

SRI VENKATESWARA UNIVERSITY:: TIRUPATI
SVU COLLEGE OF SCIENCES
DEPARTMENT OF CHEMISTRY
PHYSICAL CHEMISTRY



Syllabus for M.Sc. CHEMISTRY
Choice Based Credit System (CBCS)
Amended as per NEP-2020
(w.e.f. the Academic Year 2021-2022)

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 will 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:

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.

SRIVENKATESWARAUNIVERSITY::TIRUPATI
DEPARTMENT OF CHEMISTRY
PHYSICAL CHEMISTRY
TWO YEAR M.Sc. COURSE IN CHEMISTRY
(2021-2022)SCHEME

Semester -I

Sl. No.	Course Code	Components of Study	Title of the Course	Credit Hrs/ Week	No. of Credits	IA Marks	SEM End Exam Marks	Total
1	CHE-101	Core-Theory	Inorganic Chemistry- I	6	4	20	80	100
2	CHE-102	Core-Theory	Organic Chemistry I	6	4	20	80	100
3	CHE-103	* Compulsory Foundation	a)Physical Chemistry- I	6	4	20	80	100
			b)Chemistry of Nano materials					
4	CHE-104	* Elective Foundation	a)General Chemistry- I	6	4	20	80	100
			b)Green Chemistry					
5	CHE-105	Practicals (Core & Comp.)	a)Inorganic Practical-I	3	2	-	-	50
			b) Physical Chemistry-I	3	2	-	-	50
6	CHE-106	Practicals (Core & Elective)	a) OrganicChemistry- I	3	2	-	-	50
			b)General Chemistry-I	3	2	-	-	50
7	CHE-107	Audit Course	Values and Professional Ethics – I	0	0	100	-	
		Total		36	24			600

*Among the Compulsory and Elective Foundation a student shall choose anyone.

SEMESTER-II

Sl. No.	Course Code	Components of Study	Title of the Course	Credit Hrs/ Week	No. of Credits	IA Marks	SEM End Exam Marks	Total
1	CHE-201	Core-Theory	Inorganic Chemistry- II	6	4	20	80	100
2	CHE-202	Core-Theory	Organic Chemistry -II	6	4	20	80	100
3	CHE-203	* Compulsory Foundation	(a)Physical Chemistry- II	6	4	20	80	100
			(b) Advanced Thermodynamics and Biophysical chemistry					
4	CHE-204	* Elective Foundation	a)General Chemistry- II	6	4	20	80	100
			b)Chemistry of contemporary society					
5	CHE-205	Practicals (Core & Comp.)	a)Inorganic Practical-II	3	2	-	-	50
			b) Physical Chemistry-II	3	2	-	-	50
6	CHE-206	Practicals (Core & Elective)	a)OrganicChemistry- II	3	2	-	-	50
			b)General Chemistry-II	3	2	-	-	50
7	CHE-207	Audit Course	Human Values and Professional Ethics – I	0	0	100	-	
		Total		36	24			600

*Among the Compulsory and Elective Foundation a student shall choose anyone.

M.Sc. (PHYSICAL CHEMISTRY)**SEMESTER-III**

Sl. No	Course Code	Components of Study	Title of the Course	Credit Hrs/Week	No. of Credits	IA Marks	SEM End Exam Marks	Total
1	CHE-PC-301	Core-Theory	Physical Chemistry-III	6	4	20	80	100
2	CHE-PC -302	Core-Theory	Organic Spectroscopy	6	4	20	80	100
3	CHE-PC-303	*Generic Elective	(a) Organic Chemistry III (b) Inorganic Spectroscopy & Thermal Methods of analysis	6	4	20	80	100
4	CHE-PC-304	Core& Gen. Practical	Chemical kinetics	6	4	-	-	100
5	CHE -PC-305 A	Skill Oriented Course (theory)	Chemotherapy and drug analysis	3	2	10	40	50
	CHE -PC-305 B	Skill Oriented Course (Practicals)	Conductometry Colorimetry	3	2	-	-	50
6	CHE- 306	Open Elective (For other departments)	(a) Spectral Techniques (b) Chromatographic Techniques	6	4	20	80	100
		Total		36	24			600

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

SEMESTER-IV

Sl. No	Course Code	Components of Study	Title of the Course	Credit Hrs/Week	No. of Credits	IA Marks	SEM End Exam Marks	Total
1	CHE-PC-401	Core-Theory	Electro Chemistry	6	4	20	80	100
2	CHE-PC-402	Core-Theory	Thermodynamic, Polymers and Solid state chemistry	6	4	20	80	100
3	CHE-PC-403	Generic Elective* (Related to subject)	(a) Chemical Kinetics (b) Bioinorganic, Bioorganic & Biophysical Chemistry	6	4	20	80	100
4	CHE-PC-404	Core& Gen. Practical	Instrumental Methods of Analysis	6	4	-	-	100
5	CHE-PC-405	Core-Practicals/ Project work	Project work	6	4	-	-	100
6	CHE-406	Open Elective (For other departments)	(a) Drug Chemistry or (b) Electroanalytical Techniques	6	4	20	80	100
		Total		36	24			600

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

(Mandatory Core)

CHE-101	INORGANIC CHEISTRY I	L-5,T-1,P-0	4Credits									
Pre-requisite: Understanding of graduate level chemistry												
Course Objectives: <ul style="list-style-type: none">• 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	1	3	-	1	-	1	-	2	-	1
CO2	3	1	-	3	-	2	2	2	2	1	-	2
CO3	3	2	-	3	2	-	-	1	-	1	2	1
CO4	3	1	1	3	-	2	2	2	1	-	1	1

CHE 101: INORGANIC CHEISTRY I

UNIT-I: CO-ORDINATION COMPOUNDS

15 Hrs

Introduction to Crystal field Theory, CFSE and its calculation, Pairing 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, Shortcomings 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 π COMPLEXES-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 Spectra of 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 (5th Ed. (Viva Books)
5. W.L. Jolly: Modern Inorganic Chemistry (McGraw-Hill)
6. B.N Figgis: Introduction to Ligand Fields (John-Wiley)
7. S.F.A. Kettle: Coordination compounds.
8. Coordination Chemistry. Bassalo & Jahnsen.

(Mandatory Core)

CHE-102	Organic Chemistry I	L-3,T-1,P-2	4Credits									
Pre-requisite: Understanding of graduate level Organic Chemistry												
Course Objectives: <ul style="list-style-type: none">Classify molecules based on stereo chemical 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 participationUnderstand thermodynamic and kinetic requirements, kinetic and thermodynamic control, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects in reactive intermediatesStudy 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	2	-	1	1	-	1	-	-
CO2	3	2	1	3	-	1	2		-	2	1	1
CO3	3	1	2	3	-	1	1	2	1	-	1	-
CO4	3	2	2	3	2	1	1	1	-	1	1	1

CHE102: Organic Chemistry I

UNIT-I: Stereochemistry

Stereoisomerism-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 (C_n & S_n). 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 σ and π - bonds, phenonium ions, norbornyl and norbornenyl systems, Classical and nonclassical carbocations, NGP by halogens and heteroatoms (O,N,S) The S_N1 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, Zingiberine, 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. Ingold, 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.

(Mandatory Core)

CHE-103	Physical Chemistry I				L-5,T-1,P-6			4Credits				
Pre-requisite: Basic knowledge about Physical Chemistry												
Course Objectives:												
<ul style="list-style-type: none"> 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												
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	-	1	3	2	1	--	1	2	---	1	1
CO2	3	1	2	3	1		1		1	1	-	1
CO3	3	-	1	3	2	1	-	1		-	2	-
CO4	3	1	2	3	-	1	1	-	2	1	-	1

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 formulation of reacton rates.

(B) **Unimolecular reactions:** Lindemann, Lindemann-Hinshelwood, 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- $\text{H}_2\text{-Br}_2$, $\text{H}_2\text{-Cl}_2$ reactions, Autocatalysis, $\text{H}_2\text{-O}_2$ 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-Tetrad 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-Huckel Equation and its Verification, Debye- Falkenhagen Effect, and Wien 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 (3rded.), S. Glasstone (Affiliated East-West).

(Compulsory Foundation)

CHE-104 (A)	General Chemistry I	L-5,T-1,P-0	4Credits									
Pre-requisite: Understanding of graduate level Chemistry												
Course Objectives:												
<ul style="list-style-type: none"> • 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. • To know about ecosystem, nutrient cycle and desert ecosystem and forest ecosystem and aquatic ecosystem. • Gain knowledge on air pollution, water pollution, soil pollution, marine pollution, noise pollution and solid waste management. 												
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	To know about the principle and concept of ecosystem and their functioning											
CO4	To have an idea on environmental pollution and environmental impact assessment.											
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	-	1	-	-	2	1	1
CO2	3	2	-	3	1	-	2	1	-	1	1	-
CO3	3	3	2	3	2	1		1	2	1	1	2
CO4	3	2	1	2	3	1	1	1	-	2	1	1

CHE104-A: 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.

UNIT-III: ECOSYSTEMS

15 Hrs

Concept of an ecosystem (Abiotic and biotic environment), structure and function of an ecosystem Producers, Consumers and decomposers. Energy flow in the ecosystem, (Nutrient cycle in the ecosystem) Ecological succession Food Chain, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystems, Forest ecosystem, Grassl and ecosystem, Desert ecosystems aquatic ecosystems [ponds, streams, lakes, rivers, ocean estuaries].

UNIT-IV: ENVIRONMENTAL POLLUTION

15 Hrs

Definition a) Air pollution b) Water pollution c) Soil pollution d) Marine pollution e) Noise pollution f) Thermal pollution g) Nuclear pollution Solid waste management : Causes, effects and control measures of urban and industrial wastes. Environmental impact assessment.

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 104B	General Chemistry I				L-3,T-1,P-2				4Credits			
Pre-requisite: Understanding of graduate level Chemistry												
Course Objectives:												
<ul style="list-style-type: none"> To familiarize with the significance of green chemistry and assessment of the impact. To gain knowledge on biocatalyst in oxidation, reduction and hydrolytic reactions To have an idea on solvent free reactions and modern reaction techniques. To familiarize with the use of ionic liquids as green solvents. 												
Course Outcomes: At the end of the course, the student will be able												
CO1	To get knowledge on green reaction conditions and their impact on environment.											
CO2	To know about use of different biocatalysts as environmentally friendly reagents.											
CO3	To acquire knowledge on the use of modern techniques like ultrasound, microwave etc.											
CO4	To have an idea on the use of ionic liquids in different reactions.											
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	2	1	1	-	1	-	1	1
CO2	3	1	1	3	1	-	1	1	-	1	-	1
CO3	3	3	2	3	2	1		2	-	1	1	1
CO4	3	2	1	2	3	1	1	1	1	-	1	1

CHE 104B: General Chemistry I

UNIT-I

Fundamentals and significance of Green Chemistry: Discussion of the current state of chemistry and the environment and the definition of green chemistry. Assessment of the impact of chemistry in the environment and definition of risk hazard. An introduction to the tools of green chemistry and its fundamental principles.

Principles of Green Chemistry: Prevention of waste / by-products, Hazardous products- Designing of safer chemicals- Selection of appropriate solvents and starting materials- Use of protecting groups and catalysis- Designing of biodegradable products.

UNIT-II

Catalysis for Green Chemistry: Use of biocatalysts- Biochemical Oxidation, Biochemical Reduction, Enzyme Catalyzed Hydrolytic Process, Modified biocatalysis- transition metal catalysis- Reformatsky reaction, Wurtz reaction, Pinacol coupling, Simmons-Smith reaction, Mukaiyama reaction, Heck reaction, Ullmann's coupling.

UNIT-III

Solvent Free Reactions: Solvent free techniques- Reactions on solid mineral supports, Phase Transfer Catalysis- C-alkylation, N-alkylation, S-alkylation, Darzen's reaction, Wittig reaction. Ultrasound assisted green synthesis- Oxidation, Reduction, Hydroboration, Bouveault reaction, Strecker reaction, Microwave assisted green synthesis- Biginelli reaction, Aza-Michael reaction, Suzuki reaction, Stille reaction, Sonogashira reaction.

UNIT-IV

Ionic liquids: Definition- Types of Ionic Liquids-Synthesis of Ionic Liquids- Selection of ionic liquids- physical properties- Application in organic synthesis- alkylation, allylation, oxidation, reduction, polymerization, hydrogenation, hydroformylation, alkoxy-carbonylation, carbon-carbon bond forming reactions, alkene metathesis.

Books suggested:

1. New Trends in Green Chemistry by V.K. Ahluwalia, M. Kidwai.
2. Green Chemistry: Environment Friendly Alternatives by Rashmi Sanghi, M M Srivastava
3. Green Solvents for Organic Synthesis by V.K. Ahluwalia, Rajender S. Varma
4. Green Analytical Chemistry by Mihkel Koel and Mihkel Kaljurand

CHE 105 A & B	Core practical I: Inorganic & Physical Chemistry				L-5,T-1,P-0				4 Credits			
Pre-requisite: Understanding of graduate level Inorganic & Physical Chemistry practical.												
Course Objectives:												
<ul style="list-style-type: none"> • Basic laboratory techniques of titration and analysis. • Quantitative estimation of inorganic compounds through volumetric techniques. • Calibration of volumetric apparatus and statistical analysis of the data. • Determination of critical solution temperature of phenol-water system. 												
Course Outcomes: At the end of the course, the student will be able												
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	To study the determination of critical solution temperature, eutectic composition, distribution coefficient, adsorption of different systems.											
CO4	To calibrate the statistical data											
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	-	1	2	1	2	-
CO2	3	2	2	2	-	2	1	1	-	2	2	1
CO3	3	2	1	2	2	1	-	2	1	1	2	1
CO4	3	2	2	1	2	1	-	2	2	1	1	1

CHE 105 A & B: Core practical I: Inorganic & Physical Chemistry**Semi Micro Qualitative Analysis**

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).

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

CHE 106A & B	Core practical I: Organic & General Chemistry				L-5,T-1,P-0				4 Credits			
Pre-requisite: Understanding of graduate level Organic & General Chemistry practical.												
Course Objectives:												
<ul style="list-style-type: none"> • Identification of single organic component by systematic qualitative analysis • Preparation of derivatives and purification process • Single step preparations • Calibration of spectral analysis to this structures Identification of single organic component by systematic qualitative analysis.												
Course Outcomes: At the end of the course, the student will be able												
CO1	To familiarize the systematic procedures of analysis of organic components.											
CO2	To know the conformational tests for various functional groups.											
CO3	To understand the mechanisms and familiarize with methodologies to prepare biologically important molecules.											
CO4	Purification of compounds by different process											
Mapping of course outcomes with the program outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	1	2	-	1	-	1	1	-
CO2	3	2	2	3	-	2	-	1	1	-	1	2
CO3	2	2	2	1	2	1	2	1	-	1	-	2
CO4	1	2	2	1	1	1	1	-	1	1	1	2

CHE : 106 B : PRACTICAL – II : ORGANIC CHEMISTRY

Single step preparations

1. Preparation of aspirin
2. Preparation of p-nitroacetanilide
3. Preparation of p-bromoacetanilide

CHE 107	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:												
<ul style="list-style-type: none"> 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 tolerance, 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	2	3	1	1	2
CO2	3	2	2	3	1	1	1	2	3	-	-	2
CO3	3	1	2	3	2	-	1	-	-	1	1	3
CO4	3	1	1	3	-	1	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 Possession) 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 Tolerance, 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.

(Mandatory Core)

CHE - 201	Inorganic Chemistry II						L-5, T-1, P-0	4 Credits				
Pre-requisite: Understanding of graduate level chemistry												
Course Objectives:												
<ul style="list-style-type: none"> • 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	1	-	1
CO2	3	2	-	3	1	2	1	-	1	2	1	1
CO3	3	-	2	3	-	2	1	1	-	1		1
CO4	3	1	1	3	-	2	-	1	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, Hund's 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.

(Mandatory Core)

CHE-202	Organic Chemistry II	L-3, T-1, P-2	4 Credits									
Pre-requisite: Understanding of Organic Chemistry												
Course Objectives: <ul style="list-style-type: none">• Able to recognize, classify, explain, and apply fundamental organic reactions such as E₂, E₁, E₁CB.• 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 ₁ CB reactions, stereoselectivity 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	2	2	3	-	2	1	-	1	1	1	-
CO2	3	2	2	3	2	2		1	1	-	1	1
CO3	3	2	2	3	2	2	1	1	-	1	-	1
CO4	3	2	2	3	-	2	-	1	-	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 OsO₄ and KMnO₄.

Elimination reactions Elimination reactions E₂, E₁, E₁CB mechanisms. Orientation and stereoselectivity in E₂ eliminations. Pyrolytic syn elimination and α -elimination, elimination Vs substitution. Factors 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 Demjonoje Rearrangements

Rearrangements to electron deficient Nitrogen atom:

Hofmann, Curtius, Schmidt 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. Ingold, 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, Fessenden and Fessenden.
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.

(Mandatory Core)

CHE -203	Physical chemistry II	L-5,T-1,P-6	4Credits									
Pre-requisite: Basic knowledge about Physical Chemistry												
Course Objectives: <ul style="list-style-type: none">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	1	3	-	2	-	1	1	1	2	-
CO2	3	2	2	3	2	2	-	1	1	1	-	1
CO3	3	2	2	3	-		1	-	-	1	1	-
CO4	3	2	-	2	1	1	-	1	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 Theory Atomic 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. Meweeny: 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.

(COMPULSORY FOUNDATION)

CHE-204 A	General Chemistry II	L-5,T-1,P-0	4Credits									
Pre-requisite: Understanding of graduate level Chemistry												
Course Objectives:												
<ul style="list-style-type: none"> • Gain knowledge on the principles of different electro analytical methods • Familiarize with chromatographic techniques. • To study on biodiversity and conservation of biodiversity • To know about natural resources and non-renewable resources 												
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 principles of amperometric titrations.											
CO2	To learn general principles and classifications of chromatographic separations and applications of TLC, GLC and HPLC.											
CO3	To know about biodiversity, ecosystem diversity and conservation of biodiversity.											
CO4	To acquire knowledge on natural resources related to food, water, mineral, energy and land.											
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		1	-	1	1	2
CO2	3	-	2	3	-	2	1	-	2	1	1	1
CO3	3	3	2	2	1	2	-	1	-	-	1	2
CO4	3	3	2	2	2	2	1	1	-	1	1	1

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.

Unit – III : Biodiversity

Conservation introduction definition genetic species and ecosystem diversity, hot spots of biodiversity, threats to biodiversity habitat loss poaching of wildlife, man wildlife conflicts. Endangered and endemic species of India, conservation of biodiversity in – situ an ex-situ conservation of biodiversity.

Unit – IV Natural resources and non-renewable resources

An overview of natural resources and associated problems with references to a) Forest resources b) Water resources c) Mineral resources d) Food resources e) Energy resources f) Land resources.

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).
6. Silbey, Alberty, Bawendi. Physical chemistry. Jhon-Wiley & sons. 4th edition-2006.

CHE 204B	Chemistry in Contemporary Society	L-3,T-1,P-2	4Credits									
Pre-requisite: Understanding of graduate level Chemistry												
Course Objectives:												
<ul style="list-style-type: none"> To know about quality control and impurities in Pharmaceuticals. To have an idea on body fluids, blood, enzymes and forensic. To gain knowledge on composition of milk, oil, fats etc. To familiarize with different types of fuels, soils and its ingredients. 												
Course Outcomes: At the end of the course, the student will be able												
CO1	To acquire knowledge in pharmaceutical chemicals											
CO2	To familiarize with blood fluids, blood, enzymes and forensic											
CO3	To know about fermentation, detection of purity, beverages											
CO4	To acquire knowledge on gaseous fuels, soil ingredients and analysis of trace elements											
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	1	2	3	1	2	1	-	2	2	1	-
CO3	3	2	2	3	1	2	2	1	-	2	1	1
CO4	3	2	3	2	1	2	1	2	-	1	1	1

CHE 204B: Chemistry in Contemporary Society

UNIT – I : PHARMACEUTICALS

15 Hrs

Pharmaceuticals : Importance of quality control, drugs and pharmaceuticals, sources of impurities in pharmaceutical chemicals, analytical quality control in finished / final products, common methods of assay.

Common drugs and their uses: Analgesics – aspirin, paracetamol; Anthelmintics – mebendazole ; Antiallergics – chlorpheniramine maleate; Antibiotics-penicillin, chloramphenicol; Anti-inflammatory agents-oxyprenbutazone; **Antimalarials** – primaquine phosphate; Antituberculosists – INH; Narcotics – nicotine, morphine; Expectorants – Benadryl; Sedatives – diazepam; Vitamins – B1, B2, B6, niacin and folic acid.

UNIT – II : FORENSIC AND BIOMEDICALS

15 Hrs

Body fluids: Composition and detection of abnormal level of certain constituents leading to diagnosis, sample collection and preservation of physiological fluids, analytical methods for the constituents of physiological fluids (blood, urine).

Blood: Estimation of glucose, cholesterol, urea, haemoglobin and bilirubin.

Urine: Urea, uric acid, creatinine, calcium phosphate, sodium, potassium and chloride.

Enzymes: Biological significance, assay of enzymes (pepsin, tyrosinase), vitamins (thiamine ascorbic acid, vitamin A) and hormones (progesterone, oxytocin, insulin), chemical, instrumental and biological assays to be discussed wherever necessary.

Forensic : General discussion of poisons with special reference to mode of action of cyanide organophosphates and snake venom, poisonous materials such as lead, mercury and arsenic in biological materials.

UNIT – III : FOOD AND BEVERAGES

15 Hrs

Milk and milk products : Composition, alcohol test, fermentation, dye reduction-methylene blue and resazurin tests, analysis of fat content, minerals in milk and butter, estimation of added water in milk.

Oils and fats: General composition of edible oils, detection of purity, tests for common edible oils and groundnut oil, cottonseed oil and mustard oil, tests for adulterants like argemone oil and mineral oils,

Beverages: Soft drinks, alcoholic drinks, tea, coffee and fruit juice, analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, food preservatives like benzoates, propionates, sorbates, bisulphites, artificial sweeteners, like saccharin, dulcin and sodium cyclamate, flavours – vanillin, esters (fruit flavours) and monosodium glutamate, artificial food colourants-coal tar dyes and non-permitted colours and metallic salts, control of food quality – codex alimentarices, Indian standards.

UNIT – IV : FUEL AND SOIL

15 Hrs

Fuels : Definition, classification and characteristics of fuels, sampling, determination of calorific value. Liquid fuels-determination of flash point, fire point, aniline point. Knocking of petrol and diesel – octane and cetane numbers carbon residue. **Gaseous fuels** : Coal gas, waste gas, producer gas, gobar gas and blast furnace gas, calorific value determination by Junker's gas calorimeter, relative merits of solid, liquid and gaseous fuels. **Soil** : Ingredients of soil-organic matter, nitrogen, sulphur, sodium, potassium and calcium, analysis of trace elements, copper, molybdenum, zinc and boron.

Reference Books :

1. Pharmaceutical Analysis, T. Higuchi and E.B. Hanseen, John Wiley and Sons, New York.
2. Quantitative Analysis of drugs, P.D. Sethi, 3rd edition, CBS Publishers, New Delhi, 1997.
3. Practical Clinical biochemistry methods and interpretations, R. Chawala, J.P. Brothers Medical Publishers (P) Ltd., 1995.
4. Laboratory manual in biochemistry, J. Jayaraman. New Age International Publishers, New Delhi, 1981.

CHE 205 A & B	Core practical I: Inorganic & Physical Chemistry	L-5,T-1,P-0	4 Credits									
Pre-requisite: Understanding of graduate level Inorganic & Physical Chemistry practical.												
Course Objectives:												
<ul style="list-style-type: none"> • Separation and determination of the two component mixtures • Preparation of metal complexes • 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 separate and determine the two component mixtures											
CO2	To acquire knowledge in the preparation of metal complexes											
CO3	To study the determination of cell constant and verification of Onsagar equation, strength of strong acid by Titration of a strong acid with a strong base and vice versa											
CO4	To get knowledge on the applications of conductometry, potentiometry, coulometry and pHmetry.											
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	-	2		1	1	-
CO2	3	2	2	3	2	2	1	-	1	-	1	2
CO3	3	2	2	3	3	1	1	2	-	1	1	-
CO4	3	2	2	3	2	-	1	-	1	1	-	2

CHE 205 A & B: Core practical I: Inorganic & Physical 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. Physical Chemistry

1. Conductometry:

- (a) Determination 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. pHmetry: Strong acid, Strong base titrations.

CHE 206A & B	Core practical I: Organic & General Chemistry				L-5,T-1,P-0				4 Credits			
Pre-requisite: Understanding of graduate level Organic & General Chemistry practical.												
Course Objectives:												
<ul style="list-style-type: none"> • Familiarize with two component mixture separation and identification. • Preparation of derivatives. • Purification by components by different methods. • Calibration of products by spectral methods. 												
Course Outcomes: At the end of the course, the student will be able												
CO1	To familiarize with binary mixture separation											
CO2	To gain hands-on-experience in purification of the components, preparation of derivatives.											
CO3	To get knowledge about the chemical behavior of different components and mechanisms											
CO4	Purification and calibration of data											
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	-	1	1	-	3	3	1
CO2	3	2	2	3	-	1	-	2	1	3	3	-
CO3	3	2	2	3	1	1	2	1	-	2	-	2
CO4	3	2	2	3	1	2		1	1	2	1	2

CHE 206 A & B: Core practical II: Organic & General Chemistry

CHE-206 A : PRACTICAL – II : ORGANIC CHEMISTRY

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

CHE-206 B : PRACTICALS – II : GENERAL CHEMISTRY

Preparation of Metal Complexes:

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

CHE 207	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:												
<ul style="list-style-type: none"> • 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 trafficking and 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	2	2	3	1	1	1
CO2	3	1	2	3	1	2	2	3	3	1	1	1
CO3	3	2	1	3	-	2	1	2	2	3	-	1
CO4	3	1	1	3	1	2	1	1	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 Hippocrates 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 Education – Telugu Academy, Hyderabad.
14. I.C. Sharma Ethical Philosophy of India. Nagin& Co Julundhar.

(Mandatory Core)

CHE-PC-301	Physical Chemistry III	L-5,T-1,P-0	4 Credits									
Pre-requisite: Understanding of graduate level Physical Chemistry												
Course Objectives: <ul style="list-style-type: none">• 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	
CO2	3	2	2	3	2	2	-	-	-	2	-	-
CO3	3	2	2	3	2	2	-	-	-		-	2
CO4	3	2	2	3	-	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 , $POCl_3$, $PtCl_4^{2-} \cdot H_2O_2$ 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 Frenkel defects, insulators, 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: SPECTROSCOPY

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, anharmonicity, 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.

(Mandatory Core)

CHE-PC 302	Organic Spectroscopy and Applications	L-5,T-1,P-0	4Credits									
Pre-requisite: Understanding of Organic Spectroscopy and Applications												
Course Objectives: <ul style="list-style-type: none">• 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	-
CO2	3	2	2	3	2	2	-	-	-	2	2	-
CO3	3	2	2	3	2	2	-	-	-	2	2	2
CO4	3	2	2	3	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**

¹H 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 ¹H 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).

¹³C 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 Silverstein 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

(Mandatory Core)

CHE-PC-303A	Organic Chemistry III	L-3,T-1,P-2	4Credits									
Pre-requisite: Understanding of Organic Chemistry												
Course Objectives: Course Objectives: <ul style="list-style-type: none">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	-	2	-	2	2	-
CO2	3	2	2	3	2	2	-	2	-	-	2	-
CO3	3	2	2	3	2	2	-		-	-	-	-
CO4	3	2	2	3	2	2	-	2	-	2	2	-

CHE-PC-303A Core-Theory Organic Chemistry III

UNIT I: REAGENTS IN ORGANIC SYNTHESIS

15 Hrs

Use of the following reagents in organic synthesis: Anhydrous AlCl₃, Boran trifluoride, N-Bromosuccinimide, Diazomethane, Dicyclohexylcarbodiimide, Lead tetraacetate, Ziegler-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 oxidation, Oppenauer oxidation, oxidation with manganese dioxide, oxidation with silver carbonate (b) Alkenes to epoxides-peroxide induced epoxidations. (c) Alkenes to diols-oxidation with potassium permanganate, osmium tetroxide, 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. Ingold, 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- 304	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:												
<ul style="list-style-type: none"> • 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	-	-	-	-	2	-
CO2	3	2	2	3	2	2	-	-	-	2	2	-
CO3	3	2	2	3	2	2	-	-	-	2	-	-
CO4	3	2	2	3	2		-	-	-	-	2	-

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 $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, $\text{CaC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$. 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, Quadrupole effects, Magnetic effects. Instrumentation, spectral parameters and spectrum display.

Application 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 XPS to Qualitative analysis, to surface studies and structural analysis. Ultraviolet photoelectron spectroscopy- Principle, application of UPES in studying the molecular orbitals of O₂ and N₂ 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 Chemistry, Principles of Structure and Reactivity (4th Ed.) (Addison-Wesley)
3. Gary Wulfsberg: Inorganic Chemistry (5th Ed. (Viva Books)
4. J.D. Lee: Concise Inorganic Chemistry (Blackwell)
5. W.L. Jolly: Modern Inorganic Chemistry (McGraw-Hill)
6. R.L. Carlin: Magneto-chemistry (Springer-Verlag)
7. R.L. Dutta and A. Syamal: Elements of Magnetochemistry (Affiliate East-West).
8. K. Hussain Reddy – Text book of Bioinorganic chemistry

CHE PC 304	Core practical I: Inorganic spectroscopy and thermal methods of analysis				L-5,T-1,P-0	4 Credits						
Pre-requisite: Understanding of Inorganic Chemistry - Practical.												
Course Objectives:												
<ul style="list-style-type: none"> • 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	-	-	3	-	2	3	2	-	-	1	-
CO2	3	2	2	3	2	2	3	2	-	1		2
CO3	3	-	-	3	-	2	-	2	-	-	-	-
CO4	3	2	2	3	-	-	-	2	-	1	-	2

CHE : PC-304: Practicals (Core & Gen.)

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).

2. Flame Photometry:

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

CHE PC 305A	Chemotherapy and Drug Analysis	L-5,T-1,P-0	4 Credits									
Pre-requisite: Understanding of Chemotherapy and Drug Analysis												
Course Objectives:												
<ul style="list-style-type: none"> • Gain knowledge on chemotherapy and analysis of drugs. • Analysis of drugs chemically and biologically. 												
Course Outcomes: At the end of the course, the student will be able												
CO1	To know about the classification and synthesis of drugs.											
CO2	To familiarize with the qualitative and quantitative analysis of drugs.											
CO3												
CO4												
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			1	
CO2	3	2	2	3	2	2	3	2		1		2
CO3												
CO4												

CHE PC 305A: (SKILL ORIENTED COURSE : THEORY) : CHEMOTHEROPY AND DRUG ANALYSIS

UNIT-I: Chemotherapy

Definition, History, and Evolution of Chemotherapy; Discovery, Classification, Nomenclature, Mode of action and synthesis of the following classes of compounds with special references to specific drugs mentioned under each class

- a. Sulfa drugs- Sulfanilamide and Sulfamethoxazole.
- b. Antibacterials
- c. Lactum group of antibiotics – Penicillin, Ampicillin and Amoxycillin.
- d. Cephalosporin-C and Ciprofloxacin.
- e. Anticancer drugs – 5-Flurouracil, Methotrexate.
- f. Antifungals – Griseofulvin
- g. Antimalarials – Chloroquin

UNIT-II: Chemical and Biochemical analysis of Drugs

Qualitative and Quantitative Analysis of drugs: Uses of IR, UV, GLC and HPLC methods.

Drug Assay by Biochemical Analysis – ELISA (Cortisol, alcohol, opiates).

Radio Immuno Assay (RIA) – Enalapril, Insulin; Kidney, Lungs and Liver function tests; Use of isotopes in the Bioanalysis of drugs and in drug design programmes.

Book Suggested

1. Medicinal Chemistry and Pharmaceutical Chemistry – Harikishan Singh and Kapur
2. Medicinal Chemistry and Biochemistry – R.L.Nath
3. Introduction to Medicinal Chemistry – Patrick
4. The Organic Chemistry of Drug Synthesis Vols. 1-6 - Ledneicer Top drugs top synthetic routes – John Saunders
5. Medicinal Chemistry – Ashutoshkar
6. Synthetic Organic Chemistry and Drugs – Gurideep R Chetwal
7. Biochemistry – Harper, Conn & Stumpf, Lehninger
8. Biochemistry – Western Jodd
9. Biochemistry – Cann & Stumpf
10. Bergers Medicinal Chemistry Vols. 1-5 – Manfred E. Wolf
11. Introduction to drug design – Siverman
12. Biochemical approach to Medicinal Chemistry – Thomas Nogrady
13. Principles of Medicinal chemistry – William Foye
14. Text book of organic medicinal and pharmaceutical chemistry – Delgrado and William A
15. Industrial Microbiology – Casida

CHE PC 305B	Instrumental Methods of Analysis	L-3,T-1,P-2	4Credits									
Pre-requisite: Understanding of Instrumental Methods of Analysis Practical												
Course Objectives:												
<ul style="list-style-type: none"> • 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 understand the principle and working aspects of conductometric titrations											
CO2	To acquire knowledge on the implementation of colorometric estimations.											
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
CO2	3	2	2	3	3	2	-	-	-	2	2	2
CO3												
CO4												

CHE : PC-305 (B) : Practicals (Skill Oriented Course)

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 306	Spectral Techniques	L-5,T-1,P-0	4 Credits									
Pre-requisite: Understanding of Spectral Techniques												
Course Objectives: <ul style="list-style-type: none"> • 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	-	-	3	-	2	3	2	-	-	1	-
CO2	3	2	2	3	2	2	3	2	-	1	-	2
CO3	3	2	-	2	2	-	2	-	-	-	1	-
CO4	3	2	2	3	-	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 Silverstein 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	Chromatographic Techniques	L-5,T-1,P-0	4Credits									
Pre-requisite: Understanding of graduate level Chromatographic Techniques												
Course Objectives:												
<ul style="list-style-type: none"> • 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	-	-	3	-	2	3	2	-	-	1	-
CO2	3	2	2	3	2	2	3	2	-	1	-	2
CO3	3	2	-	2	2	-	2	-	-	-	1	-
CO4	3	2	2	3	-	2	-	-	-	1	-	2

CHE PC 306 : 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 prasad, 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 Graw Hill, New Delhi, (1973).

(Mandatory Core)

CHE-PC- 401	Electrochemistry	L-5,T-1,P-0	4Credits									
Pre-requisite: Understanding of Electrochemistry												
Course Objectives: <ul style="list-style-type: none">• 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 Publishing 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

(Mandatory Core)

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: <ul style="list-style-type: none">• 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, T_m and T_g 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, T_g , relationship between T_m and T_g 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: Occurrence 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.

(Mandatory Core)

CHE-PC-403A	Chemical Kinetics	L-3,T-1,P-2	4Credits									
Pre-requisite: Understanding of Chemical kinetics												
Course Objectives:												
<ul style="list-style-type: none"> • 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-403A : (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, Isotopic 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, chronopotentiometry, investigation of kinetic currents by chronopotentiometry.

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-403B	Bioinorganic, Bioorganic, Biophysical Chemistry					L-5,T-1,P-0	4 Credits					
Pre-requisite: Understanding of Bioinorganic, Bioorganic, Biophysical Chemistry												
Course Objectives:												
<ul style="list-style-type: none"> • 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-403(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 B₁₂, carboxy peptidase and superoxidedismutase.

Electron Transfer in Biology: Structure and functions of metalloproteins in electron transfer processes –catalase –peroxidase –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 anyhydrase, 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. dialysis 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 404	Core practical I: Inorganic Chemistry - Practical					L-5,T-1,P-0	4 Credits					
Pre-requisite: Understanding of Inorganic Chemistry - Practical.												
Course Objectives:												
<ul style="list-style-type: none"> • 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 amperometric 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 $E_{1/2}$ 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 fluorescein
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, H₂SO₄, H₃PO₄ and CH₃COOH 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:												
<ul style="list-style-type: none"> • 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 406A	Drug Chemistry					L-3,T-1,P-2			4Credits			
Pre-requisite: Understanding of Drug Chemistry												
Course Objectives:												
<ul style="list-style-type: none"> • 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, Clonidine hydrochloride);

Antiarrhythmic agents (ex: Quinidine sulfate);

Antisymphathetic 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 PGE₁, PGE₂; Synthesis and biosynthesis of PGE₂, PGF_{2α}.

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, Antipyrine, 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. Torrsell, John Wiley, 1983.

CHE PC 406	Electroanalytical Techniques	L-5,T-1,P-0	4 Credits									
Pre-requisite: Understanding of Electroanalytical Techniques												
Course Objectives:												
<ul style="list-style-type: none"> 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 of Currents : 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

- 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).