SRI VENKATESWARA UNIVERSITY:: TIRUPATI
SVU COLLEGE OF SCIENCES

DEPARTMENT OF CHEMISTRY
PHYSICAL CHEMISTRY


# Syllabus for M.Sc. CHEMISTRY
# Choice Based Credit System (CBCS)
# (w.e.f. the Academic Year 2016-2017)

**Vision**

Impart quality education & training in the field of chemistry to enable successful careers for the post graduate students in the field of research, education & industry applications of chemical sciences.

**Mission**

The Department of Chemistry strives:

- To get an ideal balance between knowledge creation and knowledge dissemination in the chemical sciences with a focus to train and mentor students to become responsible scientists and scientifically literate professionals to attain National and International impact.
- To contribute to the improvement of scientific and technological literacy, and the development of critical-thinking and problem-solving skills of all students in order to compete for the world of work and responsible citizenship

**PROGRAM EDUCATIONAL OBJECTIVES:**

At the end of the program, the student wills be able to:

| | |
|---|---|
| PEO1 | To demonstrate broad knowledge of descriptive chemistry. |
| PEO2 | To impart basic analytical and technical skills to work effectively in various fields of chemistry. |
| PEO3 | To motivate critical thinking and analysis skills to solve complex problems viz., analysis of data, synthetic logistics, spectroscopy, structure and modeling, team based problem solving etc. |
| PEO4 | To demonstrate an ability to conduct experiments in the above sub disciplines with mastery of appropriate techniques and proficiency using core chemical instrumentation and modeling method |
| PEO5 | To develop laboratory competence in relating chemical structure to spectroscopic phenomena. |
| PEO6 | To demonstrate the ability to synthesize, separate and characterize compounds using published reactions, protocols, standard laboratory equipment and modern instrumentation. |

**PROGRAM OUTCOMES:** On completion of M.Sc. Chemistry programme, graduates will be able to –

| | |
|---|---|
| PO1 | Have a firm foundation in the fundamentals and application of current chemical and scientific theories in different areas of chemistry *viz*., Analytical, Environmental, Inorganic, Organic and Physical. |
| PO2 | Understands the background of organic reaction mechanisms, complex chemical structures, and instrumental methods of chemical analysis, molecular rearrangements and separation techniques. |
| PO3 | Familiarize with the importance of various elements present in the periodic table, coordination chemistry and structure of molecules, properties of compounds, structural determination of complexes using theories and instruments. |
| PO4 | Understand about the physical aspects of atomic structure, dual behavior, reaction pathways with respect to time, various energy transformations, molecular assembly in nano-level, significance of electrochemistry, molecular segregation using their symmetry. |
| PO5 | Create awareness and sense of responsibilities towards environment and apply knowledge to solve the issues related to Environmental pollution. |

| | |
|---|---|
| PO6 | Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in the subject concerned. Ability to identify unethical behavior such as fabrication, falsification or misrepresentation of data and adoptive objective, unbiased and truthful actions in all aspects. |
| PO7 | Be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems. |
| PO8 | Clearly communicate the results of scientific work in oral, written and electronic formats. |
| PO9 | Explore new areas of research in both chemistry and allied fields of science and technology. |
| PO10 | Design, analyze and carry out scientific experiments and interpret data to provide solutions to different industrial problems. |
| PO11 | Independently carry out research to solve practical problems and present a substantial technical report. |
| PO12 | Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning throughout life, through self- paced and self- directed learning aimed at personal development, and adapting to change academic demands of work place through knowledge/ skill development/ reskilling. |

**PROGRAM SPECIFIC OUTCOMES:** At the end of the program, the student will be able to:

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|---|---|
| PSO1 | **Scientific Problem solving skills**: Deep knowledge of the topic which can develop the problem solving skills using chemical principles. |
| PSO2 | **Analytical skills**: Develop analytical skills such as synthesizing, separating, characterizing chemical compounds and chemical reactions with the help of sophisticated instruments |
| PSO3 | **Research skills**: Develop research skills through dissertation/project work in different fields of chemistry such as organic, inorganic, analytical, physical and environmental. |
| PSO4 | **Learning skills on life processes**: Acquire advanced level of knowledge in natural products as well as biological systems from the chemistry point of view. |

**S.V. UNIVERSITY, TIRUPATI**
**SVU COLLEGE OF SCIENCES**
**M.Sc., Physical Chemistry**
**CBCS Pattern (With effect from 2016-17)**
**The course of Study and Scheme of Examinations**

**SEMESTER-I**

| Sl. No. | Course Code | Components of Study | Title of the Course | No. of Credits | IA Marks | End SEM Exam Marks | Total |
|---|---|---|---|---|---|---|---|
| 1 | CHE-101 | Core-Theory | Inorganic Chemistry- I | 4 | 20 | 80 | 100 |
| 2 | CHE-102 | Core-Theory | Organic Chemistry I | 4 | 20 | 80 | 100 |
| 3 | CHE-103 | Core-Theory | Physical Chemistry- I | 4 | 20 | 80 | 100 |
| 4 | CHE-104 | Core-Practical | Inorganic Practical- I | 2 | - | - | 50 |
| 5 | CHE-105 | Core-Practical | Organic Practical-I | 2 | - | - | 50 |
| 6 | CHE-106 | Core-Practical | Physical Practical I | 2 | - | - | 50 |
| 7 | CHE-107 | Compulsory Foundation | General Chemistry-I | 2 | 10 | 40 | 50 |
| 6 | CHE-108 | Elective Foundation | an Values and Professional Ethics – I | 4 | 20 | 80 | 100 |
| | | **Total** | | **24** | | | **600** |

**SEMESTER-II**

| Sl. No. | Course Code | Components of Study | Title of the Course | No. of Credits | IA Marks | End SEM Exam Marks | Total |
|---|---|---|---|---|---|---|---|
| 1 | CHE-201 | Core-Theory | Inorganic Chemistry- II | 4 | 20 | 80 | 100 |
| 2 | CHE-202 | Core-Theory | Organic Chemistry -II | 4 | 20 | 80 | 100 |
| 3 | CHE-203 | Core-Theory | Physical Chemistry- II | 4 | 20 | 80 | 100 |
| 4 | CHE-204 | Core-Practical | Inorganic Practical- II | 2 | - | - | 50 |
| 5 | CHE-205 | Core-Practical | Organic Practical-II | 2 | - | - | 50 |
| 6 | CHE-206 | Core-Practical | Physical Practical -II | 2 | - | - | 50 |
| 7 | CHE-207 | Compulsory Foundation | General Chemistry-II | 2 | 10 | 40 | 50 |
| 6 | CHE-208 | Elective Foundation | an Values and Professional Ethics – II | 4 | 20 | 80 | 100 |
| | | **Total** | | **24** | | | **600** |

**SEMESTER-III**

| | **Course Code** | **Components of Study** | **Title of the Course** | **No. of Credits** | **IA Marks** | End SEM Exam Marks | **Total** |
|---|---|---|---|---|---|---|---|
| 1 | CHE-PC-301 | Core-Theory | Physical Chemistry III | 4 | 20 | 80 | 100 |
| 2 | CHE-PC-302 | Core-Theory | Organic Spectroscopy | 4 | 20 | 80 | 100 |
| 3 | CHE-PC-303 | Core-Practical | Practical-III | 4 | - | - | 100 |
| 4 | CHE-PC-304 | Core-Practical | Practical- III | 4 | - | - | 100 |
| 5 | CHE-305 | Generic Elective* **(Related to subject)** | (a) Organic Chemistry III | 4 | 20 | 80 | 100 |
| | | | (b) Inorganic Spectroscopy & Thermal Methods of Analysis | 4 | 20 | 80 | 100 |
| | | | (c)Green Chemistry | | | | |
| 6 | CHE-306 | Open Elective **(For other departments)** | (a) Spectral Techniques or (b) Chromatographic Techniques | 4 | 20 | 80 | 100 |
| | | **Total** | | **24** | | | **600** |

***Among the Generic Elective a student shall choose any two.**

**SEMESTER-IV**

| | Course Code | Components of Study | Title of the Course | No. of Credits | IA Marks | End SEM Exam Marks | Total |
|---|---|---|---|---|---|---|---|
| 1 | CHE-PC-401 | Core-Theory | Electrochemistry | 4 | 20 | 80 | 100 |
| 2 | CHE-PC-402 | Core-Theory | Thermodynamics, Polymers and Solid state Chemistry | 4 | 20 | 80 | 100 |
| 3 | CHE-PC-403 | Core-Practical | PRACTICAL-I | 4 | - | - | 100 |
| 4 | CHE-PC-404 | Core-Practical/ Project work | Project work | 4 | - | - | 100 |
| 5 | CHE-405 | Generic Elective* (Related to subject) | CHEMICAL KINETICS | 4 | 20 | 80 | 100 |
| | | | (b) Bioinorganic, Bioorganic & Biophysical | 4 | 20 | 80 | 100 |
| | | | (c) Chemistry of Nanomaterials & Functional meterials | | | | |
| 6 | CHE-406 | Open Elective* (For other departments) | (a)Drug Chemistry or (b) Electro analytical Techniques | 4 | 20 | 80 | 100 |
| | | Total | | 24 | | | 600 |

***Among the Generic Elective a student shall choose any two.**

| CHE-101 | INORGANIC CHEISTRY I | L-5,T-1,P-0 | 4Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level chemistry

**Course Objectives:**

- Comprehend the key features of coordination compounds, Crystal Field Theory, different properties and bonding by spectroscopic techniques
- Study the polymorphic forms of non-transition elements and their synthesis and properties
- Understand the basics of reaction mechanism and the mechanistic concepts of Dissociative (Id) and Associative interchange Mechanism (Ia), Taube's classification, Trans effect and Electron Transfer Reactions
- Familiarize with the methods of synthesis of metal carbonyls and metal nitrosyls, Synergistic effect, EAN and 18-electron rule.

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To understand the key features of coordination compounds, Crystal Field Theory, magnetic properties and bonding in transition metal complexes. |
| **CO2** | To learn about the polymorphic forms of Carbon, Sulphur and Phosphorus, synthesis and properties of sulphur-nitrogen compounds, boranes, carbides, silicates and to know Wades rules. |
| **CO3** | To explain the reactivity of complexes in terms of Valence bond and Crystal Field theories, Taube's classification, Trans effect and Electron Transfer Reactions. |
| **CO4** | To gain knowledge on synthesis and structures of different metal carbonyls, synergistic effect and 18 electron rule. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | 3 | - | 2 | 1 | 1 | - | 2 | - | 1 |
| **CO2** | 3 | 1 | 2 | 3 | - | 2 | - | 2 | 1 | 1 | - | 1 |
| **CO3** | 3 | 2 | - | 3 | 2 | | 1 | | 2 | 1 | 1 | 1 |
| **CO4** | 3 | 1 | 1 | 3 | 1 | 1 | - | 2 | 1 | - | 2 | 1 |

## CHE 101: INORGANIC CHEISTRY I

**UNIT-I: CO-ORDINATION COMPOUNDS 15 Hrs**

Introduction to Crystal field Theory, CFSE and its calculation, Paring energy, Splitting of 'd' orbitals in Trigonal bi pyramidal, square planar, square pyramid and pentagonal bipyramidal geometries, Jahn –Teller effect, Application of CFT, OSSE, site Selection in Spinels, Short comings of CFT, Evidence for covalency –Nephelauxetic effect. MOT of co-ordinate bonds –M.O. Diagrams for octahedral, tetrahedral and square planar complexes. Experimental evidences for π- bonding – Crystallography, Infrared spectroscopy and Photoelectron spectroscopy.

**UNIT-II: CHEMISTRY OF NON-TRANSITION ELEMENTS 15 Hrs**

General characteristics of the non- transition elements special features of individual elements ; Synthesis' properties and structure of their Halides and Oxides, Polymorphism of Carbon, Phosphorus and Sulphur, Synthesis, properties and structure of boranes, Carboranes, borazines, Silicates, Carbides, Sulphur-nitrogen compounds. Electron counting in boranes, Wades rules (Poly hedral skeletal electron pair theory), Isopopoly and hetero poly acids.

**UNIT-III: REACTION MECHANISMS IN COMPLEXES 15 Hrs**

Reactivity of metal complexes. Inert and Labile complexes. Concept of Labile and Inert complexes in terms of Valence bond and Crystal Field theories. Taube's classification of complexes as labile and inert complexes. Dissociative (D) and Dissociative interchange Mechanism (Id) & Associative (A) and Associative interchange Mechanism (Ia). Substitution reactions in octahedral complexes- Acid Hydrolysis -factors affecting Acid Hydrolysis - Base Hydrolysis-conjugate Base Mechanisms - Anation Reactions -Substitution Reactions in Square Planar complexes- Trans effect – Mechanisms of Trans effect: polarization and π-bonding theories.Electron Transfer Reaction-Inner Sphere and outer Sphere Mechanisms- Marcus theory.

**UNIT-IV: METAL πCOMPLEXES-I** **15 Hrs**

Nature of π bonding, Classification of π ligands, π donor ligands and π -acceptor ligands.

**Metal Carbonyls:** Synthesis of metal carbonyls, Structures of metal carbonyls of the types M(CO)n (M= Cr, Fe, Ni; n=4-6), $M_2(CO)n$ (M=Co, Fe, Mn; n=8-10), $M_3(CO)_{12}$ (M=Fe, Ru and Os), $M_4(CO)_{12}$ (M=Co, Rh, Ir). IR Spectraof metal carbonyls (i) Detection of bridging and terminal CO ligand, (ii) Synergistic effect, EAN and 18-electron rule. Electron counting methods (i) Oxidation state method and (ii) Neutral Atom method.

**Metal Nitrosyls:** Synthesis of metal Nitrosyls, bonding, Electron donation by nitric oxide, Models for NO bonding (i) Covalent model and (ii) Ionic models, Structures of metal nitrosyls (1) $[Fe_4S_3(NO)]$ (2)$[Fe_2(NO)_2I_2]$ (3) $[(\phi_3P)_2Ir(CO)Cl(NO)]^+$ (4) $[(\phi_3P)_2Ru(NO)_2Cl]$, Detection of bridging NO ligand, Applications of metal nitrosyls.

**Books Suggested**


1. F.A.Cotton and G. Wilkinson, Advanced In-organic chemistry VI Edition, 1999.John wiley & sons. Inc., New York.
2. James E. Huheey, Inorganic chemistry- Principles of structure and reactivity, VI Edition 1993. Harper Collins College Publishers, New York.
3. J.D. Lee: Concise Inorganic Chemistry (Blackwell)
4. Gary Wolfsburg: Inorganic Chemistry ($5^{th}$ Ed. (Viva Books)
5. W.L. Jolly: Modern Inorganic Chemistry (McGraw-Hill)
6. B.N Figgis: Introduction to Ligand Fields (John-Willey)
7. S.F.A. Kettle: Coordination compounds.
8. Coordination Chemistry. Bassalo & Jahnson.

| CHE-102 | Organic Chemistry I | L-3,T-1,P-2 | 4Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level Organic Chemistry

**Course Objectives:**

- Classify molecules based on stereochemical aspects study on optical and geometrical isomerism by the application of Cahn-Ingold-Prelog rules.
- Familiarize with different types of substitution reactions, able to predict products, including stereochemistry in aliphatic and aromatic nucleophilic substitution reactions, effect of neighboring group participation
- Understand thermodynamic and kinetic requirements, kinetic and thermodynamic control, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects in reactive intermediates
- Study about occurrence, isolation, structure establishment and synthesis of natural products-terpenoids.

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To detect stereochemical structures of the molecules, stereoselective and stereocontrolled reactions. |
| **CO2** | To ascertain the stereochemistry of the products with the effect of neighbouring group participation and to familiarize the various types of aromatic substitution reactions, their mechanism and the effect of substituents. |
| **CO3** | To know the concept of isotope effects, potential energy diagrams and transition states in different intermediates |
| **CO4** | To familiarize with stereospecific synthesis of naturally occurring terpenoids and degradation products of terpenoids |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 1 | - | 1 | 2 | 1 | - | 2 | - |
| **CO2** | 3 | 2 | 2 | 3 | | 1 | - | 1 | 2 | 1 | 1 | 2 |
| **CO3** | 3 | 1 | 2 | 3 | 1 | 1 | 1 | 2 | | 1 | - | - |
| **CO4** | 3 | 2 | 2 | 3 | 2 | 2 | - | 2 | - | 1 | - | 2 |

## CHE102: Organic Chemistry I

**UNIT-I**: **Stereochemistry**

**Sereoisomerism**-Stereoisomers Classification – Configuration and conformation.

**Molecular Three dimensional representations:** Wedge, Fischer, Newman and Saw-horse formulae, their description and interconversions.

**Molecular Symmetry & Chirality:** Symmetry operations and symmetry elements (Cn & Sn). Criteria for Chirality. Dissymmetrization.

**Optical isomerism:** Molecular Symmetry and Chirality-Cahn-Ingold-Prelog rules R, S-nomenclature, stereoisomerism resulting from more than one chiral center, meso and pseudoasymmetric compounds - **Axial Chirality** - Stereochemistry of allenes spiranes - biphenyl derivatives and atropisomerism - **Planar chirality** - Ansa compounds and trans - Cycloalkenes - **Helicity**. Helically chiral compounds

**Geometrical isomerism** - E, Z - nomenclature - Physical and Chemical methods of determining the configuration of geometrical isomers-Stereoisomerism in 3, 4 and 5-membered cyclic compounds.

**UNIT-II: Substitution Reactions**

**i) Aliphatic Nucleophilic Substitutions:** The $S_N2$, $S_N1$, mixed $S_N1$ and $S_N2$, SET mechanisms. Reactivity- effects of substrates, attacking nucleophiles, leaving groups and reaction medium.Common carbocation rearrangements – primary, secondary and tertiary. The neighbouring group participation (NGP) -anchimeric assistance, NGP by $\sigma$ and $\pi$- bonds, phenonium ions, norbornyl and norbornenyl systems, Classical and nonclassical carbocations, NGP by halogens and heteroatoms (O,N,S)

The $S_N^i$ and $S_N2'$ mechanisms. Nucleophilic substitution at an allylic, and vinylic carbons.

**ii. Aromatic Nucleophilic Substitution:** The $S_NAr$, $S_N1$, benzyne and $S_{RN}1$mechanisms. Reactivity - effect of substrate, structure, leaving group and attacking nucleophile. The von Richter, Sommelet - Hauser and Smiles rearrangements.

**UNIT-III: Reactive Intermediates**

Types of reactions, types of bond cleavage mechanisms, generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes and arynes. Thermodynamic and kinetic requirements, kinetic and thermodynamic control, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects**.**

**UNIT-IV: Terpenoids**

Classification of terpenoids, occurrence, isolation, general methods of structure determination. Isoprene and special isoprene rule. Structure determination and synthesis of the following representative molecules: Farnesol, Zingeberine, Cadinene and Abietic acid.

**Books Suggested:**


1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J Sundberg, Plenum.
3. Structure and Mechanism in Organic Chemistry C.K. Inglod, Cornell University Press.
4. Organic Chemistry, R.T Morrison and R.N. Boyd, Prentice - Hall.
5. Principles of Organic Synthesis, R.O.C Norman and J. M. Coxon, Blackie Academic.
6. Stereochemistry, P.S. Kalsi, Wiley Eastern.
7. Text book of Organic Chemistry, M.C. Murry
8. Organic Chemistry, Vol I, I.L. Finar, ELBS Eds.

| CHE-103 | Physical Chemistry I | L-5,T-1,P-6 | 4Credits |
|---|---|---|---|

**Pre-requisite:** Basic knowledge about Physical Chemistry

**Course Objectives:**

- Acquire knowledge in Quantum Chemistry, postulates of Quantum Mechanics., Applications of Schrodinger wave equation and Born-Oppenheimer approximation
- Study on Chemical Dynamics and theories in unimolecular, chain and fast reactions and determination of reaction rates.
- Familiarize with concepts of Thermodynamics and statistical thermodynamics, Gibbs- Duhem equation and Sackur-Tetrade equation
- Know about Thermodynamic and Kinetic concept of Electrochemistry and conductance, conductivity of electrolytes

**Course Outcomes** At the end of the course, the student will be able to

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|---|---|
| **CO1** | To know the concepts such as Operator algebra, Eigen values and Eigen functions, Degeneracy, Schrodinger wave equation and the postulates of Quantum Mechanics. |
| **CO2** | To learn about theories of reaction rates, Lindemann, Lindemann-Hinshel wood, and RRKM theories. |
| **CO3** | To know about Thermodynamic concepts and entropy change in reversible process and irreversible process, Gibbs- Duhem equation, calculation of thermodynamic properties. |
| **CO4** | To study the Thermodynamic and Kinetic Derivation of Nernst Equation and the derivation of Debye-Huckle Equation and its Verification |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 2 | 1 | - | 2 | 1 | 2 | 1 | 1 |
| **CO2** | 3 | 1 | 2 | 3 | 1 | 1 | 1 | - | 2 | 1 | - | 1 |
| **CO3** | 3 | 2 | 1 | 3 | 2 | | | 3 | | 1 | 2 | 2 |
| **CO4** | 3 | 2 | 2 | 3 | - | 1 | 1 | - | 1 | 2 | - | 2 |

**CHE-103: Physical Chemistry I**

**UNIT-I: Quantum Chemistry-I**

(A)**Introduction to Exact Quantum Mechanical Results**

Operator algebra, Eigen values and Eigen functions, Operators for momentum and energy, Degeneracy, Linear combination of Eigen functions of an operator, well behaved wave functions, Normalized and orthogonal functions, The schrodinger wave equation and the postulates of Quantum Mechanics, (B) **Applications of Schrodinger wave equation:** Particle in one dimensional and three dimensional box, harmonic oscillator, rigid rotor, hydrogen atom and its applications. Hydrogen like wave function, hydrogen like orbitals and their representation, polar plots, contour plots and boundary diagram. (C)**Approximate Methods:** The variation Theorem, Linear variation principle, perturbation Theory (first Order and non-degenerate), Application of variation Method and perturbation theory to the helium atom, The Born-Oppenheimer approximation.

**UNIT-II: Chemical Dynamics**

(A)**Theories of reaction rates:** Collision theory, steric factor. Theory of Absolute Reaction Rates-Reaction coordinate, activated complex and the transition state. Thermodynamic formiulation of reacton rates.

(B) **Unimolecular reactions:** Lindemann, Lindemann-Hinshel wood, and RRKM theories. Termolecular reactions. Complex reactions-Rate expressions for opposing, parallel and consecutive reaction (all first order type) (C) **Chain reactions:** Dynamic chain, hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane, photochemical reactions- $H_2$-$Br_2$, $H_2$-$Cl_2$ reactions, Autocatalysis, $H_2$-$O_2$ reaction explosion limits. (D) **Fast Reactions:** Flow system – Temperature and pressure Jump Methods – Relaxation Techniques.

**UNIT – III : Thermodynamics**

(A) **Brief review of Thermodynamic concepts:** Enthalpy, entropy, free energy. Concept of Entropy –Entropy as a state function –Entropy change in reversible process and irreversible process – Temperature – Entropy diagrams – Entropy change and phase change – Entropy of mixing – Entropy and disorder. (B) **Statistical thermodynamics:** Partial molar properties: their significance and determination of partial molar properties, fugacity and its determination. Concept of distribution, thermodynamic probability and most probable Distribution, Ensemble averaging, postulates of ensemble averaging, canonical, grand canonical and micro- canonical ensembles, partition functions, translational, rotational, vibrational and electronic partition functions, Gibbs- Duhem equation, calculation of thermodynamic properties in terms of partition functions, Entropy of monatomic gases (Sackur-Tetrade equation)

**UNIT-IV : Electrochemistry I**

(A) **Thermodynamic and Kinetic concept of Electrochemistry**

Thermodynamic and Kinetic Derivation of Nernst Equation, Chemical and Concentration Cells with and without Transference, Liquid Junction Potential, Derivation of the Expression for Liquid Junction Potentials-its determination and elimination, Applications of EMF Measurements: (i)Solubility product, (ii)pH Determination, (iii) Potentiometric Titrations.; (B)**Conductivity:** Theory of Electrolytic Conductance, Derivation of Debye-Huckle Equation and its Verification, Debye-Falkenhagen Effect, and Wein Effect, kohlrausch law. Calculation of Solubility of Sparingly soluble Salt from Conductance Measurements.

Conductometric Titrations : Titration of Strong Acid Vs Strong Base (HCl vs NaoH) ; Titration of Weak Acid Vs Strong Base (AcoH vs NaoH); Titration of mixture of Strong and Weak Acids vs Strong Base ; Precipitation Titrations.

**Books Suggested**


1. Physical Chemistry, P. W. Atkins (ELBS)
2. Quantum Chemistry, Ira N. Levine (Prentice Hall)
3. Atomic Structure and Chemical bond, Manas Chandra.
4. Chemical Kinetics, K.J. Laidler (Mc Graw Hill)
5. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose (Mcmilan)
6. Thermodynamics for chemists, S. Glasstone
7. Chemical thermodynamics, I.M. Klotz
8. Statistical Thermodynamics, M. Dole
9. Modern Electrochemistry, Vol. I & II, J.O. M. Bockris and A.K.N. Reddy (plen
10. An Introduction to Electrochemistry (3rd ed.), S. Glasstone (Affiliated East-West).

| CHE 104 | Core practical I: Inorganic Chemistry | L-5,T-1,P-0 | 2 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level Inorganic Chemistry practical.

**SEMI MICRO QUALITATIVE ANALYSIS**

- Basic laboratory techniques of titration and analysis.
- Quantitative estimation of inorganic compounds through volumetric techniques.

**Course Outcomes:** At the end of the course, the student will be able

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|---|---|
| **CO1** | To demonstrate mastery of basic semi-micro qualitative analysis of simple salts and interprets analytical data and will make scientific claims that are supported by the observations. |
| **CO2** | To familiarize with techniques of titration and calculation of errors |
| **CO3** | |
| **CO4** | |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 2 | - | 1 | 1 | - | 1 | 2 | - |
| **CO2** | 3 | 2 | 2 | 3 | 1 | 1 | - | 1 | 2 | 1 | 1 | 2 |
| **CO3** | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | |

**CHE 104: Core practical I: Inorganic Chemistry**

**Semi Micro Qualitative Analysis**

I. Qualitative Analysis of a mixture containing four cations including two less common cations (viz., W, Mo, Se, Te, V, Ce, Th, Zr, Li and U).

| CHE 105 | Core practical I: Organic CheImistry | L-5,T-1,P-0 | 2 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level Organic Chemistry practical.

**Course Objectives:**

- Identification of single organic component by systematic qualitative analysis
- Single step preparations

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To familiarize the systematic procedures of analysis of organic components, conformational tests for various functional groups. |
| **CO2** | To understand the mechanisms and familiarize with methodologies to prepare biologically important molecules. |
| **CO3** | |
| **CO4** | |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 2 | - | 2 | - |
| **CO2** | 3 | 2 | 2 | 3 | 2 | 2 | - | 1 | 1 | 2 | - | 2 |
| **CO3** | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | |

## CHE : 105 : PRACTICAL – II : ORGANIC CHEMISTRY

a) Identification of single organic component by systematic qualitative analysis.
   Aromatic acids
   Phenols
   Neutral compounds
   Esters
   Carbonyl compounds etc.

b) Single step preparations.
   1. Preparation of aspirin
   2. Preparation of p-nitroacetanilide
   3. Preparation of p-bromoacetanilide
   4. Hydrolysis

| CHE 106 | Core practical I: Physical CheImistry | L-5,T-1,P-0 | 2 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level Physical Chemistry practical.

**Course Objectives:**

- Determination of critical solution temperature, eutectic composition and temperature of binary system.

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To study the determination of critical solution temperature, eutectic composition, distribution coefficient, adsorption of different |
| **CO2** | To calibrate the statistical data |
| **CO3** | |
| **CO4** | |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | - | 2 | 2 | 1 | - | 2 | 1 | 1 |
| **CO2** | 3 | 2 | 2 | 2 | 1 | 2 | - | 1 | 1 | 2 | - | 2 |
| **CO3** | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | |

**CHE : 106 : PRACTICAL – III : Physical Chemistry**

Syllabus

- Calibration of volumetric apparatus and statistical analysis of the data.
- Determination of critical solution temperature of phenol-water system and study the effect of electrolyte on CST.
- Determination of Eutectic composition and temperature of binary system
- Determination of distribution coefficient of benzoic acid between water and benzene.
- Study the adsorption of acetic acid on charcoal and analysis of the data on the basis of Langmuir and Freundlich adsorption isotherms.
- Determination of rate constant of acid hydrolysis of an ester and investigate the effect of catalyst concentration, reactant concentration and temperature.

| CHE-107 | General Chemistry I | L-5,T-1,P-0 | 2 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level Chemistry

**Course Objectives:**

- Gain knowledge on precision and accuracy, Limit of detection, Limit of determination, Sensitivity and selectivity, statistical evaluation of data
- Familiarize with principles and concepts of flame emission spectroscopy and atomic absorption spectroscopy and their applications .

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To know about mean and median values, standard deviation and coefficient of variation. |
| **CO2** | To acquire knowledge on principle and instrumentation of AAS and difference between flame AAS and furnace AAS. |
| **CO3** | |
| **CO4** | |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 1 | 2 | - | 2 | - | 1 | 1 | 2 |
| **CO2** | 3 | 2 | 2 | 3 | 1 | - | 2 | 1 | - | 2 | - | 2 |
| **CO3** | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | |

## CHE107: General Chemistry I

**UNIT-I: TREATMENT OF ANALYTICAL DATA 15 Hrs**

Precision and accuracy –mean and median values –Standard deviation – coefficient of variation, Types of errors: Determinate and indeterminate errors, confidence limits, significant figures, computations, minimization of errors, statistical evaluation of data –T-test ,F- test , and $X^2$ –test. Correlation coefficient and coefficient of determination; Limit of detection (LOQ); Limit of determination(LOD) Sensitivity and selectivity of an analytical method.

**UNIT-II: FLAME EMISSION AND ATOMIC ABSORPTION SPECTROSCOPY 15 Hrs**

(a) **Flame Emission Spectroscopy**: Principles, chemical reactions in flames, Interferences, evaluation methods, flame photometer and experimental technique, procedure for determinations, limitations and disadvantages. Applications

(b)**Atomic Absorption Spectroscopy: Flame AAS:** Principle, Instrumentation – Sources of radiation (HCL and EDL), Different types of burners, Interferences- Physical, Chemical, spectral and back ground correction, and methods of minimization

GF AAS: Principle and technique –Comparison between Flame AAS and furnace AAS, Applications of AAS, Comparison between Atomic Absorption & Flame Photometry.

**Books Suggested**


1. H.W. Willard, LL. Merritt and J.A. Dean: Instrumental Methods of Analysis
2. Vogel's Text book of Quantitative Inorganic Analysis.
3. Analytical Chemistry
4. Instrumental Methods of Analysis H. Kaur

| CHE 108 | Human Values and Professional Ethics-I | L-3,T-1,P-2 | 4 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level Human Values and professional ethics

**Course Objectives:**

- Analyze values in various ethical professions
- Understand moral concepts, character and conduct multiple
- Concept of ethical values with respect to individual and society
- ethical interests at stake in areal-world situation or practice and assess own ethical values with respect to social context and problems

**Course Outcomes:** At the end of the course, the student will be able to

| | |
|---|---|
| **CO1** | To know about the needs and importance of professional ethics. |
| **CO2** | To analyze nature of Values, basic Moral Concepts character and Conduct. |
| **CO3** | To gain knowledge on individual and society ethical values, ahimsa, satya and brahmacharya. |
| **CO4** | To understand values of Bhagavd Gita, various religions, religious tolerence, Gandhian ethics. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | 1 | 3 | 2 | 1 | 1 | 2 | 3 | - | 1 | 2 |
| **CO2** | 3 | - | 2 | 3 | 1 | 2 | -- | 2 | 3 | 2 | - | 2 |
| **CO3** | 3 | 1 | | 3 | 2 | | 1 | | | | 1 | 3 |
| **CO4** | 3 | 1 | 2 | 3 | | 2 | 2 | 2 | 2 | 2 | - | 3 |

## CHE 107: ELECTIVE FOUNDATION (HUMAN VALUES AND PROFESSIONAL ETHICS – I)

**Chapter I:** Definition and Nature of Ethics – Is relation to Religion, Politics, Business, Law, Medicine and Environment. Need and Importance of Professional Ethics – Goals – Ethical Values in Various Professions.

**Chapter II:** Nature of Values – Good and Bad, Ends and Means, Actual and Potential Values, Objective and Subjective Values, Analysis of Basic Moral Concepts – Right, Ought, Duty, Obligation, Justice, Responsibility and Freedom, Good Behavior and Respect for Elders, Character and Conduct.

**Chapter III:** Individual and Society: Ahimsa (Non-Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya (Non Possesion) and Aparigraha (Non-stealing). Purusharthas (Cardinal virtues) - Dharma (Righteousness), Artha (Wealth), Kama (Fulfillment Bodily Desires), Moksha (Liberation), Crime and Theories of Punishment – (a) Reformative, Retributive and Deterrent, (b) Views on Manu and Yajnavalkya

**Chapter IV:** Bhagavd Gita – (a) Niskama Karma, (b) Buddhism – The Four Nobel Truths – Arya astanga marga, (c) Jainism - Mahavratas and Anuvratas. Values Embedded in Various Religions, Religious Tolerence, Gandhian Ethics.

**Books for study:**


1. Johns S Mackenjie: A Manual of ethics
2. "The Ethics of Management" by Larue Tone Hosmer, Richard D. Irwin Inc.
3. "Ethics in Management" by S.A. Shelekar, Himalaya Publishing House.
4. Harold H. Titus: Ethics for Today
5. Maitra, S.K: Hindu Ethics
6. William Lilly: Introduction to Ethics
7. Manu: Manava Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed) G.C. Haughton.
8. Sasruta Samhita: Tr. Kaviraj Kunjanlal, Kunjanlal Brishagratha, Chowkamba Sanskrit Series, Vol I,II and III, Varanasi, Vol I PP, 16-20, 21-32 and 74-77 only.
9. Charaka Samhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series Office. Varanasi I, II, III Vol I PP 183-191.
10. Ethics, Theory and Contemporary Issues. Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.
11. Analyzing Moral Issues, Judith A. Boss, Mayfield Publishing Company, 1999.
12. I.C. Sharma Ethical Philosophy of India. Nagin& Co Julundhar.

| CHE - 201 | Inorganic Chemistry II | L-5, T-1, P-0 | 4 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level chemistry

**Course Objectives:**

- Understand magnetic properties of transition metal complexes and various reactions on ligands with respect to synthesis.
- Gain knowledge on electronic spectra of complex molecules of octahedral and tetrahedral geometry
- Understand magnetic properties viz., diamagnetism and paramagnetism and other related properties of complex molecules
- Familiarize with different catalytic reactions of complex molecules and factors effecting the reactions.

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To familiarize with the general methods of complex preparations and properties, nature of bonding and structural features of metal complexes. |
| **CO2** | To know about Russel-Saunders coupling, splitting of energy levels in octahedral field and differentiate between Orgel diagrams and Tanabe-Sugano diagrams. |
| **CO3** | To understand about the laws of Hunds, Curie and Weiss, magnetism and magnetic susceptibility determination by Gouy's and Farady methods. |
| **CO4** | To gain knowledge on Induced reactions, Free radical reactions, Thermal decomposition reactions, Chain reactions. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | - | 2 | 1 | 2 | - | 2 | - | 1 |
| **CO2** | 3 | 1 | 1 | 3 | 1 | 2 | - | 2 | - | 1 | - | 1 |
| **CO3** | 3 | - | 2 | 3 | - | 2 | 1 | - | 2 | 1 | 1 | - |
| **CO4** | 3 | 1 | 1 | 3 | 1 | 2 | - | 1 | - | 1 | - | 1 |

## CHE 201: INORGANIC CHEISTRY II

**UNIT – I: TRANSITION METAL II – COMPLEXES II** **15 Hrs**

Transition metal π – complexes with unsaturated organic molecules – alkenes, alkynes, diene, dienyl and Cyclopentadienyl complexes and arene complexes-general methods of preparation, properties, nature of bonding and structural features – Important reactions relating to Nucleophilic and Electrophilic attack on ligands and to organic synthesis.

**UNIT – II: ELECTRONIC SPECTRA OF COMPLEXES** **15 Hrs**

Russel-Saunders coupling – Spectroscopic term symbols- Derivation of term symbols of $p^2$ and $d^2$ configuration, Hole Formulation, Energy ordering of terms (Hund's Rules), Splitting of energy levels and spectroscopic states in Octahedral field, Selection rules – Break – down of selection rules, Orgel diagrams, Definition and utility–Orgel Diagrams for $d^1$ to $d^9$ configurations in Octahedral and tetrahedral fields. Interpretation of electronic spectra of high spin octahedral and tetra hedral complexes of Ti(III), V(III), Cr(III), Mn(III), Mn(II), Fe(II), Fe(III), Co(III), Co(II), Ni(II) and Cu(II) complexes, Calculation of Dq and $B^1$ parameters for Cr(III) and Ni(II) complexes. Tanabe – Sugano diagrams, Differences between Orgel diagrams and Tanabe – Sugano diagrams, Tanabe – Sugano diagrams of $d^2$ to $d^6$ and $d^8$ configurations. Charge transfer spectra- LMCT and MLCT.

**UNIT – III: MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES** **15 Hrs**

Diamagnetism and paramagnetism-orbital and spin contributions, spin-orbit coupling, Hunds third rule and Energies of J levels – Curie law and Curie – Weiss law- Ferromagnetism and antiferromagnetism – Temperature independent magnetism Magnetic susceptibility and its determination by Gouy's and Faraday methods.Calculation of magnetic moment from magnetic susceptibility, spin-only formula, Orbital contribution to magnetic moment (Oh and Td Complexes) –Paramagnetism and crystalline fields – Ti (III), V (III), $VO^{2+}$, Cr (III), Mn (II), Fe (III), Co(II), Ni (II) and Cu (II). Magnetic Exchange in copper acetate and other dimmers – spin cross over in complexes.

**UNIT –IV: CATALYSIS** **15 Hrs**

Homogeneous catalysis, Metal ion catalyzed reactions – Redox potentials and processes – Mechanism of redox processes involving ligands – Factors affecting redox potentials - other types of metal catalyzed reactions – Reactions involving Ag (I) , Cu (II) and Os (VIII) – Reactions of Oxyanions – Factors affecting rate (General discussion only) – Induced reactions – Free radical reactions – Thermal decomposition of peroxy disulphate – Fe(III) $–S_2O_8$ reactions – chain reactions – H-Br reactions, $H_2O_2$ – $S_2O_8$reactions.

**Books Suggested**


1. Inorganic Chemistry principles of Structure and Reactivity 6th Edition. James E. Huheey.
2. Organometallic Chemistry: R.C. Mehrotra and Singh.
3. R. S. Drago: Structural methods in Inorganic Chemistry.
4. H. H. Willard, L. L. Merritt, Jr., J. A. Dean and F. A. Settle, Jr.: Instrumental Methods of Analysis (CBS Publishers).
5. R. L. Carlin: Magnetic Chemistry. R. L. Datta and A. Syamal: Elements of Magnetic Chemistry.

| CHE-202 | Organic Chemistry II | L-3, T-1, P-2 | 4 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Organic Chemistry

**Course Objectives:**

- Able to recognize, classify, explain, and apply fundamental organic reactions such as $E_2$, $E_1$, $E_{1CB}$.
- Familiar with molecular rearrangements involving electron deficient carbon, nitrogen and oxygen atoms and electron rich carbon atom.
- Provide Hantzsch-Widmann nomenclature for the three and four membered heterocycles. Be able to predict synthetic routes and chemical reactions of these heterocycles.
- Be familiar with occurrence, isolation, structural elucidation and synthesis of natural products- alkaloids

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To familiarize the mechanisms of $E_1$, $E_2$ and $E_{1CB}$ reactions, steroselectivity and synpyrolytic eliminations and use of isotopes, chemical trapping and crossover experiments. |
| **CO2** | To learn the rearrangements involving electron deficient carbon, nitrogen and oxygen atoms and electron rich carbon atom and familiarize with the limitations and applications of reactions. |
| **CO3** | To learn the synthesis of three and four membered heterocycles, mechanism of ring opening reactions and the effect of electron donating and withdrawing substituents in selectivity of ring opening reactions. |
| **CO4** | To understand the structural elucidation and synthesis of alkaloids using specific reagents. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 3 | - | 2 | 1 | 1 | 2 | - | 1 |
| **CO2** | 3 | 3 | 2 | 2 | 3 | 2 | 2 | - | 1 | - | 1 | 1 |
| **CO3** | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | |
| **CO4** | 3 | 3 | 2 | 2 | 3 | - | 2 | - | 1 | 1 | - | 1 |

## CHE- 202 : ORGANIC CHEMISTRY II

**UNIT-I: Reaction mechanism-I** **15 Hrs**

Electrophilic addition to carbon carbon double bond: Stereoselective addition to carbon carbon double bond; anti addition-Bromination and epoxidation followed by ring opening. Syn addition of $OsO_4$ and $KMnO_4$.

Elimination reactions Elimination reactions $E_2$, $E_1$, $E_{1CB}$ mechanisms. Orientation and stereoselectivity in $E_2$ eliminations. Pyrolytic syn elimination and α-elimination, elimination Vs substitution. Facors influencing the elimination reactions

Determination of reaction mechanism: Determination of reaction mechanism: Energy profiles of addition and elimination reactions, transition states, product isolation and structure of intermediates, use of isotopes, chemical trapping, crossover experiments. Use of IR and NMR in the investigation of reaction mechanism.

**UNIT-II: Molecular Rearrangements**: **15 Hrs**

Rearrangements to electron deficient Carbon atom:

Pinacol-Pinacolone, Wagner-Meerwein, Dienone-Phenol and Demjonove Rearrngements

Rearrangements to electron deficient Nitrogen atom:

Hofmann, Curtius, Schimidt and Beckmann Rearrangements.

Rearrangements to electron deficient Oxygen atom: Baeyer-Villiger and Dakins Rearrangements

Rearrangements to electron rich Carbon atom: Favorski and Neber Rearrangements

Aromatic and Sigmatropic Rearrangements: Fries and Claisen Rearrangements

**UNIT III: Three and four membered heterocycles:** **15 Hrs**

Systematic nomenclature (Hantzsch-Widmann system) and Replacement nomenclature for monocyclic heterocycles (Three and four membered rings). Synthesis and chemical reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes, and thietanes.

**UNIT-IV: Alkaloids** **15 Hrs**

Occurrence, isolation, general methods of structure elucidation and physiological action, degradation, classification based on nitrogen heterocyclic ring, structure elucidation and synthesis of the following: Atropine, Papaverine and Quinine.

**Books Suggested:**


1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J Sundberg, Plenum.
3. Structure and Mechanism in Organic Chemistry C.K. Inglod, Cornell University Press.
4. Organic Chemistry, R.T Morrison and R.N. Boyd, Prentice - Hall.
5. Modern Organic Reactions, H.O. House, Benjamin.
6. Principles of Organic Synthesis, R.O.C Norman and J. M. Coxon, Blackie Academic.
7. Stereochemistry, P.S. Kalsi, Wiley Eastern.
8. Text book of Organic Chemistry, M.C. Murry
9. Text book of Organic Chemistry, Fessendon and Fessendon.
10. Text book of Organic Chemistry, T.W. Solomon,
11. Organic Chemistry, Vol II, I.L. Finar, ELBS Eds.
12. Heterocyclic chemistry T.L Gilchrist, Longman Scientific Technical
13. An Introduction to the Heterocyclic compounds, R M Acheson, John Wiley.

| CHE -203 | Physical chemistry II | L-5,T-1,P-6 | 4 Credits |
|---|---|---|---|

**Pre-requisite:** Basic knowledge about Physical Chemistry

**Course Objectives:**

- Learn Angular momentum and Molecular Orbital Theory and application of Huckel theory to organic molecules.
- Know about concepts in Surface Chemistry, concept of electric double layer model and Micelles.
- Get knowledge on symmetry and group theory their use in spectroscopy, Mulliken character tables.
- Understand Irreversible Electrode phenomenon controlled potential electrolysis and polarography.

**Course Outcomes** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To know about Pauli Exclusion principle and Slater determinant, atomic orbitals, Simple molecular orbitals and Huckel theory of conjugated systems. |
| **CO2** | To learn Gibbs adsorption isotherm, BET equation and correlate limitations, critical micellar concentration (CMC) and factors affecting the CMC of surfactants. |
| **CO3** | To identify Relation between order of a finite group and its sub-group, conjugacy, Symmetry point group (MLS, MHS and MSS) and orthogonality theorem. |
| **CO4** | To acquire knowledge on DC-Polarography, AC-Polarography, Controlled Potential Electrolysis, to derive equation for Tafel plots, half-wave potentials for reversible system. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | 3 | - | 2 | 1 | 1 | - | 1 | 1 | 1 |
| **CO2** | 3 | 2 | 2 | 3 | 2 | 2 | 2 | - | 2 | - | 2 | - |
| **CO3** | 3 | 2 | 2 | 3 | - | - | 1 | 1 | - | 1 | 1 | 1 |
| **CO4** | 3 | 2 | - | 2 | 2 | 1 | 1 | - | 2 | 1 | 1 | 1 |

**CHE-AC-203 Physical Chemistry III**

**UNIT-I: Quantum Chemistry-II** **15 Hrs**

(A) Angular momentum: Angular momentum, Rotations and angular momentum, Eigen functions and Eigen values of angular momentum, Ladder operator, addition of angular momenta, spin, antisymmetry and pauli Exclusion principle. Slater determinant. ;

(B) Molecular Orbital TheoryAtomic Orbitals, Simple Molecular Orbitals, Hybrid Atomic Orbitals, Shapes and energies of Molecular Orbital, Systems of Organic Molecules (Ex: Methane, Ethylene, Acetylene). Huckel theory of conjugated systems, Π-bond order and charge density calculations, application of Huckel theory to ethylene, butadiene and benzene.

**UNIT-II: Surface Chemistry** **15 Hrs**

Surface tension, capillary action, pressure difference across curved surface, (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, BET adsorption isotherm, derivation of BET equation , limitations of BET equation, estimation of surface area from BET equation, Surface films on liquids. Concept of electric double layer model-Helmholtz perrin, Gouy- Chapman and stern models (no derivation)

**Micells:** Surface active agents, classification of surface active agents micellisation, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, thermodynamics of micellisation, emulsions, reverse micelles.

**UNIT-III: SYMMETRY AND GROUP THEORY** **15 Hrs**

Definition of a group, rules that are set for a group, sub-group, order of a group, Relation between order of a finite group and its sub-group, conjugacy relation and class of a group, symmetry elements and symmetry operation. Symmetry point group (MLS, MHS and MSS), Schoenflies symbols - Representation of groups by matrices (representation for $C_n$, $C_{nv}$, $D_{nh}$ etc. groups to be worked out explicitly), character of a representation, group multiplication tables, reducible - irreducible representations The great orthogonality theorem (without proof) - character tables ($H_2O$,$NH_3$) and their use in spectroscopy, Mulliken character tables.

**UNIT-IV: ELECTROCHEMISTRY- II** **15 Hrs**

**Irreversible Electrode phenomenon:** Reversibility and irreversibility, Dissolution and deposition potentials, Decomposition voltage, overvoltage, diffusion overvoltage, charge transfer overvoltage, concentration overvoltage-hydrogen and oxygen overvoltages, Tafel plots, Exchange current density and Transfer coefficient, Butler-Volmer equation for one electron transfer processes.

**Polarography:**Theory, classification , principle , Instrumentation of Polarography, DME, HMDE diffusion current, Ilkovic equation, DC-Polarography, AC-Polarography, Controlled Potential Electrolysis, Millicoulometry, Equation for half-wave potentials, for reversible system when oxidant alone, reductant alone and both are present.

**Books Suggested**


1. P.W. Atkins: Physical Chemistry (ELBS).
2. Ira N. Levine: Quantum Chemistry (Prentice Hall).
3. R. Mcweeny: Coulson's Valence (ELBS).
4. J.O.M. Bockris and A.K.N. Reddy, Modern Electrochemistry, vol.I & II (Plenum).
5. S. Glasstone; An Introduction to Electrochemistry (3rd ed.)(Affiliated East-West).
6. V. Moroi: Micelles, theoretical and applied aspects (Plenum).
7. Maron and prutton: principles of physical Chemistry.
8. Silbey, Alberty, Bawendi. Physical Chemistry.Jhon-Wiley & Sons. 4th edition-2006.
9. D.N. Bajpai: Advanced physical Chemistry: S. Chand & Company, 1998.

| CHE 204 | Core practical I: Inorganic Chemistry | L-5,T-1,P-0 | 2 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level Inorganic Chemistry practical.

**SEMI MICRO QUALITATIVE ANALYSIS**

- Separation and determination of the two component mixtures.
- Preparation of metal complexes

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | CO 1: To separate and determine the two component mixtures. |
| **CO2** | CO 2: To acquire knowledge in the preparation of metal complexes |
| **CO3** | |
| **CO4** | |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 2 | 1 | - | 2 | - | 3 | 3 | 1 |
| **CO2** | 3 | 2 | 2 | 3 | - | 1 | 2 | - | 2 | 3 | 3 | 1 |
| **CO3** | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | |

## CHE 204: Core practical I: Inorganic Chemistry

**I . Quantitative Analysis:**

Separation and determination of two component mixtures:

(i) Separation of Al(III) and Determination of Fe (III)
(ii) Separation of Cu(II) and Determination of Zn (II)
(iii) Separation of Ca(II) and Determination of Mg (II)
(iv) Separation of Cu(II) and Determination of Ni (II)
(v) Determination of Ferrocyanide and Ferricyanide

**II. Preparation of Metal Complexes:**

(i) Tetra(ammine) copper (II) sulphate.
(ii) Mercury tetra( thiocyanato) cobaltate(II).
(iii) Hexa(ammine) Nickel (II) chloride.
(iv) Tris(acetylacetonato) Manganese (III) chloride.
(v) Tris (ethylenediammine) Nickel (II) thiosulpha

| CHE 106 | Core practical II: Organic CheImistry | L-5,T-1,P-0 | 2 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level Organic Chemistry practical.

**Course Objectives:**

- Familiarize with two component mixture separation and identification.
- preparation of derivatives and purification by different methods

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To familiarize with binary mixture separation and to gain hands-on-experience in purification of the |
| **CO2** | To get knowledge about the chemical behavior of different components and mechanisms. |
| **CO3** | |
| **CO4** | |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 2 | - | 1 | 2 | - | 1 | 1 | 1 |
| **CO2** | 3 | 2 | 2 | 3 | - | 2 | - | 1 | 2 | 1 | - | 2 |
| **CO3** | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | |

## CHE : 205 : PRACTICAL – II : ORGANIC CHEMISTRY

Separation and Identification of two component organic mixture by systematic qualitative analysis.

Binary mixture of

Acid + Neutral
Phenol + Neutral
Base + Neutral
Acid + Ether insoluble component
Phenol + Ether insoluble component
Base + Ether insoluble component

| CHE 206 | Core practical II: Physical CheImistry | L-5,T-1,P-0 | 2 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level Physical Chemistry practical.

**Course Objectives:**

- Familiarize with conductometric, potentiometric and redox methods of analysis
- Colorometric and pHmetric methods of analysis

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To study the determination of cell constant and verification of Onsagar equation, strength of strong |
| **CO2** | To get knowledge on the applications of conductometry, potentiometry, coulometry and pH metry. |
| **CO3** | |
| **CO4** | |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | **2** | **2** | **3** | **3** | **1** | **1** | **2** | **-** | **1** | **1** | **1** |
| **CO2** | **3** | **2** | **2** | **3** | **2** | **1** | **1** | **-** | **2** | **1** | **-** | **2** |
| **CO3** | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | |

**CHE : 106 : PRACTICAL – III : Physical Chemistry**

Syllabus

1. Conductometry:
   - (a) Getermination of cell constant
   - (b) Verification of Onsagar equation
   - (c) Determination of dissociation constant of a weak acid
   - (d) Titration of a strong acid with a strong base
   - (e) Titration of a weak acid with a strong base
2. Potentiometry:
   - (a) Titration of a strong acid with a strong base
   - (b) Titration of a weak acid with a strong base
   - (c) Redox titration
3. Coulometry: Estimation of Manganese
4. pH metry: Strong acid, Strong base titrations.

| CHE-207 | General Chemistry II | L-5,T-1,P-0 | 2 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level Chemistry

**Course Objectives:**

- Gain knowledge on the principles of different electro analytical methods.
- Familiarize with chromatographic techniques.

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To acquire knowledge on ion selective electrodes, solid membrane electrodes and glass electrodes and |
| **CO2** | To learn general principles and classifications of chromatographic separations and applications of TLC, GLC |
| **CO3** | |
| **CO4** | |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 1 | 2 | - | 2 | 2 | - | 1 | 1 |
| **CO2** | 3 | - | 2 | 3 | 1 | 2 | 1 | 2 | - | 2 | 1 | 1 |
| **CO3** | | | | | | | | | | | | |
| **CO4** | | | | | | | | | | | | |

## CHE 204-A: General Chemistry II

**UNIT-I: ELECTRO ANALYTICAL METHODS**

Theory of potentiometry, calculation electrode potential at the equivalence. Finding of equivalence volume, derivative and linear titration plots. Ion-sensitive electrodes –types of ion sensitive electrodes –metal based cation and anion sensitive electrodes, solid membrane electrodes, glass electrodes. Liquid ion-exchange electrodes, gas sensing membrane electrodes, Amperometric titrations - Anodic stripping voltammetry, chronoamperometry, chronopotentiometry, Cyclic Voltammetry, Differential Pulse Polarography, linear sweep voltammetry, square wave voltammetry.

**UNIT-II: CHROMATOGRAPHY**

General principles and classifications of chromatographic separations

**Thin layer chromatography:** Classification, principle, experimental technique, sample application, development of plate, retardation factor.

**Gas liquid chromatography:** Gas liquid chromatography - instrumentation (columns and detectors), retention time and retention volume. Chromatographic behaviour of solutes, column efficiency and resolution, column processes and band broadening, time of analysis and resolution, Van-Deemter equation.

**High performance liquid chromatography:** Theory and instrumentation-column performance, gradient elution, delivery system, sample introduction, separation columns, detectors and applications of HPLC.

**Books Suggested**


1. H.W. Willard, LL. Merrit and J.A.Dean: Instrumental Methods of Analysis. Affiliated East-West).
2. G.H. Jeffery J. Bassett, J. Mendham and R.C. Denny. Vogel"s Text Book of Quantitative Chemical Analysis (ELBS).
3. D.A. Skoog and D.M. West: Principles of Instrumental Analysis (Holt, Rinehart and Wilson).
4. J.G. Dick : Analytical Chemistry (McGraw Hill).
5. D. Midgley and K. Torrance : potentiometric Water Analysis (John Wiley).

| CHE 208 | Human Values and professional ethics-II | L-3,T-1,P-2 | 4 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Human Values and professional ethics

**Course Objectives:**

- Gain knowledge on value education, family values and adjustability
- Develop ethics towards medical, health care professionals and ethical issues in genetic engineering
- Understand the importance of social ethics towards organ trade, human traffic king human rights violation and social disparities.
- Know about environmental ethics, ecological crises, pollution and protection of environment

**Course Outcomes:** At the end of the course, the student will be able to

| | |
|---|---|
| **CO1** | To understand the concepts of human values, responsibilities of family values and status of women in family and society. |
| **CO2** | To acquire knowledge on different medical ethics the views of charaka and sushruta on moral responsibilities of medical practitioners. |
| **CO3** | To gain knowledge on social ethics and understand the characteristics of ethical problems in management. |
| **CO4** | To familiarize environmental ethics, ethical theory and ecological crisis. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 3 | 1 | 2 | 1 | - | 3 | 1 | 1 | 1 |
| **CO2** | 3 | 1 | 1 | 3 | - | 2 | - | 3 | 3 | 1 | 1 | 1 |
| **CO3** | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | - | 1 |
| **CO4** | 3 | 1 | 1 | 3 | 1 | 2 | - | - | 2 | 3 | 1 | 1 |

**CHE 207: ELECTIVE FOUNDATION (HUMAN VALUES AND PROFESSIONAL ETHICS-II)**

**Chapter I:** Value Education – Definition – Relevance to present day – Concept of human values - Self introspection – Self-esteem. Family values-Components, Structure and responsibilities of family Neutralization of anger – Adjustability – Threats of family life – Status of women in family and society – Caring for needy and elderly – Time allotment for sharing ideas and concerns.

**Chapter II:** Medical ethics – Views of Charaka, Sushruta and Hippocratus on moral responsibility of medical practitioners. Code of ethics for medical and healthcare professionals. Euthanasia, Ethical obligation to animals, Ethical issues in relation to health care professionals and patients. Social justice in health care, human cloning, problem of abortion. Ethical issues in genetic engineering and Ethical issues raised by new biological technology or knowledge.

**Chapter III:** Social ethics – Organ trade, Human trafficking, Human rights violation and social disparities, Feminist ethics, Surrogacy/pregnancy. Ethics of media – Impact of Newspapers, Television, Movies and Internet, Business ethics – Ethical standards of business – Immoral and illegal practices and their solutions. Characteristics of ethical problems in management, ethical theories, causes of unethical behavior, Ethical abuses and work ethics.

**Chapter IV:** Environmental ethics – Ethical theory, man and nature - Ecological crisis, Pest control, Pollution and waste, Climate change, Energy and pollution, Justice and environmental health.

**Books for study:**


1. Johns S Mackenjie: A Manual of ethics
2. "The Ethics of Management" by Larue Tone Hosmer, Richard D. Irwin Inc.
3. Management Ethics – Integrity at work by Joseph A. Petrick and John F. Quinn, Response Books, New Delhi.
4. "Ethics in Management" by S.A. Shelekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today
6. Maitra, S.K: Hindu Ethics
7. William Lilly: Introduction to Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manava Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed) G.C. Haughton.
10. Sasruta Samhita: Tr. KavirajKunjanlal, KunjanlalBrishagratha, Chowkamba Sanskrit Series, Vol I,II and III, Varanasi, Vol I PP, 16-20, 21-32 and 74-77 only.

11. Charaka Samhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series Office. Varanasi I, II, III Vol I PP 183-191.
12. Ethics, Theory and Contemporary Issues. Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.
13. Text Book for Intermediate First Year Ethics and Human Values, Board of Intermediate Eduction – Telugu Academy, Hyderabad.
14. I.C. Sharma Ethical Philosophy of India. Nagin& Co Julundhar.

| CHE-PC-301 | Physical Chemistry III | L-5,T-1,P-0 | 4 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of graduate level Physical Chemistry

**Course Objectives:**

- Learn applications of Group Theory, symmetry criteria and symmetry restrictions.
- Applications of X-ray Diffraction and Electron Diffraction on solid state chemistry.
- Familiarize with the applications of Microwave spectroscopy, infrared spectroscopy and Raman spectroscopy.
- Get knowledge on concept of Thermodynamics of polymer dissolution and Flory-Huggins theory of polymer solutions.

**Course Outcomes:** At the end of the course, the student will be able to

| | |
|---|---|
| **CO1** | To know the determination of Character Co-ordinate of $C_2V$ point group based on 3N Coordinates and to learn the Mutual exclusion Principle. |
| **CO2** | To learn the Bragg conditions-Miller Indices- Laue method, Bragg method, Debye Scherrer method of X-ray structural analysis of crystals. |
| **CO3** | To study the rigid rotator model, stark effect, vibration-rotation spectroscopy, PQR branches, selection rules and Vibrational- rotational Raman spectroscopy. |
| **CO4** | To study the concepts on heat of dissolution, regular solution theory, Hildebrand solubility parameter, concept of Flory-Huggins theory of polymer solutions |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | - | 2 | 2 | 1 | 1 | - | 2 | 2 |
| **CO2** | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | - | 1 |
| **CO3** | 3 | 2 | 2 | 3 | 2 | 2 | - | 2 | - | 1 | 2 | 2 |
| **CO4** | 3 | 2 | 2 | 3 | - | 2 | 2 | - | 2 | 2 | - | 2 |

## CHE-PC-301 CORE-THEORY PHYSICAL CHEMISTRY III

**UNIT-I Applications of Group Theory** **15 Hrs**

Construction of reducible and irreducible representations, Determination of Character Co-ordinate of $C_2V$ point group based on 3N Coordinates. Standard reduction formula, Determination of normal modes of vibrations of $SO_2$, $NH_3$, $POCl_3$, $PtCl_4^{2-}$ $H_2O_2$ molecules. Mutual exclusion Principle, Direct Product, Accidental Degeneracy and Fermi resonance Group Theory and Spectroscopy: IR Spectral activity of $NH_3$ molecule, selection rules, symmetry Criteria for optical activity, symmetry restrictions on dipole moments, symmetry and stereo isomerism. Prediction of IR and Raman Spectral activity of $H_2O$ and $CO_2$.

**UNIT-II: X-ray Diffraction:** **15 Hrs**

**(A) Solid State Chemistry** Dislocation of Solids, Schottky and Frenkeldefects, insulaters, a,d semiconductors, Band theory of solids,solid state reactions.

**(B)** Bragg conditions-Miller Indices- Laue method, Bragg method, Debye Scherrer method of X-ray structural analysis of crystals. Index reflections, identification of unit cells from systematic absences in diffraction pattern- structure of simple lattices and X-ray intensities- structure factor and its relation to intensity and electron density- Description of procedure for X-ray structure analysis (NaCl and KCl).

**(C) Electron Diffraction:** Scattering intensity Vs scattering angle, Wierlequation, and its importance. Measurement techniques, Elucidation of structures of simple gas phase molecules, Low energy electron diffraction (LEED) for the study of surfaces.

**UNIT-III: SPECTROSCOPHY** **15 Hrs**

**Microwave spectroscopy:** classification of molecules, rigid rotator model, effect of isotopic substitution on the transition frequencies, intensities- stark effect.

**Infrared spectroscopy:** Linear harmonic oscillator, zero point energy, anharmonity, Mores potential energy diagram, fundamental and overtone transitions, hot bands and combinations bands. Vibration-rotation spectroscopy, PQR branches, selection rules, factors affecting the band positions and intensities for IR region. **Raman spectroscopy:** Classical and quantum theories of Raman effect, pure rotational, pure vibrational Raman spectroscopy, selection rules, mutual exclusion principle, resonance Raman spectroscopy and coherent antistokes Raman spectroscopy. Vibrational- rotational Raman spectroscopy.

**UNIT-IV: POLYMER SOLUTIONS** **15 Hrs**

Thermodynamics of polymer dissolution, effect of molecular weight on solubility, solubility of crystalline and amorphous polymer, heat of dissolution, regular solution theory, Hildebrand solubility parameter, Flory-Huggins theory of polymer solutions, conformational entropy, osmotic pressure and viscosity of polymer solutions. Molecular weight determination by light scattering, ultra-centrifugation and sedimentation equilibrium method. Liquid Crystals- synthesis and applications

**Books Suggested**


1. F.A. Cotton : Introduction to Group theory for chemists.
2. Geroge Davidson Elsevier : Introductory Group Theory for Chemists.
3. Gurdeep Raj , Ajay Bhagi&Vinod Jain : Group Theory and Symmetry in Chemistry
4. Instrumental methods of analysis – M.H. Willard, Meritt Jr. and J.A. Dean
5. Principles of instrumental analysis – Skoog and West
6. F. W. Billmeyer, Jr.: Text Book of Polymer Science. Wiley Interscience.
7. V. R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar.: polymer Science. New Age international Publishers.

| CHE-PC 302 | Organic Spectroscopy and Applications | L-5,T-1,P-0 | 4Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Organic Spectroscopy and Applications

**Course Objectives:**

- Familiarize with the instrumentation of UV and visible spectroscopy, applications of identifying the structures of the molecules.
- Understand IR spectrometry and applications to ascertain the fundamental groups by observing absorption bands
- Study on the applications of NMR spectroscopy in ascertaining the stereochemical structures of the molecules.
- Understand the working principle and fragmentation rules of different molecules in Mass spectroscopy

**Course Outcomes:** At the end of the course, the student will be able to

| | |
|---|---|
| **CO1** | To get experience to calculate λ max values for dienes, enones, polyenes, aromatic and heteroaromatic compounds. |
| **CO2** | To familiarize with the absorption bands of the molecules with specific functional groups |
| **CO3** | To interpret the data to different types of protons and carbons present in a molecule so as to ascertain the structure of the molecule based on the data provided |
| **CO4** | To acquire knowledge about specific fragmentation rules of different molecules which are unique. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 2 | 2 | 2 | - | - | 2 | 2 | - |
| **CO2** | 3 | 2 | 2 | 3 | 2 | 2 | - | 2 | 2 | 2 | 2 | 2 |
| **CO3** | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | - | 2 | 2 | 2 |
| **CO4** | 3 | 2 | 2 | 3 | 2 | 2 | - | 2 | - | 2 | 2 | 2 |

**CHE-PC 302: CORE THEORY: ORGANIC SPECTROSCOPY AND APPLICATIONS**

**UNIT-I: ULTRAVIOLET AND VISIBLE SPECTROSCOPY: 15Hrs**

Various electronic transitions (185-800 nm), effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fisher-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

**UNIT – II: INFRARED SPECTROSCOPY 15Hrs**

Instrumentation and sample handling. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ether, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance, FT-IR

**UNIT –III: NMR SPECTROSCOPY: 15Hrs**

**$^1$H NMR spectroscopy:** Magnetic properties of nuclei, Principles of NMR. Instrumentation, CW and pulsed FT instrumentation, equivalent and nonequivalent protons, enantiotopic and diastereotopic protons, Chemical shifts, factors affecting the chemical shifts, electronegativity and anisotropy, shielding and deshielding effects, Signal integration, Spin-spin coupling: vicinal, germinal and long range, Coupling constants and factors affecting coupling constants.

Applications of $^{1}H$ NMR spectroscopy: Reaction mechanisms (cyclic bromonium ion, electrophilic and nucleophilic substitutions, carbocations and carbanions), E, Z isomers, conformation of cyclohexane and decalins, keto-enol tautomerism, hydrogen bonding, proton exchange processes (alcohols, amines and carboxylic acids), C-N rotation. Stereochemistry, hindered rotation, Karplus curve variation of coupling constant with dihedral angle. Simplification of complex spectra, nuclear magnetic double resonance, contact shift reagents, nuclear Overhauser effect (NOE).

**$^{13}C$ NMR spectroscopy:** General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimensional NMR spectroscopy-COSY.

**UNIT-IV: MASS SPECTROMETRY 15Hrs**

Introduction, ion production, type of ionization, EI, CI, FD, and FAB-factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular-ion peak, metastable peak, Mc. Lafferty rearrangement. Nitrogen rule, isotope labeling. High resolution mass spectrometry, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

**Books suggested:**


1. Organic spectroscopy, W. Kemp 5th Ed, ELBS
2. Spectroscopy of organic compounds, RM Silversteen and others, 5th Ed, John Wiley
3. Spectroscopy of organic compounds, P.S. Kalsi, Wiley, 1993.
4. NMR in chemistry-A multi nuclear introduction, William Kemp, Mc Millan, 1986.
5. Spectroscopic methods in Organic chemistry, DH Williams & I Flemmi

| CHE PC 303 & 304 | Core practical I: Physical Chemistry-practicals I & II | L-5,T-1,P-0 | 4 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Inorganic Chemistry - Practical.

**Course Objectives:**

- Study on chemical kinetics of different reactions
- Flame photometry to determine different cations
- Familiarize with conductometric titrations of mixtures
- Colorometric estimation of different molecules.

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To study chemical kinetics of homogeneous solutions |
| **CO2** | To gain knowledge on the determination of different cations by flame photometry |
| **CO3** | To understand the principle and working aspects of conductometric titrations |
| **CO4** | To acquire knowledge on the implementation of colorometric estimations. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 2 | - | 2 | - | 1 | 2 | - | 2 |
| **CO2** | 3 | 2 | 2 | 3 | 3 | 2 | - | 2 | - | 2 | 2 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | - | 2 | 1 | - | 2 | - | 2 | 2 |
| **CO4** | 3 | 2 | 2 | 3 | 3 | 2 | 1 | 2 | - | 2 | 2 | 2 |

## CHE-PC-303: Core-Practical PRACTICAL-I

**1. Chemical Kinetics:**

a) Study of the kinetics of halogenations of acetone.
b) Determination of activation energy of reaction between iodide and Persulphate
c) Determination rate constant of oxidation of iodide ion by persulphate ion and study the effect of neutral salt (KCl) on this reaction.

**2. Flame Photometry:**

a) Determination of Na
b) Determination of K
c) Determination of Cu

## CHE- PC-304: Core-Practical PRACTICAL-II

**1.** Conductometry:

a) Titration of mixture of halides
b) Titration of mixture of HCl+HOAC
c) Saponification of an ester

**2.** Colorimetry:

a) Estimation of Manganese
b) Estimation of Iron
c) Estimation of Phosphate
d) Titration of copper Vs EDTA

| CHE PC 305 A | Organic Chemistry III | L-3,T-1,P-2 | 4Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Organic Chemistry

**Course Objectives: Course Objectives**:

- Familiarize with the applications of different reagents in organic synthesis, Mechanisms and stereochemistry.
- Study the methods of preparation and applications of organometallic reagents.
- Understand topocity, prochirality, auxillary and reagent-controlled methods in asymmetric synthesis.
- Applications of different oxidizing and reducing agents in organic synthesis with region and stereo controlled products.

**Course Outcomes:** At the end of the course, the student will be able to

| | |
|---|---|
| **CO1** | To familiarize with the specific functions of the reagents particularly diazomethane, N-bromosuccinimide, Ziegler Natta catalyst, 1,3-dithianes and Merrifield resin in the synthesis of a variety of complex molecules. |
| **CO2** | To gain knowledge in the synthesis of different organometallic reagents and also stereo and regio specificity and selectivity of reactions with organometallic reagents |
| **CO3** | To understand diastereoselectivity, stereoselectivity and substrate controlled auxillary controlled reactions |
| **CO4** | To acquire knowledge about the reagents which causes oxidation in various compounds and also the reagents that causes selective and complete reductions to synthesize various compounds. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | - | 2 | 2 | 2 |
| **CO2** | 3 | 2 | 2 | 3 | 2 | 2 | - | 2 | 2 | 2 | 2 | 2 |
| **CO3** | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | - | 2 | - |
| **CO4** | 3 | 2 | 2 | 3 | 2 | 2 | - | 2 | - | 2 | 2 | 1 |

## CHE-PC-305A Core-Theory Organic Chemistry III

**UNIT I: REAGENTS IN ORGANIC SYNTHESIS** **15 Hrs**

Use of the following reagents in organic synthesis: Anhydrous $AlCl_3$, Boran trifluoride, N-Bromosuccinimide, Diazomethane, Dicyclohexylcarbodiimide, Lead tetraacetate, Zieglar-Natta catalysts, DDQ, Dithianes, Merrifield resin.

**UNIT-II: ORGANOMETALLIC REAGENTS** **15 Hrs**

Synthesis and applications of Grignard reagents, Organolithium, Zinc, Copper, Mercury, Palladium and Rhodium compounds in Organic Synthesis, Homogeneous catalytic hydrogenation and hydroformylation reactions

**UNIT III: ASYMMETRIC SYNTHESIS** **15 Hrs**

**Topocity - Prochirality**- Substrate selectivity - Diastereoselectivity and enantioselectivity-Substrate controlled methods-use of chiral substrates - examples

**Auxiliary controlled methods**-Use of chiral auxiliaries-Chiral enolates-alkylation of chiral imines – Stereoselective Diels-Alder reaction

**Reagent controlled methods**-Use of chiral reagents-Asymmetric oxidation-Sharpless epoxidation-Asymmetric reduction-Use of lithium aluminium hydride and borate reagents.

**UNIT IV: METHODS OF ORGANIC SYNTHESIS** **15 Hrs**

**i).** ***Oxidations:*** **(a)** Alcohols to carbonyls-Chromium (iv) oxidants-Dimethylsulfoxide oxidation, periodate xidation, Oppenauer oxidation, oxidation with manganese dioxide, oxidation with silver carbonate **(b)** Alkenes to epoxides-peroxide induced epoxidations. **(c)** Alkenes to diols-oxidation with potassium permanaganate, osmium tetraoxide, Prevost reaction **(d)** Ketones to esters-Bayer-Villiger oxidation **(e)** Oxidative bond cleavage-cleavage of alkenes by transition metals. **(f)** Oxidation of alkyl or alkenyl fragments-selenium dioxide and chromium trioxide oxidations.

**ii).** ***Reductions*** **:** Reduction with lithium aluminium hydride, sodium borohydride, alkoxides, bis- methoxy ethoxy aluminium hydride, Boran aluminium hydride and derivatives-catalytic,hydrogenation-dissolving metal reductions, Non-Metallic reducing agents including enzymatic and microbial reductions.

**Suggested Books**


1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. Structure and Mechanism in Organic Chemistry, C.K. Inglod, Cornell University Press.
4. Organic Chemistry, R.T Morrison and R.N. Boyd, Prentice - Hall.
5. Name reactions and reagents in organic synthesis, B.P. Muway and M.G Ellord, John Wiley.
6. Principles of Organic Synthesis, R.O.C Norman and J.M Coxon, Blackie Academic & Professional.
7. Reaction Mechanism in Organic Chemistry, P.S. Kalsi, New Age International.
8. Principles of organometallic chemistry, P. Powell, ELBS.
9. Organo transition metal chemistry-Applications to organic synthesis, S.G. Davis, Pergmon.
10. Stereochemistry to Organic Compounds, D. Nasipuri, New Age International.
11. Stereochemistry, P.S. Kalsi, Wiley Eastern.

| CHE-PC- 305 B | Inorganic Spectroscopy and Thermal Methods of Analysis | L-5,T-1,P-0 | 4Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Basic Inorganic Spectroscopy and Thermal Methods of Analysis

**Course Objectives:**

- Gain knowledge on thermal methods of analysis and principles and applications to inorganic materials
- Familiarize with basics of Mossbauer and NQR spectroscopy.
- Learn the properties like g-factor, nuclear spin, hyperfine coupling constants
- Study the ESR instrumentation, various applications and photoelectron spectroscopy.

**Course Outcomes :**At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To know about TG and DTA and applications of different scanning calorimetry. |
| **CO2** | To gain knowledge on Doppler shift and chemical shift, basic principles and applications of NQR spectroscopy. |
| **CO3** | To learn zero field splitting and Kramer's degeneracy, relaxation processes, instrumentation and applications of ESR. |
| **CO4** | To know about photoelectric effect and Koopmans theorem and impart the applications of X-ray and UV photoelectron. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | - | 2 | 1 | 1 | - | 1 | 2 | 1 |
| **CO2** | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | - |
| **CO3** | 3 | 2 | 2 | 3 | 2 | 2 | - | 2 | 1 | 2 | - | 1 |
| **CO4** | 3 | 2 | 2 | 3 | 2 | 1 | 1 | - | 2 | - | 2 | 1 |

## CHE-PC- 304: Inorganic Spectroscopy and Thermal Methods of Analysis

### UNIT –I: THERMAL METHODS OF ANALYSIS 15 Hrs

Thermo gravimetry –Principle, Factors affecting the results, instrumentation. Application with special reference to $CuSO_45H_2O$, $CaC_2O_4\ 2H_2O$. Different thermal analysis – principle, instrumentation, difference between TG and DTA, applications with special reference to the clays and minerals.Different scanning calorimetry –principle, and applications to inorganic materials like chlorates and perchlorates, ammonium nitrate.

### UNIT –II: MOSSBAUER SPECTROSCOPY and NQR 15 Hrs

**Mossbauer spectroscopy:** Basic principles, Recoil energy, Doppler shift, Chemical shift, Quadrapole effects, Magnetic effects. Instrumentation, spectral parameters and spectrum display.

Aapplication of the technique to the studies of (1) bonding and structures of $Fe^{2+}$ and $Fe^{3+}$ compounds, (2) $Sn^{2+}$ and $Sn^{4+}$ compounds.

**NQR spectroscopy:** Basic principles of NQR spectroscopy, quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant and applications.

### UNIT –III: ELECTRON SPIN RESONANCE SPECTROSCOPY 15 Hrs

Basic Principles, Hyper fine splitting, Factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, Hamiltonian and spin densities. Zero field splitting and Kramer's degeneracy, Relaxation process and line widths. Instrumentation and Applications.The EPR spectrum of bis(salicylidimine)-copper(II) complex, study of inorganic free radicals, biological applications of Electron Spin Resonance (Study of free radicals and Iron-sulfur proteins)

### UNIT –IV: PHOTO ELECTRON SPECTROSCOPY 15 Hrs

Photoelectric effect, Koopmans's theorem, ionization energy.

**X-ray photoelectron spectroscopy (ESCA):** Principle, Binding energies, Chemical shift, Applications of XPES to Qualitative analysis , to surface studies and structural analysis. Ultraviolet photoelectron spectroscopy- Principle, application of UPES in studying the molecular orbitals of $O_2$ and $N_2$ molecules. Block diagram of photoelectron spectrophotometer. Sources of radiation, detectors. Auger spectra – Principle, Applications of Auger spectra to surface studies and use of Auger spectra as a finger print tool.

**Books Suggested**


1. F.A. Cotton and G. Wilkinson, Advanced In-organic chemistry VI Edition, 1999. John wiley & sons. Inc., New York.
2. J.E. Huheey, E.A. Keiter and R.L. Keiter: Inorganic Chemsitry, Principles of Structure and Reactivity ($4^{th}$ Ed.) (Addison-Wesley)
3. Gary Wulfsberg: Inorganic Chemistry ($5^{th}$ Ed. (Viva Books)
4. J.D. Lee: Concise Inorganic Chemistry (Blackwell)
5. W.L. Jolly: Modern Inorganic Chemsitry (McGraw-Hill)
6. R.L. Carlin: Magneto-chemsitry (Springer-Verlag)
7. R.L. Dutta and A. Syamal: Elements of Magnetochemsitry (Affiliate East-West).
8. K. Hussain Reddy – Text book of Bioinorganic chemistry

| CHE PC 306 A | Spectral Techniques | L-5,T-1,P-0 | 4 Credits |
|---|---|---|---|

**Pre-requisite**: Understanding of Spectral Techniques

**Course Objectives:**

- Familiarize with the instrumentation of UV and visible spectroscopy, applications of identifying the structures of the molecules.
- Understand IR spectrometry and applications to ascertain the fundamental groups by observing absorption bands.
- Study on the applications of flame atomic absorption spectroscopy.
- Understand the working principle and fragmentation rules of different molecules in Mass spectroscopy.

**Course Outcomes:** At the end of the course, the student will able

| | |
|---|---|
| **CO1** | To know the basic principles of spectroscopy. |
| **CO2** | To familiarize with the analysis of various functional groups by using different spectroscopic techniques. |
| **CO3** | To Understand the applications of AAS. |
| **CO4** | To gain knowledge about Mass spectral fragmentation of organic compounds and common functional groups. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 1 | 3 | - | 2 | 3 | 2 | 1 | - | 1 | 1 |
| **CO2** | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | - | 2 |
| **CO3** | 3 | 2 | - | 2 | 2 | - | 2 | 2 | | 2 | 1 | - |
| **CO4** | 3 | 2 | 2 | 3 | 1 | 2 | 1 | - | 2 | 1 | - | 2 |

**CHE : PC : 306(A): (OPEN ELECTIVE) SPECTRAL TECHNIQUES**

**UNIT – I: ULTRAVIOLET AND VISIBLE SPECTROSCOPY 15 Hrs**

Various electronic transitions (185-800nm.), Beer-Lambert Law, effect of solvent on electronic transitions , ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, Fieser-Woodward rules for conjugated dienes and carbonyl compounds

**UNIT – II : INFRARED SPECTROSCOPY 15 Hrs**

Instrumentation and sample handling, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, amines, ketones, aldehydes, esters, amides, acids and anhydrides. Effect of hydrogen bonding.

**UNIT – III:ATOMIC ABSORPTION SPECTROSCOPY: FLAME AAS: 15 Hrs**

Principle, Instrumentation – Sources of radiation (HCL and EDL), Different types of burners, Interferences- Physical, Chemical, spectral and back ground correction, and methods of minimization

GF AAS: Principle and technique –Comparison between Flame AAS and furnace AAS, Applications of AAS, Comparison between Atomic Absorption & Flame Photometry.

**UNIT –IV: MASS SPECTROMETRY 15 Hrs**

Principle, instrumentation, different methods of ionization, EI, CI, FD and FAB, Mass spectra-molecular ion, base peak, meta-stable peak, nitrogen rule and Mc Lafferty rearrangement. Mass spectral fragmentation of organic compounds and common functional groups. Normal and branched alkanes, alkenes, cycloalkanes, benzene and its derivatives, alcohols and phenols, ethers, aldehydes and ketones, carboxylic acids and their derivatives , amines and nitro compounds. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

**Books Suggested:**

1. Organic spectroscopy, W. Kemp 5th Ed, ELBS .2.

2. Spectroscopy of organic compounds, RM Silversteen and others 5th Ed, John Wiley 1991
3. Spectroscopy of organic compounds, PS Kalsi, Wiley, 1993
4. NMR in chemistry – A Multi nuclear introduction, William Kemp, Mc Millan 1986
5. Spectroscopic methods in Organic Chemistry, DH Williams & I Flemmi TMH . 2005

| CHE PC 306 B | Chromatographic Techniques | L-5,T-1,P-0 | 4Credits |
|---|---|---|---|

**Pre-requisite**: Understanding of graduate level Chromatographic Techniques

**Course Objectives:**

- Familiarize with Classification of Chromatographic methods.
- Understand Demonstration experiment in TLC.
- Study on the applications of High-Performance Liquid Chromatography (HPLC).
- Understand the working principle of gas chromatography.

**Course Outcomes:** At the end of the course, the student will able to

| | |
|---|---|
| **CO1** | To know the stationary and mobile phases in chromatographic techniques. |
| **CO2** | To familiarize applications of different chromatographic methods. |
| **CO3** | To Understand the principle of chromatographic techniques. |
| **CO4** | To gain knowledge on the normal phase and reverse phase. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | 2 | 3 | - | 2 | 3 | 2 | 2 | - | 1 | 1 |
| **CO2** | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | - | 1 | - | 2 |
| **CO3** | 3 | 2 | - | 2 | 2 | - | 2 | - | 2 | - | 1 | - |
| **CO4** | 3 | 2 | 2 | 3 | 1 | 2 | - | 2 | - | 1 | - | 2 |

**CHE PC 306 B : Chromatographic Techniques**

**Unit –I:** Introduction - Classification of Chromatographic methods – Column chromatography-Adsorption phenomenon: Nature of adsorbents-Solvent systems-Differential migration-Separation of mixture of o-/p-nitro anilines (A demonstration experiment).

**Unit –II:** Thin-Layer Chromatography (TLC)-Coating materials and preparation of TLC plates- Solvents for development-Detection of compounds in TLC- $R_f$ values in TLC-Applications of TLC in chemistry-Preparative TLC – Demonstration experiment in TLC.

**Unit –III:** High-Performance Liquid Chromatography (HPLC) - Application of HPLC- HPLC instrument-Stationary phases in HPLC-Normal and reversed phase HPLC: A comparison- Normal phase HPLC: Principle-Retention times in Normal and reversed phase HPLC- Reversed phase HPLC: Principle.

**Unit –IV:** Gas-Liquid Chromatography- Instruments for Gas-Liquid Chromatography- Gas-Chromatographic Columns and the Stationary Phase- Application of Gas-Liquid Chromatography- Gas-Solid Chromatography.

**Reference Books:**


1. Analytical chemistry: G L David Krupadanam, D. Vijaya prsad, K. Varaprasad Rao, KLN Reddy, C. Sudhakar.
2. Analytical chemistry: Skoog West Holler.
3. Modern Analytical Chemistry : David Harvey DePauw University.
4. J.G. Dick. Analytical Chemistry, Mc Grraw Hill, New Delhi, (1973).

| CHE-PC- 401 | Electrochemistry | L-5,T-1,P-0 | 4Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Electrochemistry

**Course Objectives:**

- Study industrial electrochemistry, corrosion and methods of prevention
- Learn about electrochemical batteries and cells and their performance
- Study on electro kinetics and electro capillary phenomena and electrokinetic effect
- Familiarize polarography techniques and chemical passivity

**Course Outcomes :**At the end of the course, the student will be able to

| | |
|---|---|
| **CO1** | Know the techniques of deposition of metals, throwing power simultaneous discharge of cations and methods of corrosion protection |
| **CO2** | Learn about electrochemical Batteries, fuel cells and nickel-cadmium batteries. |
| **CO3** | Understand electrical double layer systems, sedimentation potential, null points of metals and zeta potential. |
| **CO4** | Calculate electrochemical parameters; familiarize mixed ligand systems and reversible systems. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | - | - | 1 | 2 |
| **CO2** | 3 | 3 | 3 | 3 | 2 | - | - | 2 | - | 2 | - | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | - | - | 2 | - | - | - | 2 |
| **CO4** | 3 | 3 | 3 | 3 | - | 2 | - | - | - | - | - | 3 |

**CHE PC-401:** CORE THEORY: **ELECTROCHEMISTRY**

**UNIT-I: Industrial Electrochemistry** **15 Hrs**

Deposition of metals, Factors influencing physical nature of electrodeposited metals – current density, concentration of electrolyte, temperature, colloidal matter, electrolyte and basis metal. Throwing power, simultaneous discharge of cations. Separation of metals by electrolysis. Electrochemical passivity. Passivity and current density. Chemical passivity. Theories of passivity. Mechanical passivity. The corrosion of metals. Hydrogen evolution type of corrosion, corrosion in presence of depolarizer. Differential oxygenation corrosion. Methods of corrosion protection.

**UNIT- II: Electrochemical Devices:** **15 Hr**

Batteries- their performance – characteristics – considerations in the selection and applications, Chemistry of primary batteries – Zinc – Carbon, Mercuric oxide, silver oxide and lithium cells – Solid electrolyte cells.

Chemistry of secondary batteries – Lead acid , Nickel cadmium batteries, Water activated batteries, Fuel cells – Their thermodynamics- performance

**UNIT-III: Electrokinetic's and Electro capillary phenomena:** **15 Hrs**

Electrical double layer, Helmholtz – Perrin, Gouy – Chapman and Stern theories of electrical double layer. Lipmann equation.

**Electrokinetic effect:** Electro osmosis, Electrophoresis, streaming potential , sedimentation potential and their relation to zeta potential. Determination of zeta potential from electrophoresis measurements. Tiselius apparatus. Electro capillary curves, Null points of metals and their experimental determination.

**UNIT-IV**: **Advances in Polarography**: **15 Hrs**

**(A) Polarography of Metal Complexes**

Reversible, Diffusion-controlled systems, Determination of Formulae and Stability, Constants of Complexed Metal Ions, Determination of Stability Constants and Coordination Numbers of metal complexes, Calculation of Individual Complex, Stability Constants, Mixed Ligand Systems- the Method of Schaap and Mcmasters

**(B) Polarography of organic compounds**

Structural Effects, Nature of Electroactive group, Steric Effects, substituent Effects.

**Books suggested:**


1. S. Glasstone. An introduction to Electrochemistry. Affiliated East-West Press Pvt. Ltd.
2. P.T.K. Kissinger, W.R. Heinemann. Laboratory Techniques in Electro analytical Chemistry, Marsal Debber, Inc.
3. Willard, Merit. Instrumental methods of analysis, Welowarth Publiching Co.,
4. L. Antropov. Theoretical Electrochemistry. Mir Publications.
5. Silbey, Alberty, Bawendi. Physical chemistry. Jhon-Wiley & sons. 4th edition-2006.
6. V.S. Bagotsky. Fundamental of Electrochemistry. Jhon Wiley & Sons. 2nd editions-2006.
7. Introduction to polarography and allied Technique by Dr.K. Zutshi

| CHE-PC 402 | Thermodynamics, Polymers and Solid-state Chemistry | L-5,T-1,P-0 | 4Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Thermodynamics, Polymers and Solid-state Chemistry

**Course Objectives:**

- To learn thermodynamic Properties of fluids, phase equilibria and flash calculations.
- Thermodynamic properties of liquids, activity and activity coefficients.
- Polymer structures, morphology and properties.
- To get knowledge on concept of solid state chemistry and super conductance.

**Course Outcomes:** At the end of the course, the student will be able to

| | |
|---|---|
| **CO1** | Derive Gibbs Duhem equation and to calculate fugacity and chemical potential. |
| **CO2** | Calculate excess free energy and entropy, to draw Hildebrand curves and to correlate excess functions and activity coefficients |
| **CO3** | Learn morphology, Tm and Tg points and to calculate transition temperatures and to identify cross linking in polymers. |
| **CO4** | Identify magnetic properties of solids, magnetic materials, superconductors and BCS theory |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 2 | - | - | - | - | 1 | - | 3 |
| **CO2** | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 1 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | 2 | - | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | - | - | - | - | 2 | - | 1 |

**CHE PC-402:** CORE THEORY: **THERMODYNAMICS, POLYMERS AND SOLID STATE CHEMISTRY**

**UNIT-I: Thermodynamic properties of fluids: 15 Hrs**

Thermodynamic relationship residual properties – systems of variable composition- ideal and non-ideal behaviour – fugacity-fugacity coefficient in solutions- Phase equilibrium of low to moderate pressures- dew point-bubble point and flash calculations**.**

**UNIT – II: Thermodynamic properties of 'Liquid Mixtures 15 Hrs**

Activity and activity coefficients-excess free energy-excess enthalpy-excess volume-excess entropy-relation between excess functions and activity coefficients –Application of Gibbs-Deuhem equation-regular solutions –van Laar theory and Scachard-Hildebrand theory.

**UNIT-III: Polymers- structure and properties 15 Hrs**

Morphology and order in crystalline polymers, configuration of Polymer chains, crystal structures and polymers, Stain induced morphology, morphology of chrystalline polymers, crystallisation and melting- polymer structure and physical properties, crystalline melting point, $T_m$-melting point of homogeneous series, effect of chain flexibility and other steric factors- entropy and heat of fusion, the glass transition temperature, Tg , relationship between Tm and Tg effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking.

**UNIT-IV: Solid State Chemistry 15 Hrs**

Magnetic properties of solids- Classification of magnetic materials, Magnetic Susceptibility, Langevin diamagnetism, Weiss theory of para magnetism. Electronic properties of metals, insulators and semiconductors: Electronic Structure of solids, Band theory, band Structure of metals, insulators and semiconductors. Electrons, holes and Excitons. The temperature dependence of conductivity of extrinsic semiconductors. Photo conductivity and photovoltaic effect –P-n-Junctions. Super conductivity: Occurence of superconductivity. Destruction of Superconductivity by magnetic fields-Meisner effect. Types of superconductors. Theories of super conductivity BCS theory.

**Books suggested:**


1. J.M. Pransnitz. Molecular Thermodynamics of Fluid Phase Equilibrium. Prentice. Hall
2. Kuriocose and Rajram. Thermodynamics
3. Smith and Van Ners. Chemical Thermodynamics.
4. R.C. Srivastava, Subi. K. Saha. Thermodynamics-A care course. Prentice-Hall of India Pvt, Ltd,. 3rd edition-2007.
5. Silbey, Alberty, Bawendi. Physical chemistry. Jhon-Wiley & sons. 4th edition-2006.
6. F. W. Billmeyer, Jr.: Text Book of Polymer Science. Wiley Interscience.
7. V. R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar.: polymer Science. New Age international Publishers.
8. Solid State chemistry by M.G. Arora.
9. Solid State Chemistry by Wiley.

| CHE PC 403 | Core practical I: Inorganic Chemistry - Practical | L-5,T-1,P-0 | 4 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Inorganic Chemistry - Practical.

**Course Objectives:**

- Learn potentiometric titrations of mixture of acids
- Determination of electrode potential by polarography
- Gain knowledge on interpretation of data from IR, AAS, HPLC and GC
- Determination of alkanility and purity by pH metry

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To perform titration of mixture of halides and to draw potentiometry curves |
| **CO2** | To learn ampherometric titrations and mixtures by polarography |
| **CO3** | To Correlation of data obtained from IR, AAS, HPLC and GC |
| **CO4** | To Determination of alkanility and purity by pH metry |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 2 | 3 | - | - | 2 | - | 2 | - | 3 |
| **CO2** | 3 | 3 | 3 | 2 | 3 | 2 | - | - | - | 2 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 2 | 3 | - | 2 | - | | 2 | 3 |
| **CO4** | 3 | 3 | 3 | 2 | 3 | 3 | - | 2 | - | 2 | - | 3 |

## CHE PC 403: CORE PRACTICALS: PRACTICAL – I-

1. Potentiometry: a) Titration of mixture of acids
   b) Titration of mixture of halides
   c) Titration of ferrous ammonium sulphate with potassium dichromate
   d) Redox titrations
   e) Solubility of Sparingly soluble salt.
   f) Formula and instability constant of a complex
   g) Dissociation constant of acetic acid

2. Polarography: a) Determination of E1/2 of Zn and Cd
   b) Determination of Zn and Cd in mixture
   c) Amperometric titration.

## II DEMONSTRATION EXPERIMENTS

1. IR – Interpretation of IR spectrum of alcohols, ketones, aldehydes and other standard materials
2. AAS: Demonstration of AAS – Determination of Zn, Cd, Pb, Mn, Fe and Ni in effluents using AAS.
3. Spectrofluorimetry – estimation of quinine and fluoroscene
4. Ion selective electrodes – estimation of $F^-$, $S^{2-}$ and $CN^-$ in effluents using ion selective electrode meter.
5. Polarography and Anode stripping voltametry
6. Polarography and Anode stripping voltametry – behavior of Cd, Zn, Pb in a mixture.
7. Determination of Pb and Cd in samples using Anode stripping voltametr
8. Gas chromatography- Determination of pesticides
9. HPLC- Determination of pesticides
10. NMR
11. (a)Demonstration of NMR spectrometer and study of hydrogen bonding in a given alcohol or phenol.
12. (b)Interpretation of NMR chemical shifts of ethyl benzene, ethyl alcohol.
13. TGA, DTA, DSC – Demonstration of TG, DTA and DSC and study of decomposition of calcium oxalate, calcium carbonate, copper sulfate, oxalic acid.
14. pH metry
    a. Determination of alkalinity in a colored effluent using pH metric end point.
    b. Determination of purity of commercial HCl, $H_2SO_4$, $H_3PO_4$ and $CH_3COOH$ using pH metric end point

| CHE PC 404 | Project Work | L-5,T-1,P-0 | 4 Credits |
|---|---|---|---|

**Pre-requisite:** Physical Chemistry Project Work

**Course Objectives:**

- Identification of problem by literature survey
- Carry out the problem independently
- Interpretation of data
- Communication of research results through presentations and preparation of dissertation

**Course Outcomes:** At the end of the course, the student will be able

| | |
|---|---|
| **CO1** | To identify research problems and to collect research literature |
| **CO2** | To propose hypothesis of a research problem |
| **CO3** | To perform research experiments |
| **CO4** | To analyse the data and conclude the research outcomes |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | - | - | - | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 2 | 3 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | - | 2 | - | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | - | 2 | - | 3 |

**CHE PC 404: PRACTIAL II/ PROJECT WORK**

| CHE-PC-405A | Chemical Kinetics | L-3,T-1,P-2 | 4Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Chemical kinetics

**Course Objectives:**

- Differentiate homogeneous and heterogeneous catalysis enzyme catalysis and applications
- Learn photo chemistry, chemical excitations and rate of photochemical reactions
- To familiarize electrochemical relaxation methods, photochemical and isotope effects
- Radical photochemical reactions, theory and applications

**Course Outcomes:** At the end of the course, the student will be able to

| | |
|---|---|
| **CO1** | Draw skrabal pH diagram and to separate unimolecular and bimolecular reactions |
| **CO2** | Study laws of photochemistry, to derive stern-volmer equation |
| **CO3** | Identify chromo potentiometry points and to investigate kinetic currents and isotopic effects |
| **CO4** | Learn photochemical thresholds, chemiluminescence |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 2 | - | - | - | - | 1 | 2 | 1 |
| **CO2** | 3 | 3 | 3 | 3 | | 2 | - | - | - | 1 | - | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 2 | 2 |

## CHE PC-405A : (GENERIC ELECTIVE): CHEMICAL KINETICS

**UNIT – I: Catalysis** **15 Hrs**

**Homogeneous catalysis:** Steady state and equilibrium treatments of acid-base catalysis. Skrabal $P^H$ diagrams, Protolytic and Prototropic mechanism. Acidity functions, Zucker, Hammett, Bunnett and Yates hypothesis in the elucidation of the mechanism. Enzyme catalysis – influence of concentration, $P^H$ and temperature. **Heterogeneous Catalysis:** Mechanism of interface reactions, application of transition state theories to unimolecular and bimolecular surface reactions

**UNIT – II: Photochemistry:** **15 Hrs**

Interaction of electromagnetic radiation with matter, laws of photochemistry, Quantum yield, types of excitations, Fate of excited molecule, transfer of excitation energy, kinetics of unimolecular and bimolecular photophysical process, Stern-Volmer equation, Kinetics of photochemical reaction rate constants and life times of reactive energy states, determination of rate constants of reactions, effect of light intensity on the rate of photochemical reactions.

**UNIT-III: Electrochemical relaxation methods, Photochemical methods, Isoptopic effect** **15 Hrs**

**Electrochemical relaxation methods:**Introduction , advantages of Electrochemical transient (or) relaxation techniques, application of these methods, various types of perturbation of a system, pulse polarography, chronopotentiametry, investigation of kinetic currents by chronopoptentiometry.

**Photochemical methods**: Introduction , phenomena of ISC, fluorescence and phosphorescence, experimental arrangement of fluorescence measurements. Example of quenching reactions.

**Isotopic Effects**: Equilibrium isotope effects, equilibria in solution, primary kinetic isotopic effects semiclassical treatments, Quantum-mechanical Tunneling,Reactions of the Type $H+H_2$,Transfer of $H^+$,H and $H^-$ reactions of Huonium,Isotope effect with Havier atoms.

**Unit-IV: Photo Chemical and Radiation Chemical Reactions** **15 Hrs**

Photochemical reactions photochemical primary process, reactions of electronically excited states of species, photo chemical thresholds, laws of photochemical equivalence, rotating-sector technique, multi photon excitation, photosensitization, radiation chemical primary process, chemiluminiscence**.**

**Books suggested**:


1. K.K. Rohatgi Mukerjee. Fundamentals of Photochemistry.
2. C. Kalidas. Principles of fast reactions techniques and Applications.
3. V. Yegnaramam, C.A. Basha And G. Prabhakar Rao : Applications of Electrochemistry.
4. Keith J.Laidler: Chemical Kinetics.
5. J. Dalton: A New System of Chemical Philosophy.
6. Chemical Kinetics:Keith J.Laider.

(Compulsory Foundation)

| CHE-PC-405B | Bioinorganic, Bioorganic, Biophysical Chemistry | L-5,T-1,P-0 | 4 Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Bioinorganic, Bioorganic, Biophysical Chemistry

**Course Objectives:**

- Highlighten metal complexes as oxygen carriers and electron transfer in biology.
- Metal ion transport and storage in biological systems and importance of trace metals in biology.
- Learn physiological functions of carbohydrates, lipids, enzymes classification, stereospecificity.
- The basic concepts of biophysical chemistry in biochemical reactions, exergonic and endergonic reactions.

**Course Outcomes:** At the end of the course, the student will be able to

| | |
|---|---|
| **CO1** | Gain knowledge on metallo proteins in electron transfer processes. |
| **CO2** | Know the applications of trace metal ions and metal ions as chelating agents in medicine. |
| **CO3** | Achieve and develop highly stereoselective synthesis of organic compounds and drugs by adopting environmentally. |
| **CO4** | Understand thermodynamics of biopolymer reactions and to correlate free energy and biopolymer parameters. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 3 | - | 2 | - | 2 | - | 1 | 1 | 1 |
| **CO2** | 3 | 3 | 3 | 3 | - | 2 | - | 2 | - | - | 1 | 3 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | | - | 3 | - | 1 | 1 | 3 |
| **CO4** | 3 | 2 | 2 | 3 | 2 | 2 | - | | - | 2 | - | 1 |

## CHE PC-405(B): (GENERIC ELECTIVE): BIOINORGANIC, BIOORGANIC, BIOPHYSICAL CHEMISTRY

UNIT-I: **BIO-INORGANIC CHEMISTRY- I** **15 Hrs**

Metal complexes as oxygen carriers –Heme proteins –Hemoglobin and myoglobin –Non heme proteins –hemerythrin and hemocyanin – model synthetic complexes of iron, cobalt and copper.Co-enzymes Vitamin $B_{12}$,carboxy peptidase and superoxidedismutase.

**Electron Transfer in Biology:** Structure and functions of metalloproteins in electron transfer processes –catalase –peroxidose –cytochromes and iron –sulphur proteins –synthetic models.

**UNIT – II: BIOINORGANIC CHEMISTRY- II:** Metal ion transport and storage in biological systems**,** Metal ions in Biology, Molecular mechanism of ion transport across membranes: ionophores, photosynthesis.

**Hydrolytic metalloenzymes:** Carbonic anyhdrase, carboxy peptidase, calcium in control processes, calcium and muscle contraction, calcium and secretion, calcium in blood clotting mechanisms. Therapeutic uses of enzymes.

**Importance of trace metals in biology:** Metal ions as chelating agents in medicine, trace metal ions and metal and non-metal deficiency. Biological nitrogen fixation,in-vivo and in-vitro nitrogen fixation.

**UNIT-III: BIOORGANIC CHEMISTRY**

**Carbohydrates:** Structure and biological functions of mucopolysaccharides, glycoproteins, and glycolipids- Role of sugars in biological recognition-Blood group substances

**Lipids:** Essential fatty acids-structure and function of triglycerols, Glycerophospholipids, cholesterol, bile acids prostaglandins- composition and functioning of lipoproteins

**Enzymes:** Nomenclature and classification, properties, factors affecting enzyme catalysis, enzyme inhibition- reversible and irreversible inhibition. Uses of enzymes in food drink industry and clinical laboratories.

**UNIT-IV: BIOPHYSICAL CHEMISTRY:**

Standard free energy change in biochemical reactions, exergonic and endergonic reactions, hydrolysis of ATP, thermodynamics of biopolymer solutions, chain configuration of bio polymers, and calculation of average dimensions. Membrane equilibrium, ion transport through cell membrane. dialosis and its function. Structure and functions of proteins, enzymes, DNA and RNA in living systems, forces involved in bio polymer interactions, electrostatic forces, hydrophobic forces, molecular expansion, and dispersion forces.

**Books Suggested**


1. M.N. Hughes, The Inorganic chemistry of Biological Processes, John wiley and Sons, New York 2nd Edition, 1981.
2. A Text book of Biochemistry, A.V.S.S. Rama Rao
3. Physical chemistry by Atkenes
4. Physical chemistry by Albertz.
5. Bio physical chemistry by Van Holde
6. Bio Physics by Narayanam
7. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
8. Chemistry of Natural Products, P.S. Kalsi, Kalyani Publishers.
9. Chemistry of Organic Natural Products, O. P. Agarwal, Vols., 1 & 2, Geol Pubs.
10. Natural products Chemistry K.B.G. Torssell, John Wiley, 1983.
11. Burger's Medicinal Chemistry, M.E. Wolff, John Wiley
12. Medicinal Chemistry, A. Kar, New Age International

| CHE PC 406A | Drug Chemistry | L-3,T-1,P-2 | 4Credits |
|---|---|---|---|

**Pre-requisite:** Understanding of Drug Chemistry

**Course Objectives:**

- To learn about the natural products as leads for new drugs
- Determination of cardiovascular drugs
- To study Autacoids
- Interpretation of Antipyretics

**Course Outcomes:** At the end of the course, the student will be able to

| | |
|---|---|
| **CO1** | Know about natural products. |
| **CO2** | Know Interpretation of cardiovascular drugs. |
| **CO3** | Know the Analyzing about prostaglandins. |
| **CO4** | Know the Definition, Classification, Nomenclature, Structure and Synthesis of anti-inflammatory drugs. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | - | - | 2 | - | - | 2 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | - | 2 | - | 2 | - | 2 | - | 3 |
| **CO3** | 3 | 3 | | 3 | - | 3 | - | 2 | - | 3 | - | 3 |
| **CO4** | 3 | - | 3 | - | 3 | 2 | - | - | - | 2 | - | 3 |

## CHE : PC : 406 (A): (OPEN ELECTIVE) : DRUG CHEMISTRY

### UNIT – I: NATURAL PRODUCTS AS LEADS FOR NEW DRUGS

Occurrence, Structure and therapeutic uses of Drugs acting on Central Nervous System

Morphine alkaloids (morphine, codeine, thebaine, heroin, pethidine)

Cannabinoids (9-cannabinol, Tetrahydrocannabinol)

Neuromuscular Blocking Agents (Curare, Decamethonium)

Vinca Alkaloids (Vincristin and Vinblastin), Taxol and Taxotere, podophyllotoxin, Etoposide, Teniposide.

### UNIT – II: CARDIOVASCULAR DRUGS

Definition, Classification, Nomenclature, Structure and Synthesis.

Cardiac glycosides (ex: Digoxin, Digitoxin);

Antihypertensive drugs (ex: Methyl dopa, Clonidene hydrochloride);

Antiarrhythmic agents (ex: Quinidine sulfate);

Antisympathetic drugs (ex: Propranolol hydrochloride, Verapamil hydrochloride);

Vasopressor drugs (ex: Prenylamine, Buphenine).

### UNIT – III: AUTACOIDS

Definition, Occurrence, Isolation, Nomenclature, Classification, Synthesis, Biosynthesis and Stereochemical structures of Prostaglandins. Structural elucidation of $PGE_1$, $PGE_2$; Synthesis and biosynthesis of $PGE_2$, $PGF_{2\alpha}$.

Structure and Biosynthesis of Thromboxane A2 and Prostacyclin (synthesis not expected).

### UNIT – IV: ANTI-INFLAMMATORY DRUGS

Definition, Classification, Nomenclature, Structure and Synthesis of Paracetamol, Aspirin (Antipyretic), Salol, Cinchophen, Antipyrene, Phenylbutazone, Indomethacin, Tolmetin, Ibuprofen, Diclofenac and Naproxen.

**Books suggested:**


1. Medicinal Chemistry by Ashitosh Kar
2. Medicinal Chemistry by D. Sriram, P. Yogeeswari
3. Medicinal Chemistry by David A. Williams, Thomas L. Lemke
4. Medicinal Chemistry by V. Alagarsamy
5. Biochemistry by U. Satyanarayana
6. Natural Products Chemistry and Applications by Sujata V. Bhat, B.A. Nagasampagi, S. Meenakshi
7. Medicinal Chemistry by V.K. Ahluwalia, Madhu Chopra
8. Medicinal Chemistry by Balkishen Razdar
9. Advanced Practical Medicinal Chemistry by Ashutosh Kar
10. Chemistry of Organic Natural Products by O. P. Agarwal, Vols., 1 & 2, Geol Pubs.
11. Chemistry of Natural Products by S. V. Bhat, B.A. Nagasampagi, M. Sivakumar
12. Natural Products Chemistry by K.B.G. Torssell, John Wiley, 1983.

| CHE PC 406 B | Electroanalytical Techniques | L-5,T-1,P-0 | 4 Credits |
|---|---|---|---|

**Pre-requisite**: Understanding of Electroanalytical Techniques

**Course Objectives:**

- To learn about the classification of electroanalytical methods
- Determination of types of currents
- Principle, instrumentation, reversible and irreversible cyclic voltammograms..
- Interpretation of Ion selective electrodes

**Course Outcomes:** At the end of the course, the student will able to

| | |
|---|---|
| **CO1** | Ability to interpret potentiometry and conductometry |
| **CO2** | Interpretation of results while adhering to DC Polarography. |
| **CO3** | Analysing and compiling the data and results in polarography. |
| **CO4** | Familiarize Types of ion sensitive electrodes. |

**Mapping of course outcomes with the program outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | - | - | 2 | - | - | 2 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | - | 2 | - | 2 | - | 2 | - | 3 |
| **CO3** | 3 | 3 | - | 3 | - | 3 | - | 2 | - | 3 | - | 3 |
| **CO4** | 3 | - | 3 | - | 3 | 2 | - | - | - | 2 | - | 3 |

**CHE : PC : 406 (B): (OPEN ELECTIVE) : ELECTRO ANALYTICAL TECHNIQUES**

**Unit I:** Types and Classification of Electro analytical Methods.

**i) Potentiometry-** Types of electrodes, Hydrogen gas, Calomel, Quin hydrone and glasselectrodes. Determination of pH. Potentiometric titrations.

**ii) Conductometry –** Definition of terms – conductivity, specific conductivity, cell constant. Mobility of ions, Conductometric titrations.

**Unit II:** D.C Polarography :. Dropping mercury electrode- Instrumentation-polarogram. Types ofCurrents : Residual, Migration, Limiting. Two and Three electrode assemblies. Ilkovic equation(derivation not necessary) and its consequences. Types of limiting Currents: Adsorption, Diffusion, Kinetic. Applications of polarography in qualitative and quantitative analysis. Analysis of mixtures. Application to inorganic and organic compounds. Determination of stability constants of complexes.

**Unit III:** (i) A.C. polarography (ii) Square-wave polarography (iii) Pulse polarography (iv) Differential pulse polarography(V) Cyclic Voltammetry: Principle, instrumentation, reversible and irreversible cyclic voltammograms.

**Unit IV: Ion selective electrodes:** Ion-sensitive electrodes –types of ion sensitive electrodes –metal based cation and anion sensitive electrodes, solid membrane electrodes. Liquid ion-exchange electrodes, gas sensing membrane electrodes.

**Books Suggested**


1. H.W. Willard, LL. Merrit and J.A. Dean: Instrumental Methods of Analysis. Affiliated East-West).
2. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denny. Vogel's Text Book of Quantitative Chemical Analysis (ELBS).
3. D.A. Skoog and D.M. West: Principles of Instrumental Analysis (Holt, Rinehart and Wilson).
4. J.G. Dick : Analytical Chemistry (Mc Graw Hill).