinetics of polymerization - free Radical, cationic, anionic polymerization - Polycondensation.

**Text Book(s):**

1. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd edition, S.L.N. Chand and Co., Jalandhar, 1986.
2. I.M. Klotz and R.M. Rosenberg, Chemical thermodynamics, 6th edition, W.A. Benjamin Publishers, California, 1972.

3. M.C. Gupta, Statistical Thermodynamics, New Age International, Pvt. Ltd., New Delhi, 1995.
4. K.J. Laidler, Chemical Kinetics, 3rdedition, Pearson, Reprint- 2013.
5. J. Rajaram and J.C.K uriokose, Kinetics and Mechanisms of chemical transformation, Macmillan India Ltd, Reprint – 2011.

**Reference Books:**

1. D.A. McCurry and J.D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd. New Delhi, 1999.
2. R. P. Rastogi and R. R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 1990.
3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Publishers, New York, 1974.
4. K.B. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamum Press, 1996.
5. Gurdeep Raj, Phase rule, Goal Publishing House, 2011.

**Web Resources:**

1. https://nptel.ac.in/courses/104/103/104103112/
2. https://bit.ly/3tL3GdN

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To explain the classical and statistical concepts of thermodynamics. | K1 |
| CO2 | To compare and correlate the thermodynamic concepts to study the kinetics of chemical reactions. | K2 |
| CO3 | To discuss the various thermodynamic and kinetic determination. | K3 |
| CO4 | To evaluate the thermodynamic methods for real gases admixtures. | K4 |
| CO5 | To compare the theories of reactions rates and fast reactions. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

| Mapping (COs vs POs) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** |
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L – Low**

| **Semester: II** | **Course Code: 23PCHCCP02** | **Hours/Week: 5** | **Credit: 4** |
|---|---|---|---|
| **COURSE TITLE: CORE COURSE - II INORGANIC CHEMISTRY PRACTICAL** | | | |

**Course Overview:**

1. This course recalls the principle and theory in preparing standard solutions.
2. These courses generally provide the skill in estimating the amount of ion accurately present in the solution.
3. In this course covers to determine the amount of ions, present in a binary mixture accurately.
4. These courses give the gravimetric skill to separate the inorganic compound.

**Learning Objectives:**

1. To understand and enhance the visual observation as an analytical tool for the quantitative estimation of ions.
2. To recall the principle and theory in preparing standard solutions.
3. To train the students for improving their skill in estimating the amount of ion accurately present in the solution.
4. To estimate metal ions, present in the given solution accurately without using instruments.
5. To determine the amount of ions, present in a binary mixture accurately.

| Unit - I | Analysis of mixture of captions | 20 Hours |
|---|---|---|

Analysis of a mixture of four cations containing two common cations and two rare cations. Cations to be tested.

Group-I : W, Tl and Pb.

Group-II : Se,Te, Mo, Cu,Bi and Cd.

Group-III : Tl,Ce,Th,Zr,V,Cr,Fe,Ti and U.

Group-IV : Zn, Ni, Co and Mn.

Group-V : Ca,Ba and Sr.

Group-VI : Li and Mg.

| Unit - II | Preparation of metal complexes | 20 Hours |
|---|---|---|

Preparation of inorganic complexes:

a. Preparation of tristhiourea copper (I) sulphate.

b. Preparation of potassium trioxalatechromate (III).

c. Preparation of tetra mine copper (II) sulphate.

d. Preparation of sodium trioxalato ferrate (III).

e. Preparation of hexathiourea copper (I) chloride dehydrate.

| Unit - III | Complex metric Titration | 20 Hours |
|---|---|---|

1. Estimation of zinc, nickel, magnesium, and calcium.

2. Determination of manganese in the presence of iron.

3. Determination of nickel in the presence of iron.

**Text Book(s):**

1. A .Jeya Rajendran, Micro analytical Techniques in Chemistry: Inorganic Qualitative Analysis, United global publishers, 2021.
2. V.V. Ramanujam, Inorganic Semi micro Qualitative Analysis; 3rd ed., The National Publishing Company, Chennai, 1974.
3. Vogel's Textbook of Inorganic Qualitative Analysis, 4thed. ELBS, London.

**Reference Books:**

1. G. Pass, and H. Sutcliffe, Practical Inorganic Chemistry; Chapman Hall, 1965.
2. W.G. Palmer, Experimental Inorganic Chemistry; Cambridge University Press, 1954.

**Web Resources:**

1. https://www.youtube.com/watch?v=jltLlzZ6FqU
2. https://www.youtube.com/watch?v=F7cSlwKfoHw
3. https://www.youtube.com/watch?v=XHWHSIEc9_s
4. https://www.youtube.com/watch?v=qqAunXcGo8A
5. https://www.youtube.com/watch?v=7i6sGH5Me6g

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To identify the anions and cations present in a mixture of salts. | K1 |
| CO2 | To apply the principles of semi micro qualitative analysis to categorize acid radicals and basic radicals. | K2 |
| CO3 | To acquire the qualitative analytical skills by selecting suitable confirmatory tests and spot tests. | K3 |
| CO4 | To choose the appropriate chemical reagents for the detection of anions and cations. | K4 |
| CO5 | To synthesize coordination compounds in good quality. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L – Low**

| Semester: II | Course Code: 23PCHEC03 | Hours/Week: 3 | Credit: 3 |
|---|---|---|---|

## COURSE TITLE: ELECTIVE - III MEDICINAL CHEMISTRY

**Course Overview:**

1. This course familiarize with the mode of action of diabetic agents and treatment of diabetes.
2. These courses generally provide the knowledge on mechanism and action of drugs.
3. In this course covers the identify and apply the action of various antibiotics.
4. This course introduces the concepts antibiotics and usage of drugs.

**Learning Objectives:**

1. To study the chemistry behind the development of pharmaceutical materials.
2. To gain knowledge on mechanism and action of drugs
3. To familiarize with the mode of action of diabetic agents and treatment of diabetes.
4. To identify and apply the action of various antibiotics.
5. To understand the need of antibiotics and usage of drugs.

| Unit - I | Introduction to receptors | 08 Hours |
|---|---|---|

Introduction, targets, Agonist, antagonist, partial agonist. Receptors, Receptor types, Theories of Drug – receptor interaction, Drug synergism, Drug resistance, Physicochemical factors influencing drug action. Clinical application of penicillin.

| Unit - II | Anticancer agents | 07 Hours |
|---|---|---|

Drug target, proteins receptor. enzymes, nucleic acid, hormones, ion channel, Phases of cell cycle - types of anticancer agents - alkylating agents - cisplatin, carboplatin, chlorambucil – antimetabolites - plant alkaloids - vincristine, vinblastine - topoisomerase, inhibitors - camptothecin, epipodo phyllotoxin - DNA binders - doxorubicin, daunorubicin – hormones – tamoxifen - monoclonal antibodies – bevacizumab - modern drugs - palbociclib, Ribociclib, gleevec. Cephalosporin. Current trends in Antibiotic therapy.

| Unit - III | Antihypertensive agents and diuretics | 07 Hours |
|---|---|---|

Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amyloids.

| Unit - IV | Antibiotics, Antiviral and Antibacterial | 07 Hours |
|---|---|---|

Introduction, Targets of antibiotics action, classification of antibiotics, enzyme - based mechanism Of action, SAR of penicillin's and tetracycline. Classification of antiviral agents, Mechanism of Action - Chloroquine Phosphate, Amodiaquine hydrochloride and Pyrimethamine. Antibacterial: Classification and mechanism of action - Sulphanilamide, Sulphapyridine, Sulphadiazine and Sulphisoxazole.

| Unit - V | Analgesics, Antipyretics and Anti-inflammatory Drugs | 07 Hours |
|---|---|---|

Introduction, Mechanism of inflammation, classification and mechanism of action and Paracetamol, Ibuprofen, Diclofenac, naproxen, indomethacin, phenyl butanone and meperidine. Medicinal Chemistry of ant diabetic agents introduction, types of diabetics, drugs used for the Treatment, chemical classification, Mechanism of action, Treatment of diabetic mellitus. Chemistry of insulin, sulfonic urea.

**Text Book(s):**


1. Wilson and Griswold’s textbook of organic medicinal and pharmaceutical chemistry,
2. Wilson, Charles Owens: Beale, John Marlowe; Block, John, Lippincott William, 12th edition, 2011.
3. Graham. Patrick, an Introduction to Medicinal Chemistry, 5thedition, Oxford University Press, 2013. Jayashree Ghosh, A text book of Pharmaceutical Chemistry, S. Chand and Co. Ltd, 1999, 1999 End.
4. O.Le Roy, Natural and synthetic organic medicinal compounds, Ealemi, 1976.
5. S. Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi, 1993, New end.
6. Jayashree Ghosh, A text book of Medicinal Chemistry, S. Chand & Company Ltd, 1997.


**Reference Books:**


1. Foye’sPrincles of Medicinal Chemistry, Lippincott Williams, Seventh Edition, 2012.
2. Burger's Medicinal Chemistry, Drug Discovery and Development, Donald J. Abraham, David P. Rotella, Alfred Burger, AcademicPress, 2010.
3. Wilson and Griswold’s Textbook of Organic Medicinal and Pharmaceutical Chemistry, John M. BealeJrand John M. Block, Walters Kluwer, 2011, 12$^{th}$edn.
4. P. Parimoo, a Textbook of Medical Chemistry, New Delhi: CBS Publishers. 1995.

5. S. Ramakrishnan, K.G. Prasannan and R. Rajan, Text book of Medical Biochemistry, Hyderabad: Orient Longman. 3rd edition, 2001.

**Web Resources:**

1. https://www.ncbi.nlm.nih.gov/books/NBK482447/
2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html
3. https://www.classcentral.com/course/swayam-medicinal-chemistry-12908

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Predict drugs properties based on its structure. | K1 |
| CO2 | Describe the factors that affect its absorption, distribution, metabolism, and excretion, and hence the considerations to be made in drug design. | K2 |
| CO3 | Explain the relationship between drug's chemical structure and its therapeutic properties. | K3 |
| CO4 | Designed to give the knowledge of different theories of drug actions at molecular level. | K4 |
| CO5 | To identify y different targets for the development of new drugs for the treatment of infectious and GIT. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L - Low**

| Semester: II | Course Code: 23PCHEC04 | Hours/Week: 3 | Credit: 3 |
|---|---|---|---|

## COURSE TITLE: ELECTIVE - IV BIO INORGANIC CHEMISTRY

**Course Overview:**

1. This course provides information about various metallo enzymes properties.
2. These courses give the knowledge on diagnostic agents.
3. In this course covers the toxicity of metals in medicines.
4. This course introduces the biological significance of iron, sulfur.

**Learning Objectives:**

1. To understand the role of trace elements.
2. To understand the biological significance of iron, sulfur.
3. To have knowledge on diagnostic agents.
4. To discussion various metallo enzymes properties.
5. To study the toxicity of metals in medicines.

| Unit - I | Essential trace elements | 08 Hours |
|---|---|---|

Selective transport and storage of metal ions: Ferritin, Transferrin and sidorphores; Sodium and Potassium transport, Calcium signaling proteins. Metalloenzymes, Zinc enzymes – Carboxypeptidase and carbonicanhydrase. Ironenzymes – catalase, peroxidase. Copper enzymes – Superoxide dismutase, Plastocyanin, Ceruloplasmin, Tyrosine. Coenzymes – Vitamin - B12 Coenzymes.

| Unit - II | Transport Proteins | 07 Hours |
|---|---|---|

Oxygen carriers - Hemoglobin and myoglobin - Structure and oxygenation Bohr Effect. Binding Of CO, NO, CN – to Myoglobin and Hemoglobin. Biological redox system: Cytochromes - Classification, cytochrome a, b and c. Cytochrome P-450. Non-hemi oxygen carriers - Hemerythrin and hemocyanin. Iron – sulphurproteins - Rubredoxin and Ferredoxin - Structure and Classification.

| Unit - III | Nitrogen fixation | 07 Hours |
|---|---|---|

Introduction, types of nitrogen fixing microorganisms. Nitrogenize enzyme - Metal clusters in nitrogenase - redox property - Dinitrogen complexes transition metal complexes of dinitrogen - Nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia. Photosynthesis, Photosystem - I and photosystem – II - chlorophylls Structure and function.

| Unit - IV | Metals in medicine | 07 Hours |
|---|---|---|

Metal Toxicity of Hg, Cd, Zn, Pb, As, Sb. Therapeutic Compounds, Vanadium - Based Diabetes Drugs; Platinum - Containing Anticancer Agents, Chelation, therapy, Cancer treatment. Diagnostic Agents, Technetium Imaging Agents; Gadolinium, MRI Imaging, Agents, Temperature and critical magnetic Field.

| Unit - V | Enzymes | 07 Hours |
|---|---|---|

Introduction and properties - nomenclature and classification. Enzyme kinetics, free energy of Activation and the effects of catalysis. Michelins - Menton equation - Effect of pH, temperature on Enzyme reactions. Factors contributing to the efficiency of enzyme.

**Text Book(s):**

1. Williams, D. R – Introduction to Bioinorganic chemistry.
2. F.M. Fibber and D.R. Williams – The Principles of Bioinorganic Chemistry, Royal Society of Chemistry, Monograph for Teachers-31.
3. K.F. Purcell and Kotz. Inorganic chemistry, WB Saunders Co., USA.
4. G.N. Mugherjea and ArabindaDas, Elements of Bioinorganic Chemistry - 1993.
5. R. Gopalan, V. Ramalingam, Concise Coordination Chemistry, S. Chand, 2001.
6. Asim K. Das, Fundamental Concepts of Inorganic Chemistry Vol-6, Kindle Edition, 2017
7. B.R. Puri, L.R. Sharma, K.C. Kalia & Geetanjli Kaushal, Textbook of Inorganic Chemistry IV, Vishal Publishing Co., 2020.

**Reference Books:**

1. M. Satake and Y. Mido, Bioinorganic Chemistry- Discovery Publishing House, New Delhi (1996).
2. M.N. Hughes, 1982, The Inorganic Chemistry of Biological processes, II Edition, Wiley London.
3. R.W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1987.
4. R.M. Roat-Malone, Bio Inorganic Chemistry, John Wiley, 2002.
5. T.M. Loehr, Iron carriers and Iron proteins, VCH, 1989.

**Web Resources:**

1. https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry-the-instant-notes-chemistry-series-d162097454.html
2. https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry-5th-edition-d161563417.html

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| **Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning. |

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | The students will be able to analyses trace elements. | K1 |
| CO2 | Students will be able to explain the biological redox systems. | K2 |
| CO3 | Students will gain skill in analyzing the toxicity in metals. | K3 |
| CO4 | Students will have experience in diagnosis. | K4 |
| CO5 | Learn about the nitrogen fixation and photosynthetic mechanism. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | M | S |
| **CO2** | M | S | S | S | M | S | S | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S |
| **CO4** | S | S | S | S | S | S | S | M | M |
| **CO5** | S | M | S | S | S | S | S | M | M |

**S - Strong, M – Medium, L - Low**

| Semester: II | Course Code: 23PCHSEC01 | Hours/Week: 3 | Credit: 2 |
|---|---|---|---|

## COURSE TITLE: SKILL ENHANCEMENT COURSE - I INDUSTRIAL CHEMISTRY

**Course Overview:**

1. These courses provide principles of chemical technology.
2. These courses generally provide basic principle behind various mixtures used in chemical industries.
3. In this course covers the safety and hazardous criteria related to unit process.
4. This course provides knowledge about fertilizer.

**Learning Objectives:**

1. The knowledge of important chemical and reagents used in chemical industries.
2. To understand the basic principle behind various mixtures used in chemical industries and their selection in respective applications.
3. To understand the safety and hazardous criteria related to unit process.
4. To gain knowledge about fertilizer.
5. To outline safety signs and colors used in industries.

| Unit - I | Principles of Chemical Technology | 08 Hours |
|---|---|---|

Introduction – basic principles of chemical technology – importance of chemical technology – classification of technological process – designing and modeling of chemical plants – unit, Process and unit operations. Basic requirements of industrial reactors – choice and selectivity of reactor – basic principles of homogeneous and Heterogeneous processes and reactors with Examples.

| Unit - II | Raw Materials and Energy for Chemical Industry | 07 Hours |
|---|---|---|

Raw materials – Characteristics of raw materials and their resources – methods of raw material, Concentration – integral utilization of raw materials. Energy for chemical industry – power and fuels – classification of fuels – coal – fuel gases and liquid fuels – petroleum – cracking– Chemical corrosion – types of corrosion and preventive measures.

| Unit - III | Small Scale Chemical Industries | 07 Hours |
|---|---|---|

Electro - thermal and electro - chemical industries: electroplating – surface coating industries – Oils, fats and waxes – soaps and detergents – cosmetics. Match industries and Fire Works: Manufacture of some industrially important chemicals like potassium chlorate, Potassium nitrate, barium nitrate and red phosphorous – metal powders.

| Unit - IV | Large Scale Chemical Industries | 07 Hours |
|---|---|---|

Manufacturing process – raw materials – composition and uses of products in Port land cement – ceramics – plastics, synthetic fibers – synthetic rubber – fertilizers – insecticides and pesticides – photo Film industries – commercial aspects of starting an industry.

| Unit - V | Safety Signs and Colors used in Industries | 07 Hours |
|---|---|---|

Industrial Hazards and Accidents – Classification of Hazards – Physical, chemical Biological, Ergonomic and stress Hazards – Causes, prevention and control – case study on industrial accidents Bhopal gas Tragedy – Heat stress – sources and control – Noise Pollution in industry – sources and control.

**Text Book(s):**

1. Mukhlynov (ed.), Chemical Technology, Vol.1, Mir Publication, Moscow, III edn. 1979.
2. A.K.De, Environmental Chemistry, Wiley Eastern Ltd., II edn. Meerut 1989, Chas, 5 – 7.
3. R.K. Goal, Process know-how and material of construction for Chemical Industries, S.B. Publ., Delhi, 1977.
4. B.N. Chakrabarthy, Industrial Chemistry, Oxford and IBH Publ., Now Delhi, 1984.
5. B. K. Sharma, Industrial Chemistry GOEL Publishing House, 2000.

**Reference Books:**

1. Industrial Safety and Environment–A.K. Gupta–University Science press, New Delhi.
2. R. Norris Shreve and J.A. Brink, Jr. Chemical Process Industries, IV edn. McGraw Hill, Tokyo, 1977.
3. O. P. Vermani and A. K. Narula, Industrial Chemistry, galgotia publication pvt ltd, Delhi, 2008.

**Web Resources:**

1. https://onlinecourses.nptel.ac.in/noc24_cy15/preview
2. https://nptel.ac.in/courses/103/107/103107086/
3. https://nptel.ac.in/courses/105/106/105106178/
4. https://nptel.ac.in/courses/116/104/116104044/

| |
|---|
| **Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning. |

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Understand the important chemical and reagents used in chemical industries. | K1 |
| CO2 | Knowledge about the basic principle behind various mixtures used in chemical industries and their selection in respective applications. | K2 |
| CO3 | Aware about safety and hazardous criteria related to unit process. | K3 |
| CO4 | Increase knowledge to the fertilizer. | K4 |
| CO5 | The knowledge on signs and colors used in industries. | K5 |
| K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create | | |

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L - Low**

| Semester: III | Course Code: 23PCHCC05 | Hours/Week: 5 | Credit: 5 |
|---|---|---|---|

## COURSE TITLE: CORE COURSE - V ORGANIC SYNTHESIS AND PHOTOCHEMISTRY

**Course Overview:**

1. This course covers the knowledge of photochemical organic reactions.
2. These courses generally provide the knowledge on various synthetically important reagents for any successful organic synthesis.
3. In this course covers the complexity of carbon skeletons.
4. This course introduces the concepts of peri cyclic reaction mechanisms.

**Learning Objectives:**

1. To understand the molecular complexity of carbon skeletons and the presence of functional groups and their relative positions.
2. To study various synthetically important reagents for any successful organic synthesis.
3. To apply disconnection approach and identifying suitable synthase to effect successful organic synthesis.
4. To learn the concepts of peri cyclic reaction mechanisms.
5. To gain the knowledge of photochemical organic reactions.

| Unit - I | Planning an Organic Synthesis and Control elements | 10 Hours |
|---|---|---|

Preliminary Planning – know n's and unknowns of the synthetic system studied, analysis of the Complex and interrelated carbon framework into simple rational precursors, alternate synthetic routes, key intermediates that would be formed, available starting materials and Resulting yield of alternative methods. Linear Vs convergent synthesis. Synthesis based on ump lung concepts of See back, Control elements: Region specific control elements and Stereo specific control elements.

| Unit - II | Organic Synthetic Methodology: Retrosynthetic analysis | 09 Hours |
|---|---|---|

Alternate synthetic routes. Synthesis of organic mono and bi functional compounds via Disconnection approach. Protection of hydroxyl, carboxyl, carbonyl, thiol and amino groups. Illustration of protection and deportation in synthesis. Use of protective groups, activating Groups and bridging elements. Functional group alterations and transposition.

| Unit - III | Peri cyclic Reactions | 10 Hours |
|---|---|---|

Woodward Hoffmann Rules, The Mobius and Hackle concept, FMO, PMO method and Correlation diagrams. Cycle addition and retrocyclo addition reactions; [2+2], [2+4], [4+4, Cationic, anionic, and 1, 3 - dipolarcycloadditions. Cheletropic reactions.; Electro cyclization and ring opening reactions of conjugated dines and trienes.S igmatropic rearrangements: (1,3), (1, 5), (3, 3) and (5, 5)-carbon migrations, degenerate rearrangements. Ionic sigma tropic Rearrangements. Group transfer reactions. Regio selectivity, Stereo selectivity and per selectivity In per cyclic reactions.

| Unit - IV | Organic Photochemistry - I | 10 Hours |
|---|---|---|

Photochemical excitation: Experimental techniques; electronic transitions; Jablonskii diagrams; intersystem crossings; energy transfer processes; Stern volmer equation. Reactions of electronically excited ketones; $\pi \rightarrow \pi^*$triplets; Norrish type-I and type-II Cleavage reactions; photo reductions; Paterno - Buchi reactions.

| Unit - V | Organic Photochemistry - II | 09 Hours |
|---|---|---|

Photochemistry of $\alpha$, $\beta$ - unsaturated ketones; cist-trans isomerization. Photon energy transfer reactions, Photocyclo additions, Photochemistry of aromatic compounds; photochemical rearrangements; photo - Stationery state; di-$\pi$-methane rearrangement; Reaction of conjugated cyclohexadienoneto3, 4 - diphenyl phenols; Barton's reactions.

**Text Book(s):**


1. F.A. Carey and Sandburg Advanced Organic Chemistry, 5thed, Tata McGraw-Hill, New York, 2003.
2. J. March and M. Smith, Advanced Organic Chemistry, 5$^{th}$ed., John-Wiley and sons, 2007.
3. R.E. Ireland, Organic synthesis, Prentice Hall India, Goal publishing house, 1990.
4. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016.
5. M. B. Smith, Organic Synthesis 3$^{rd}$edn, McGraw Hill International Edition, 2011.
6. K K Rohotgi, Fundamentals of Photochemistry, New Age Publishers, 2017.

**Reference Books:**


1. Gill and Wills, Pericyclic Reactions, Chapman Hall, London, 1974.
2. J.A. Joule, G.F. Smith, Heterocyclic Chemistry, Garden City Press, Great Britain, 2004.
3. W. Caruthers, Some Modern Methods of Organic Synthesis 4$^{th}$edn, Cambridge University Press, Cambridge, 2007.
4. H.O. House. Modern Synthetic reactions, W.A. BenjaminInc, 1972.
5. Jagdamba Singh and Jaya Singh, Photochemistry and Pericyclic Reactions, New Age International Publishers, New Delhi, 2012.


**Web Resources:**

1. https://rushim.ru/books/praktikum/Monson.pdf

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To recall the basic principles of organic chemistry and to understand the various reactions of organic compounds with reaction mechanisms. | K1 |
| CO2 | To understand the versatility of various special reagents and to correlate their reactivity with various reaction conditions. | K2 |
| CO3 | To implement the synthetic strategies in the preparation of various organic compounds. | K3 |
| CO4 | To predict the suitability of reaction conditions in the preparation of tailor-made organic compounds. | K4 |
| CO5 | To design and synthesize novel organic compounds with the methodologies learnt during the course. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

| Mapping (COs vs POs) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** |
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L – Low**

| **Semester: III** | **Course Code: 23PCHCC06** | **Hours/Week: 5** | **Credit: 5** |
|---|---|---|---|
| **COURSE TITLE: CORE COURSE - VI COORDINATION CHEMISTRY - I** | | | |

**Course Overview:**

1. This course covers the knowledge in modern theories of bonding in coordination compounds.
2. These courses evaluate the reactions of octahedral and square planar complexes.
3. In this course covers the information about construct correlation diagrams and predict the electronic transitions that are taking place in the complexes.
4. This course describes various substitution and electron transfer mechanistic pathways of reactions in complexes.

**Learning Objectives:**

1. To gain insights in to the modern theories of bonding in coordination compounds.
2. Tolerant various methods to determine the stability constants of complexes.
3. To undress and construct correlation diagrams and predicts the electronic transition that is taking place in the complexes.
4. To describe various substitution and electron transfer mechanistic pathways of reactions in complexes.
5. To evaluate the reactions of octahedral and square planar complexes.

| Unit - I | Modern theories of coordination compounds | 10 Hours |
|---|---|---|

Crystal field theory - splitting of d orbitals in octahedral, tetrahedral and square planar symmetries - measurement of 10Dq - factors affecting 10Dq - spectrochemical series – crystal field stabilization energy for high spin and low spin complexes- evidences for crystal field splitting - site selections in spinals and anti spinels - Jahn Teller distortions and its Consequences. Molecular orbital theory and energy level diagrams concept of weak and Strong fields, sigma and pi bonding in octahedral, square planar and tetrahedral complexes.

| Unit - II | Spectral characteristics of complexes | 09 Hours |
|---|---|---|

Term states for d ions - characteristics of d-d transitions - charge transfer spectra - selection rules for electronic spectra – Or gel correlation diagrams – Sugano - Tanabe energy level diagrams - nephelauxetic series - Racha parameter and calculation of inter - electronic repulsion Parameter.

| Unit - III | Stability and magnetic property of the complexes | 10 Hours |
|---|---|---|

Stability of complexes: Factors affecting stability of complexes, Thermodynamic aspects of complex formation, Stepwise and overall formation constants, Stability correlations, statistical factors and chelate effect, Determination of stability constant and composition of the complexes: Formation curves and Bjerrum's half method, Potentiometric method, Spectrophotometric method, Ion exchange method, Polorographic method and Continuous variation method (Job's method) Magnetic property of complexes: Spin - orbit coupling, effect Of spin - orbit coupling on magnetic moments, quenching of orbital magnetic moments.

| Unit - IV | Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes | 10 Hours |
|---|---|---|

Inert and Labile complexes; Associative, Dissociative and SNCB mechanistic pathways for substitution reactions; acid and base hydrolysis of octahedral complexes; Classification of metal ions based on the rate of water replacement reaction and their correlation to Crystal Field Activation Energy; Substitution reactions in square planar complexes: Trans effect, theories of Trans effect and applications of trans effect in synthesis of square planar compounds; Kurnakovtest.

| Unit - V | Electron Transfer reactions in octahedral complexes | 09 Hours |
|---|---|---|

Outer sphere electron transfer reactions and Marcus - Hush theory; inner sphere electron transfer Reactions; nature of the bridging ligand in inner sphere electron transfer reactions. Photo - redox, Photo - substitution and photo - isomerization reactions in complexes and their applications.

**Text Book(s):**


1. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006.
2. GLMeissler and DAT arr, Inorganic Chemistry, 3rdEdition, Pearson Education Inc., 2008
3. D. Bannerjea, Co-ordination Chemistry, TATA McGraw-Hill, 1993.
4. B.N. Figgis, Introduction to Ligand Fields, Wiley EasternLtd, 1976.
5. F. A. Cotton, G. Wilkinson. C. A. Murillo; M. Bachmann, Advanced Inorganic Chemistry, 6thed. Wiley Inter-science: New York, 1988.
6. R. Gopalan, Concise Coordination Chemistry, Vikas Publishing House, 2001.


**Reference Books:**


1. Keith Purcell and John Klotz, Inorganic Chemistry, Saunders Publications, USA, 1977.
2. Peter Atkins and Tina Overton, Shriver and Atkins' Inorganic Chemistry, 5th Edition, Oxford University Press, 2010.
3. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson, P.L. Guas, John Wiley, 2002, 3rd edn.
4. Concepts and Models of Inorganic Chemistry. Douglas. McDaniel, J. Alexander, John Wiley, 1994, 3rd edn.
5. Inorganic Chemistry, D. F. Shriver, P. W. Atkins, W. H. Freeman and Co, London, 2010.


**Web Resources:**

1. https://ocw.mit.edu/courses/5-04-principles-of-inorganic-chemistry-ii-fall-08/pages/syllabus/

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Understand and comprehend various theories of coordination compounds. | K1 |
| CO2 | Understand the spectroscopic and magnetic properties of coordination complexes. | K2 |
| CO3 | Explain the stability of complexes and various experimental methods to determine the stability of complexes. | K3 |
| CO4 | Predict the electronic transitions in a complex based on correlation diagrams and UV-Visible s spectral details. | K4 |
| CO5 | Comprehend the kinetics and mechanism of substitution reactions in octahedral and square planar complexes. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L – L**

| Semester: III | Course Code: 23PCHCCP03 | Hours/Week: 5 | Credit: 5 |
|---|---|---|---|

## COURSE TITLE: CORE COURSE - III PHYSICAL CHEMISTRY PRACTICAL

**Course Overview:**

1. This course covers the knowledge of conductivity experiments through conduct metric titrations.
2. These courses provide the details of kinetics adsorption of oxalic acid on charcoal.
3. In this course covers the potential energy diagram of hydrogen ion and charge density distribution.
4. These courses give the Maxwell's speed distribution by computational calculation.

**Learning Objectives:**

1. To understand the principle of conductivity experiments through conduct ometrictitrations.
2. To evaluate the order of the reaction, temperature coefficient, and activation energy of the reaction by following pseudo first order kinetics.
3. To construct the phase diagram of two component system forming congruent melting solid and find its eutectic temperatures and compositions.
4. To determine the kinetics of adsorption of oxalic acid on charcoal.
5. To develop the potential energy diagram of hydrogen ion, charge density distribution and Maxwell's speed distribution by computational calculation.

| Unit - I | Conductivity Experiments | 20 Hours |
|---|---|---|

1. Determination of equivalent conductance of astrongel ectrolyte & the verification of DHO equation.
2. Verification of Ostwald's Dilution Law& Determination of pKa of a weak acid.
3. Verification of Kohlrausch's Law for weak electrolytes.
4. Determination of solubility of a sparingly soluble salt.
5. Acid-base titration (strong acid and weak acid vsNaOH).
6. Precipitation titrations (mixture of halides only).

| Unit - II | Kinetics | 20 Hours |
|---|---|---|

1. Study the kinetics of acid hydrolysis of an ester; determine the temperature coefficient and also the activation energy of the reaction.
2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half - life method and determine the order with respect to iodine and acetone.

| Unit - III | Phase diagram | 20 Hours |
|---|---|---|

Construction of phase diagram for a simple binary system

1. Naphthalene - phenanthrene.
2. Benzophenone - diphenylamine.

**Adsorption**

Adsorption of oxalic acid on charcoal & determination of surface area (Freundlich isotherm Only).

**Text Book(s):**


1. B. Viswanathan and P.S. Raghavan, Practical Physical Chemistry, Viva Books, New Delhi, 2009.
2. Sundaram, Krishnan, Raghavan, Practical Chemistry (PartII), S. Viswanathan Co. Pvt., 1996.
3. V.D. Athawale and ParulMathur, Experimental Physical Chemistry, New Age International (P) Ltd., New Delhi, 2008.
4. E.G. Lewers, Computational Chemistry: Introduction to the Theory and Applications of Molecular and Quantum Mechanics, 2nd Ed., Springer, New York, 2011.


**Reference Books:**


1. J.B. Yadav Advanced Practical Physical Chemistry, Goel Publishing House, 2001.
2. G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009.
3. J. N. Gurthu and R. Kapoor Advanced Experimental Chemistry, S. Chand and Co., 1987.
4. Shailendra K Sinha, Physical Chemistry: A laboratory Manual, Narosa Publishing House Pvt, Ltd., New Delhi, 2014.
5. F. Jensen, Introduction to Computational Chemistry, 3rd Ed., Wiley- Blackwell.

**Web Resources:**

1. https://web.iitd.ac.in/~nkurur/2015-16/Isem/cmp511/lab_handout_new.pdf

| |
|---|
| **Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning |

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To recall the principles associated with various physical chemistry experiments. | K1 |
| CO2 | To scientifically plan and perform all the experiments. | K2 |
| CO3 | To observe and record systematically the readings in all the experiments. | K3 |
| CO4 | To calculate and process the experimentally measured values and compare with graphical data. | K4 |
| CO5 | To interpret the experimental data scientifically to improve students' efficiency for societal developments. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L – Low**

| Semester: III | Course Code: 23PCHEC05 | Hours/Week: 3 | Credit: 3 |
|---|---|---|---|

## COURSE TITLE: ELECTIVE - V BIOMOLECULES AND HETERO CYCLIC COMPOUNDS

**Course Overview:**

1. This course covers elucidate the structure determination of biomolecules and natural products.
2. These courses generally provide the functions of alkaloids and terpenoids.
3. In this course give information of several of functions of carbohydrates, proteins, nucleic acids, steroids and hormones.
4. This course introduces the basic concepts and biological importance of biomolecules and natural products.

**Learning Objectives:**

1. To learn the basic concepts and biological importance of biomolecules and natural products.
2. To explain various of functions of carbohydrates, proteins, nucleic acids, steroids and hormones.
3. To understand the functions of alkaloids and terpenoids.
4. To elucidate the structure determination of biomolecules and natural products.
5. To extract and construct the structure of new alkaloids and terpenoids from different methods.

| Unit - I | Chemistry and metabolism of carbohydrates | 08 Hours |
|---|---|---|

Definition, Classification and biological role of carbohydrates. Mono saccharides: Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structured Determination not required), physical and chemical properties of glucose and fructose. Disaccharides: Ring structures (Haworth formula) – occurrence, physical and chemical Propertys of maltose, lactose and sucrose. Polysaccharides: Starch, Glycogen and cellulose – Structure and properties, glycolysis of carbohydrates.

| Unit - II | Proteins | 07 Hours |
|---|---|---|

Separation and purification of proteins – dialysis, gel filtration and electrophoresis. Catabolism of Amino acids - transamination, oxidative deamination and decarboxylation. Biosynthesis of Proteins, Steroids – occurrence – classification – cholesterol - structural elucidation – synthesis - Function of sex hormones – androgen - estrogen.

| Unit - III | Nucleic acids | 07 Hours |
|---|---|---|

Role of nucleic acids. Amino acid metabolism and urea cycle. Structure, methods for the synthesis of nucleosides - direct combination, formation of heterocyclic base and Nucleoside modification, conversion of nucleoside to nucleotides. Primary and secondary Structure of RNA and DNA, Watson - Crick model, solid phase synthesis of oligo nucleotides.

| Unit - IV | Vitamins | 07 Hours |
|---|---|---|

Introduction, Classification, Sources and deficiency diseases. Structural determination and synthesis of VitaminA1, Vitamin B6, Vitamin B12, Folic acid, Vitamin H, Vitamin E And Vitamin K2.

| Unit - V | Fused Ring Heterocyclic Compounds | 07 Hours |
|---|---|---|

Benz of used five Membered rings: In dole, isoindole, benzo furan and benzothiophene, Preparation and properties. Benz of used six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions, Reactions: Mechanism of electrophilic and nucleophilic Substitutions, oxidation and Reduction reactions.

**Text Book(s):**


1. T. K Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH, North America, 2007.
2. I.L. Finar, Organic Chemistry Vol-2,5t$^{h}$ edition, Pearson Education Asia, 1975.
3. V.K. Ahluwalia and M. Goyal, Text book of Heterocyclic compounds, Narosa Publishing, New Delhi, 2000.
4. M.K. Jain and S.C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2014.
5. V.K. Ahluwalia, Steroids and Hormones, Ane books pub., New Delhi, 2009.

**Reference Books:**


1. I.L. Finer, Organic Chemistry Vol-1,6th edition, Pearson Education Asia, 2004.
2. Pelletier, Chemistry of Alkaloids, Van No strand Rein hold Co, 2000.
3. Shoppe, Chemistry of the steroids, Butter worthies, 1994.
4. I.A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vole 1 and Vole 10, Ukkaz Publications, Hyderabad, 2004.
5. M.P. Singh.and H. Panda, Medicinal Herbs with their formulations, Daya Publishing House, Delhi, 2005.


**Web Resources:**

1. ps://www.organic-chemistry.org/
2. ps://www.studyorgo.com/summary.php
3. ps://www.clutchprep.com/organic-chemistry

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To understand the basic concepts of biomolecules and natural products. | K1 |
| CO2 | To integrate and assess the different methods of preparation of structurally different biomolecules and natural products. | K2 |
| CO3 | To illustrate the applications of biomolecules and their functions in the metabolism of living organisms. | K3 |
| CO4 | To analyze and rationalize the structure and synthesis of heterocyclic compounds. | K4 |
| CO5 | To develop the structure of biologically important heterocyclic compounds by different methods. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

| Mapping (COs vs POs) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** |
| **CO1** | S | S | S | S | M | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S |
| **CO4** | M | S | S | S | S | M | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S |

**S - Strong, M – Medium, L - Low**

| **Semester: III** | **Course Code: 23PCHED01** | **Hours/Week: 3** | **Credit: 4** |
|---|---|---|---|
| **COURSE TITLE: CORE COURSE - EXTRA DISCIPLINARY - I CHEMISTRY IN CONSUMER PRODUCTS** | | | |

**Course Overview:**

1. This course gives the skill to develop start ups.
2. These courses generally provide the knowledge of inorganic consumer products.
3. In this course covers the knowledge of .firms.
4. These courses provide hands on experience to prepare and develop products.

**Learning Objectives:**

1. To develop start ups.
2. To develop entrepreneur skills in students.
3. To provide hands on experience to prepare and develop products.
4. To familiarizing inorganic consumer products.
5. To discuss the knowledge of .firms.

| **Unit - I** | **Inorganic Consumer Products** | **08 Hours** |
|---|---|---|

Ceramic materials – Preparation, Properties and Uses. Glass - Preparation, Properties and Uses. Graphite - Preparation, Properties and Uses. Silica Aerogel - Preparation, Properties and Uses.

| Unit - II | Soaps and Detergents | 07 Hours |
|---|---|---|

Saponification of oils and fats. Manufacture of soaps. Formulation of toilet soaps. Different ingredients used. Their functions. Mechanism of action of soap. ISI Specifications. Testing procedures/limits. Anionic detergents: Manufacture of LAB (linear alkyl benzene). Sulphonation of LAB Preparation of acid slurry. Different Ingredients in the formulation of detergent powders And soaps Liquid detergents. Foam boosters. AOS (alpha olefin sulphonates. Cationic detergents: examples. Manufacture and applications. Mechanism of action of Detergents Comparison of soaps and detergents. Biodegradation – environmental effects. ISI specifications/ limits.

| Unit - III | Shampoos | 07 Hours |
|---|---|---|

Manufacture of SLS and SLES. Ingredients. Functions. Different Kinds of shampoos – anti - Dandruff, anti - lice, herbal and baby shampoos. Hair dye. Manufacture of conditioners. Coco betainesor Coco diethanol amides – ISI specifications. Testing procedures and limits.

| Unit - IV | Skin Preparations | 07 Hours |
|---|---|---|

Face and skin powders. Ingredients, functions. Different types. Snows and face creams. Chemical ingredients used. Anti per spirants. Sun screen preparations. UV absorbers. Skin bleaching agents. Depilatories. Turmeric and Neem preparations. Vitamin oil. Nail polishes: nail Polish preparation, nail polish removers. Article removers. Lipsticks, roughs, eye brow pencils. Ingredients and functions – hazards. ISI specifications.

| Unit - V | Firms | 07 Hours |
|---|---|---|

Leading firms, brand names, choosing the right product. Packing regulations. Marketing. Licensing – drug license – legal aspects. GMP – ISO 9000/12000 – consumer education. Evaluation of the product – advertisements.

**Text Book(s):**

1. Gobala Rao. S, Outlines of chemical technology, Affiliated East West press, 1998.
2. Kafaro, Wasteless chemical processing, Mir publishers, 1995.

**Reference Books:**

1. Sawyer.W, Experimental cosmetics, over publishers, New York, 2000.

**Web Resources:**

1. https://collegedunia.com/exams/soaps-and-detergents-preparation- differences-process-examples-science-articleid-755 -
2. https://www.cdc.gov/infectioncontrol/guidelines/disinfection/disinfection-methods/chemical.html
3. https://onlinecourses.swayam2.ac.in/cec20_lb05/preview

| |
|---|
| **Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning. |

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Identify inorganic consumer products. | K1 |
| CO2 | Prepare inorganic products and become entrepreneurs. | K2 |
| CO3 | Educate others about consumer product and motivate them to become entrepreneurs. | K3 |
| CO4 | Knowledge about skin products. | K4 |
| CO5 | Instruct to prepare soaps and detergents. | K1 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | M | S |
| **CO2** | M | S | S | S | M | S | S | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S |
| **CO4** | M | S | S | S | M | S | S | M | M |
| **CO5** | S | S | S | M | S | S | S | M | S |

**S - Strong, M – Medium, L - Low**

| Semester: III | Course Code: 23PCHSEC02 | Hours/Week: 3 | Credit: 2 |
|---|---|---|---|

## COURSE TITLE: SKILL ENHANCEMENT COURSE - II PREPARATION OF CONSUMER PRODUCTS

**Course Overview:**

1. These courses give the skill to develop start ups.
2. These courses generally provide the knowledge of consumer products.
3. In this course covers the knowledge of .soaps and detergents.
4. These courses provide hands on experience to prepare and develop products.

**Learning Objectives:**

1. To discuss the knowledge of Disinfectants and Hand wash soaps.
2. To develop entrepreneur skills in students.
3. To provide hands on experience to prepare and develop products.
4. To familiarizing consumer products.
5. To develop start ups.

| Unit - I | Preparation of following Consumer Products, | 36 Hours |
|---|---|---|

1. Soaps
2. Laundry Detergents
3. Shampoos
4. Talc powder
5. Incense sticks
6. Tooth paste
7. Candles
8. Lysol
9. Disinfectants
10. Hand wash soaps

**Text Book(s):**

1. Ajay Kumar Gupta, Soaps, Detergents and Disinfectants Technology Handbook, 3rd Ed, NIIR project consultancy services publisher, 2021.

**Reference Books:**

1. EIRI, Complete Technology Book on Soaps, Detergents, Cleaners and Fragrance with Formulae, EIRI Publisher, 2017.
2. EIRI, Manufacture of Washing Soap Toilet Soap Detergent Powders Liquid Soap Herbal and Paste Detergents and Perfumes with Formulations (PB), EIRI Publisher, 2017.

**Web Resources:**

1. https://collegedunia.com/exams/soaps-and-detergents-preparation- differences-process-examples-science-articleid-755 -
2. https://www.cdc.gov/infectioncontrol/guidelines/disinfection/disinfection-methods/chemical.html
3. https://iris.paho.org/bitstream/handle/10665.2/52172/PAHOCDECECOVID-19200019_eng.pdf?sequence=1&isAllowed=y
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7245492/ https://labmonk.com/preparation-of-tooth

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning.

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Identify consumer products. | K1 |
| CO2 | Prepare products and become entrepreneurs. | K2 |
| CO3 | Educate others about consumer product and motivate them to become entrepreneurs. | K3 |
| CO4 | Know the ingredients used in the papered products. | K4 |
| K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create | | |

| Mapping (COs vs POs) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** |
| **CO1** | S | S | S | S | S | S | S | M | S |
| **CO2** | M | S | S | S | M | S | S | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S |
| **CO4** | M | S | S | S | M | S | S | M | M |

**S - Strong, M – Medium, L - Low**

| **Semester: III** | **Course Code: 23PBTNME2** | **Hours/Week: 2** | **Credit: 2** |
|---|---|---|---|

## COURSE TITLE: NON MAJOR ELECTIVE COURSE - TISSUE ENGINEERING

**Course Overview:**

1. The subject will explore the history and basic concepts of tissue engineering.
2. Learn about the need for tissue replacement, the different types of tissues, and the overall goals of this field.
3. Delve into the world of cells used in tissue engineering.
4. Introduce you to the engineering principles applied in tissue engineering.
5. Explore the real-world applications of tissue engineering.

**Learning Objectives:**

1. The subject imparts knowledge on the fundamentals of tissue and its function
2. The student will be provided with a basic knowledge and understanding about the functions of tissue and its biomedical applications.
3. The student develops in the field of biomaterials.
4. Develop the ability to identify challenges in tissue engineering and propose solutions using the knowledge gained throughout the course
5. Effectively communicate scientific concepts related to tissue engineering

| **Unit - I** | **Basic biology of tissue engineering** | **06 Hours** |
|---|---|---|

Basic biology of tissue engineering: The basis of growth and differentiation - morphogenesis and tissue Engineering

| Unit - II | In vitro control of tissue development | 06 Hours |
|---|---|---|

In vitro control of tissue development - Growth factors - Tissue engineering bioreactors - In vitro Synthesis of Tissue and organs - Organotypic and histotypic engineered tissues. 3D cell culture - Tissue assembly in microgravity

| Unit - III | Biomaterials in tissue engineering | 06 Hours |
|---|---|---|

Biomaterials in tissue engineering - Scaffolds, extracellular matrix, polymers and nanocomposites. Approaches to transplanting engineered cells

| Unit - IV | Bioartificial pancrease | 06 Hours |
|---|---|---|

Bioartificial pancrease, Hepatassist liver supportsystem, Artificial Womb, Heamatopoietic system: Red blood cell substitutes, Renal replacement devices

| Unit - V | Structural tissue engineering | 06 Hours |
|---|---|---|

Structural tissue engineering - Bone regeneration through cellular engineering, Skin tissue engineering, Brain implants - Neural stem cells, Periodontal applications

**Text Book(s):**

1. Sylvia, S. Mader, 2011, Human Biology, Twelfth edition, Mc Graw Hill, USA.

2. Robert P. Lanaza, Robert Langer and Joseph Vacanti, 2007. Principles of Tissue Engineering. Third edition Academic Press.

3. Micklem.H.S.,Loutit John.F., 2004, Tissue grafting and radiation, Academic Press, New York.

**Reference Books:**

1. Penso.G., Balducci.D., 2004.Tissue cultures in biological research, Elsevier, Amsterda

2. Cecie Starr, 1996, Biology, Third edition, Wordsworth, America.

**Web Resources:**

1. www.nuigalway.ie/anatomy/tissue_engineering.htm
2. https://onlinecourses.nptel.ac.in/noc19_bt33/preview
3. https://archive.nptel.ac.in/courses/102/104/102104059/
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5271153/
5. https://onlinecourses.nptel.ac.in/noc21_bt14/preview

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**
Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Understand the Basics of Tissue Engineering | K1 |
| CO2 | Apply the knowledge to create tissue culture methods | K2 |
| CO3 | Acquire adequate knowledge in the use of tissue in medical application | K3 |
| CO4 | Evaluate the benefits of Tissue Engineering & Pharmaceutical Products | K4 |
| CO5 | Analyze the importance of applications of tissue engineering | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **S** | **M** | **M** | **S** | **M** | **M** |
| **CO2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **M** | **S** |
| **CO3** | **S** | **S** | **S** | **S** | **M** | **M** | **S** | **M** | **S** |
| **CO4** | **M** | **S** | **S** | **S** | **S** | **S** | **S** | **M** | **M** |
| **CO5** | **S** | **S** | **S** | **M** | **S** | **M** | **S** | **S** | **S** |

**S - Strong, M – Medium, L – Low**