

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



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

## Vision

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

## Mission

The Department of Chemistry strives:

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

## PROGRAM EDUCATIONAL OBJECTIVES:

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

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

**SEMESTER-I**

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

**SEMESTER-II**

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

**SEMESTER-III**

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

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

**SEMESTER-IV**

	<b>Course Code</b>	<b>Components of Study</b>	<b>Title of the Course</b>	<b>No. of Credits</b>	<b>IA Marks</b>	<b>End SEM Exam Marks</b>	<b>Total</b>
1	CHE-OC-401	Core-Theory	Organic synthesis -I	4	20	80	100
2	CHE-OC-402	Core-Theory	Organic Synthesis- II	4	20	80	100
3	CHE-OC-403	Core-Practical	Spectral Identification of organic compounds	4	-	-	100
4	CHE-OC-404	Core-Practical/ Project work	Project work	4	-	-	100
5	CHE-405	Generic Elective* <b>(Related to subject)</b>	Heterocycles & Natural products	4	20	80	100
			(b) Bioinorganic, Bioorganic & Biophysical Chemistry	4	20	80	100
			(c) Chemistry of Nanomaterials & Functional materials				
6	CHE-406	Open Elective* <b>(For other departments)</b>	(a) Drug Chemistry or (b) Electro analytical Techniques	4	20	80	100
		<b>Total</b>		<b>24</b>			<b>600</b>

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

CHE-101	INORGANIC CHEISTRY I				L-5,T-1,P-0				4Credits			
<b>Pre-requisite:</b> Understanding of graduate level chemistry												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Comprehend the key features of coordination compounds, Crystal Field Theory, different properties and bonding by spectroscopic techniques</li> <li>Study the polymorphic forms of non-transition elements and their synthesis and properties</li> <li>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</li> <li>Familiarize with the methods of synthesis of metal carbonyls and metal nitrosyls, Synergistic effect, EAN and 18-electron rule.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	To understand the key features of coordination compounds, Crystal Field Theory, magnetic properties and bonding in transition metal complexes.											
<b>CO2</b>	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.											
<b>CO3</b>	To explain the reactivity of complexes in terms of Valence bond and Crystal Field theories, Taube's classification, Trans effect and Electron Transfer Reactions.											
<b>CO4</b>	To gain knowledge on synthesis and structures of different metal carbonyls, synergistic effect and 18 electron rule.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	-	3	-	2	1	1	-	2	-	1
<b>CO2</b>	3	1	2	3	-	2	-	2	1	1	-	1
<b>CO3</b>	3	2	-	3	2		1		2	1	1	1
<b>CO4</b>	3	1	1	3	1	1	-	2	1	-	2	1

### CHE 101: INORGANIC CHEISTRY I

#### UNIT-I: CO-ORDINATION COMPOUNDS

**15 Hrs**

Introduction to Crystal field Theory, CFSE and its calculation, Paring energy, Splitting of 'd' orbitals in Trigonal bi pyramidal, square planar, square pyramid and pentagonal bipyramidal geometries, Jahn –Teller effect, Application of CFT, OSSE, site Selection in Spinel, Short comings of CFT, Evidence for covalency –Nephelauxetic effect. MOT of co-ordinate bonds –M.O. Diagrams for octahedral, tetrahedral and square planar complexes. Experimental evidences for  $\pi$ - 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  $\pi$ -bonding theories. Electron Transfer Reaction-Inner Sphere and outer Sphere Mechanisms- Marcus theory.

**UNIT-IV: METAL  $\pi$ COMPLEXES-I****15 Hrs**

Nature of  $\pi$  bonding, Classification of  $\pi$  ligands,  $\pi$  donor ligands and  $\pi$ -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 (5<sup>th</sup> 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 & Jahnson.

CHE-102	Organic Chemistry I	L-3,T-1,P-2	4Credits									
<b>Pre-requisite:</b> Understanding of graduate level Organic Chemistry												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Classify molecules based on stereochemical aspects study on optical and geometrical isomerism by the application of Cahn-Ingold-Prelog rules.</li> <li>Familiarize with different types of substitution reactions, able to predict products, including stereochemistry in aliphatic and aromatic nucleophilic substitution reactions, effect of neighboring group participation</li> <li>Understand thermodynamic and kinetic requirements, kinetic and thermodynamic control, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects in reactive intermediates</li> <li>Study about occurrence, isolation, structure establishment and synthesis of natural products-terpenoids.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	To detect stereochemical structures of the molecules, stereoselective and stereocontrolled reactions.											
<b>CO2</b>	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.											
<b>CO3</b>	To know the concept of isotope effects, potential energy diagrams and transition states in different intermediates											
<b>CO4</b>	To familiarize with stereospecific synthesis of naturally occurring terpenoids and degradation products of terpenoids											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	1	3	1	-	1	2	1	-	2	-
<b>CO2</b>	3	2	2	3		1	-	1	2	1	1	2
<b>CO3</b>	3	1	2	3	1	1	1	2		1	-	-
<b>CO4</b>	3	2	2	3	2	2	-	2	-	1	-	2

### 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  $\sigma$  and  $\pi$ - 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.

<b>CHE-103</b>	<b>Physical Chemistry I</b>	<b>L-5,T-1,P-6</b>	<b>4Credits</b>									
<b>Pre-requisite:</b> Basic knowledge about Physical Chemistry												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Acquire knowledge in Quantum Chemistry, postulates of Quantum Mechanics., Applications of Schrodinger wave equation and Born-Oppenheimer approximation</li> <li>Study on Chemical Dynamics and theories in unimolecular, chain and fast reactions and determination of reaction rates.</li> <li>Familiarize with concepts of Thermodynamics and statistical thermodynamics, Gibbs- Duhem equation and Sackur-Tetrade equation</li> <li>Know about Thermodynamic and Kinetic concept of Electrochemistry and conductance, conductivity of electrolytes</li> </ul>												
<b>Course Outcomes</b> At the end of the course, the student will be able to												
<b>CO1</b>	To know the concepts such as Operator algebra, Eigen values and Eigen functions, Degeneracy, Schrodinger wave equation and the postulates of Quantum Mechanics.											
<b>CO2</b>	To learn about theories of reaction rates, Lindemann, Lindemann-Hinshel wood, and RRKM theories.											
<b>CO3</b>	To know about Thermodynamic concepts and entropy change in reversible process and irreversible process, Gibbs- Duhem equation, calculation of thermodynamic properties.											
<b>CO4</b>	To study the Thermodynamic and Kinetic Derivation of Nernst Equation and the derivation of Debye-Huckle Equation and its Verification											
<b>Mapping of course outcomes with the program outcomes</b>												
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	2	1	3	2	1	-	2	1	2	1	1
<b>CO2</b>	3	1	2	3	1	1	1	-	2	1	-	1
<b>CO3</b>	3	2	1	3	2			3		1	2	2
<b>CO4</b>	3	2	2	3	-	1	1	-	1	2	-	2

### CHE-103: Physical Chemistry I

#### UNIT-I: Quantum Chemistry-I

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

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

##### UNIT-II: Chemical Dynamics

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

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

### UNIT – III : Thermodynamics

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

### UNIT-IV : Electrochemistry I

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

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

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

#### Books Suggested

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

<b>CHE 104</b>	<b>Core practical I: Inorganic Chemistry</b>	<b>L-5,T-1,P-0</b>	<b>2 Credits</b>									
<b>Pre-requisite:</b> Understanding of graduate level Inorganic Chemistry practical.												
<b>SEMI MICRO QUALITATIVE ANALYSIS</b>												
<ul style="list-style-type: none"> <li>• Basic laboratory techniques of titration and analysis.</li> <li>• Quantitative estimation of inorganic compounds through volumetric techniques.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	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.											
<b>CO2</b>	To familiarize with techniques of titration and calculation of errors											
<b>CO3</b>												
<b>CO4</b>												
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	2	-	1	1	-	1	2	-
<b>CO2</b>	3	2	2	3	1	1	-	1	2	1	1	2
<b>CO3</b>												
<b>CO4</b>												

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

**Semi Micro Qualitative Analysis**

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

<b>CHE 105</b>	<b>Core practical I: Organic Chemistry</b>	<b>L-5,T-1,P-0</b>	<b>2 Credits</b>									
<b>Pre-requisite:</b> Understanding of graduate level Organic Chemistry practical.												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>• Identification of single organic component by systematic qualitative analysis</li> <li>• Single step preparations</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	To familiarize the systematic procedures of analysis of organic components, conformational tests for various functional groups.											
<b>CO2</b>	To understand the mechanisms and familiarize with methodologies to prepare biologically important molecules.											
<b>CO3</b>												
<b>CO4</b>												
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	1	2	2	1	2	-	2	-
<b>CO2</b>	3	2	2	3	2	2	-	1	1	2	-	2
<b>CO3</b>												
<b>CO4</b>												

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

- a) Identification of single organic component by systematic qualitative analysis.
- Aromatic acids
  - Phenols
  - Neutral compounds
  - Esters
  - Carbonyl compounds etc.
- b) Single step preparations.
1. Preparation of aspirin
  2. Preparation of p-nitroacetanilide
  3. Preparation of p-bromoacetanilide
  4. Hydrolysis

<b>CHE 106</b>	<b>Core practical I: Physical Chemistry</b>	<b>L-5,T-1,P-0</b>	<b>2 Credits</b>									
<b>Pre-requisite:</b> Understanding of graduate level Physical Chemistry practical.												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Determination of critical solution temperature, eutectic composition and temperature of binary system.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	To study the determination of critical solution temperature, eutectic composition, distribution coefficient, adsorption of different											
<b>CO2</b>	To calibrate the statistical data											
<b>CO3</b>												
<b>CO4</b>												
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	-	2	2	1	-	2	1	1
<b>CO2</b>	3	2	2	2	1	2	-	1	1	2	-	2
<b>CO3</b>												
<b>CO4</b>												

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

#### Syllabus

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

<b>CHE-107</b>	<b>General Chemistry I</b>				<b>L-5,T-1,P-0</b>				<b>2 Credits</b>			
<b>Pre-requisite:</b> Understanding of graduate level Chemistry												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Gain knowledge on precision and accuracy, Limit of detection, Limit of determination, Sensitivity and selectivity, statistical evaluation of data</li> <li>Familiarize with principles and concepts of flame emission spectroscopy and atomic absorption spectroscopy and their applications .</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	To know about mean and median values, standard deviation and coefficient of variation.											
<b>CO2</b>	To acquire knowledge on principle and instrumentation of AAS and difference between flame AAS and furnace AAS.											
<b>CO3</b>												
<b>CO4</b>												
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	1	3	1	2	-	2	-	1	1	2
<b>CO2</b>	3	2	2	3	1	-	2	1	-	2	-	2
<b>CO3</b>												
<b>CO4</b>												

**CHE107: General Chemistry I**

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

**15 Hrs**

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

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

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

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

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

**Books Suggested**

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

<b>CHE 108</b>	<b>Human Values and Professional Ethics-I</b>	<b>L-3,T-1,P-2</b>	<b>4 Credits</b>									
<b>Pre-requisite:</b> Understanding of graduate level Human Values and professional ethics												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Analyze values in various ethical professions</li> <li>Understand moral concepts, character and conduct multiple</li> <li>Concept of ethical values with respect to individual and society</li> <li>ethical interests at stake in areal-world situation or practice and assess own ethical values with respect to social context and problems</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able to												
<b>CO1</b>	To know about the needs and importance of professional ethics.											
<b>CO2</b>	To analyze nature of Values, basic Moral Concepts character and Conduct.											
<b>CO3</b>	To gain knowledge on individual and society ethical values, ahimsa, satya and brahmacharya.											
<b>CO4</b>	To understand values of Bhagavd Gita, various religions, religious tolerance, Gandhian ethics.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	-	1	3	2	1	1	2	3	-	1	2
<b>CO2</b>	3	-	2	3	1	2	--	2	3	2	-	2
<b>CO3</b>	3	1		3	2		1				1	3
<b>CO4</b>	3	1	2	3		2	2	2	2	2	-	3

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

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

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

**Chapter III:** Individual and Society: Ahimsa (Non-Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya (Non 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.

<b>CHE - 201</b>	<b>Inorganic Chemistry II</b>	<b>L-5, T-1, P-0</b>	<b>4 Credits</b>									
<b>Pre-requisite:</b> Understanding of graduate level chemistry												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Understand magnetic properties of transition metal complexes and various reactions on ligands with respect to synthesis.</li> <li>Gain knowledge on electronic spectra of complex molecules of octahedral and tetrahedral geometry</li> <li>Understand magnetic properties viz., diamagnetism and paramagnetism and other related properties of complex molecules</li> <li>Familiarize with different catalytic reactions of complex molecules and factors effecting the reactions.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	To familiarize with the general methods of complex preparations and properties, nature of bonding and structural features of metal complexes.											
<b>CO2</b>	To know about Russel-Saunders coupling, splitting of energy levels in octahedral field and differentiate between Orgel diagrams and Tanabe-Sugano diagrams.											
<b>CO3</b>	To understand about the laws of Hunds, Curie and Weiss, magnetism and magnetic susceptibility determination by Gouy's and Farady methods.											
<b>CO4</b>	To gain knowledge on Induced reactions, Free radical reactions, Thermal decomposition reactions, Chain reactions.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	-	2	1	2	-	2	-	1
<b>CO2</b>	3	1	1	3	1	2	-	2	-	1	-	1
<b>CO3</b>	3	-	2	3	-	2	1	-	2	1	1	-
<b>CO4</b>	3	1	1	3	1	2	-	1	-	1	-	1

### CHE 201: INORGANIC CHEISTRY II

#### UNIT – I: TRANSITION METAL II – COMPLEXES II

**15 Hrs**

Transition metal  $\pi$  – 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 tetrahedral complexes of Ti(III), V(III), Cr(III), Mn(III), Mn(II), Fe(II), Fe(III), Co(III), Co(II), Ni(II) and Cu(II) complexes, Calculation of  $Dq$  and  $B^1$  parameters for Cr(III) and Ni(II) complexes. Tanabe – Sugano diagrams, Differences between Orgel diagrams and Tanabe – Sugano diagrams, Tanabe – Sugano diagrams of  $d^2$  to  $d^6$  and  $d^8$  configurations. Charge transfer spectra- LMCT and MLCT.

#### UNIT – III: MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES

**15 Hrs**

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

#### UNIT –IV: CATALYSIS

**15 Hrs**

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

**Books Suggested**

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

CHE-202	Organic Chemistry II	L-3, T-1, P-2	4 Credits									
<b>Pre-requisite:</b> Understanding of Organic Chemistry												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>• Able to recognize, classify, explain, and apply fundamental organic reactions such as E<sub>2</sub>, E<sub>1</sub>, E<sub>1CB</sub>.</li> <li>• Familiar with molecular rearrangements involving electron deficient carbon, nitrogen and oxygen atoms and electron rich carbon atom.</li> <li>• Provide Hantzsch-Widmann nomenclature for the three and four membered heterocycles. Be able to predict synthetic routes and chemical reactions of these heterocycles.</li> <li>• Be familiar with occurrence, isolation, structural elucidation and synthesis of natural products- alkaloids</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	To familiarize the mechanisms of E <sub>1</sub> , E <sub>2</sub> and E <sub>1CB</sub> reactions, stereoselectivity and synpyrolytic eliminations and use of isotopes, chemical trapping and crossover experiments.											
<b>CO2</b>	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.											
<b>CO3</b>	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.											
<b>CO4</b>	To understand the structural elucidation and synthesis of alkaloids using specific reagents.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	2	2	3	-	2	1	1	2	-	1
<b>CO2</b>	3	3	2	2	3	2	2	-	1	-	1	1
<b>CO3</b>	3	3	2	2	3	2	2	1	1	1	2	
<b>CO4</b>	3	3	2	2	3	-	2	-	1	1	-	1

### CHE- 202 : ORGANIC CHEMISTRY II

#### UNIT-I: Reaction mechanism-I

**15 Hrs**

Electrophilic addition to carbon carbon double bond: Stereoselective addition to carbon carbon double bond; anti addition-Bromination and epoxidation followed by ring opening. Syn addition of OsO<sub>4</sub> and KMnO<sub>4</sub>.

Elimination reactions Elimination reactions E<sub>2</sub>, E<sub>1</sub>, E<sub>1CB</sub> mechanisms. Orientation and stereoselectivity in E<sub>2</sub> 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, thiranes, 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, Fessendon and Fessendon.
10. Text book of Organic Chemistry, T.W. Solomon,
11. Organic Chemistry, Vol II, I.L. Finar, ELBS Eds.
12. Heterocyclic chemistry T.L Gilchrist, Longman Scientific Technical
13. An Introduction to the Heterocyclic compounds, R M Acheson, John Wiley.

<b>CHE -203</b>	<b>Physical chemistry II</b>	<b>L-5,T-1,P-6</b>	<b>4 Credits</b>									
<b>Pre-requisite:</b> Basic knowledge about Physical Chemistry												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Learn Angular momentum and Molecular Orbital Theory and application of Huckel theory to organic molecules.</li> <li>Know about concepts in Surface Chemistry, concept of electric double layer model and Micelles.</li> <li>Get knowledge on symmetry and group theory their use in spectroscopy, Mulliken character tables.</li> <li>Understand Irreversible Electrode phenomenon controlled potential electrolysis and polarography.</li> </ul>												
<b>Course Outcomes</b> At the end of the course, the student will be able												
<b>CO1</b>	To know about Pauli Exclusion principle and Slater determinant, atomic orbitals, Simple molecular orbitals and Huckel theory of conjugated systems.											
<b>CO2</b>	To learn Gibbs adsorption isotherm, BET equation and correlate limitations, critical micellar concentration (CMC) and factors affecting the CMC of surfactants.											
<b>CO3</b>	To identify Relation between order of a finite group and its sub-group, conjugacy, Symmetry point group (MLS, MHS and MSS) and orthogonality theorem.											
<b>CO4</b>	To acquire knowledge on DC-Polarography, AC-Polarography, Controlled Potential Electrolysis, to derive equation for Tafel plots, half-wave potentials for reversible system.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	-	3	-	2	1	1	-	1	1	1
<b>CO2</b>	3	2	2	3	2	2	2	-	2	-	2	-
<b>CO3</b>	3	2	2	3	-	-	1	1	-	1	1	1
<b>CO4</b>	3	2	-	2	2	1	1	-	2	1	1	1

### CHE-AC-203 Physical Chemistry III

#### UNIT-I: Quantum Chemistry-II

15 Hrs

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

(B) Molecular Orbital 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,  $\Pi$ -bond order and charge density calculations, application of Huckel theory to ethylene, butadiene and benzene.

#### UNIT-II: Surface Chemistry

15 Hrs

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

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

#### UNIT-III: SYMMETRY AND GROUP THEORY

15 Hrs

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

#### UNIT-IV: ELECTROCHEMISTRY- II

15 Hrs

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

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

#### Books Suggested

1. P.W. Atkins: Physical Chemistry (ELBS).
2. Ira N. Levine: Quantum Chemistry (Prentice Hall).
3. R. Mcweeny: Coulson's Valence (ELBS).
4. J.O.M. Bockris and A.K.N. Reddy, Modern Electrochemistry, vol.I & II (Plenum).
5. S. Glasstone; An Introduction to Electrochemistry (3<sup>rd</sup> 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. 4<sup>th</sup> edition-2006.
9. D.N. Bajpai: Advanced physical Chemistry: S. Chand & Company, 1998.

<b>CHE 204</b>	<b>Core practical I: Inorganic Chemistry</b>				<b>L-5,T-1,P-0</b>				<b>2 Credits</b>			
<b>Pre-requisite:</b> Understanding of graduate level Inorganic Chemistry practical.												
<b>SEMI MICRO QUALITATIVE ANALYSIS</b>												
<ul style="list-style-type: none"> <li>• Separation and determination of the two component mixtures.</li> <li>• Preparation of metal complexes</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	CO 1: To separate and determine the two component mixtures.											
<b>CO2</b>	CO 2: To acquire knowledge in the preparation of metal complexes											
<b>CO3</b>												
<b>CO4</b>												
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	2	1	-	2	-	3	3	1
<b>CO2</b>	3	2	2	3	-	1	2	-	2	3	3	1
<b>CO3</b>												
<b>CO4</b>												

### CHE 204: Core practical I: Inorganic Chemistry

#### I. Quantitative Analysis:

Separation and determination of two component mixtures:

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

#### II. Preparation of Metal Complexes:

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



<b>CHE 106</b>	<b>Core practical II: Organic Chemistry</b>	<b>L-5,T-1,P-0</b>	<b>2 Credits</b>									
<b>Pre-requisite:</b> Understanding of graduate level Organic Chemistry practical.												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Familiarize with two component mixture separation and identification.</li> <li>preparation of derivatives and purification by different methods</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	To familiarize with binary mixture separation and to gain hands-on-experience in purification of the											
<b>CO2</b>	To get knowledge about the chemical behavior of different components and mechanisms.											
<b>CO3</b>												
<b>CO4</b>												
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	2	-	1	2	-	1	1	1
<b>CO2</b>	3	2	2	3	-	2	-	1	2	1	-	2
<b>CO3</b>												
<b>CO4</b>												

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

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

Binary mixture of

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

<b>CHE 206</b>	<b>Core practical II: Physical Chemistry</b>	<b>L-5,T-1,P-0</b>	<b>2 Credits</b>									
<b>Pre-requisite:</b> Understanding of graduate level Physical Chemistry practical.												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Familiarize with conductometric, potentiometric and redox methods of analysis</li> <li>Colorometric and pHmetric methods of analysis</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	To study the determination of cell constant and verification of Onsagar equation, strength of strong											
<b>CO2</b>	To get knowledge on the applications of conductometry, potentiometry, coulometry and pH metry.											
<b>CO3</b>												
<b>CO4</b>												
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	3	1	1	2	-	1	1	1
<b>CO2</b>	3	2	2	3	2	1	1	-	2	1	-	2
<b>CO3</b>												
<b>CO4</b>												

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

#### Syllabus

- Conductometry:
  - Determination of cell constant
  - Verification of Onsagar equation
  - Determination of dissociation constant of a weak acid
  - Titration of a strong acid with a strong base
  - Titration of a weak acid with a strong base
- Potentiometry:
  - Titration of a strong acid with a strong base
  - Titration of a weak acid with a strong base
  - Redox titration
- Coulometry: Estimation of Manganese
- pH metry: Strong acid, Strong base titrations.

<b>CHE-207</b>	<b>General Chemistry II</b>	<b>L-5,T-1,P-0</b>	<b>2 Credits</b>									
<b>Pre-requisite:</b> Understanding of graduate level Chemistry												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>• Gain knowledge on the principles of different electro analytical methods.</li> <li>• Familiarize with chromatographic techniques.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	To acquire knowledge on ion selective electrodes, solid membrane electrodes and glass electrodes and											
<b>CO2</b>	To learn general principles and classifications of chromatographic separations and applications of TLC, GLC											
<b>CO3</b>												
<b>CO4</b>												
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	1	2	-	2	2	-	1	1
<b>CO2</b>	3	-	2	3	1	2	1	2	-	2	1	1
<b>CO3</b>												
<b>CO4</b>												

#### CHE 204-A: General Chemistry II

#### UNIT-I: ELECTRO ANALYTICAL METHODS

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

#### UNIT-II: CHROMATOGRAPHY

General principles and classifications of chromatographic separations

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

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

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

#### Books Suggested

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

<b>CHE 208</b>	<b>Human Values and professional ethics-II</b>	<b>L-3,T-1,P-2</b>	<b>4 Credits</b>									
<b>Pre-requisite:</b> Understanding of Human Values and professional ethics												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>• Gain knowledge on value education, family values and adjustability</li> <li>• Develop ethics towards medical, health care professionals and ethical issues in genetic engineering</li> <li>• Understand the importance of social ethics towards organ trade, human trafficking human rights violation and social disparities.</li> <li>• Know about environmental ethics, ecological crises, pollution and protection of environment</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able to												
<b>CO1</b>	To understand the concepts of human values, responsibilities of family values and status of women in family and society.											
<b>CO2</b>	To acquire knowledge on different medical ethics the views of Charaka and Sushruta on moral responsibilities of medical practitioners.											
<b>CO3</b>	To gain knowledge on social ethics and understand the characteristics of ethical problems in management.											
<b>CO4</b>	To familiarize environmental ethics, ethical theory and ecological crisis.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	1	3	1	2	1	-	3	1	1	1
<b>CO2</b>	3	1	1	3	-	2	-	3	3	1	1	1
<b>CO3</b>	3	2	2	3	2	2	2	2	2	3	-	1
<b>CO4</b>	3	1	1	3	1	2	-	-	2	3	1	1

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

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

**Chapter II:** Medical ethics – Views of Charaka, Sushruta and 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.

<b>CHE-OC-301</b>	<b>Organic Chemistry III</b>					<b>L-3,T-1,P-2</b>			<b>4Credits</b>			
<b>Pre-requisite:</b> Understanding of Organic Chemistry												
<b>Course Objectives: Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Familiarize with the applications of different reagents in organic synthesis, Mechanisms and stereochemistry.</li> <li>Study the methods of preparation and applications of organometallic reagents.</li> <li>Understand topocity, prochirality, auxillary and reagent-controlled methods in asymmetric synthesis.</li> <li>Applications of different oxidizing and reducing agents in organic synthesis with region and stereo controlled products.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able to												
<b>CO1</b>	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.											
<b>CO2</b>	To gain knowledge in the synthesis of different organometallic reagents and also stereo and regio specificity and selectivity of reactions with organometallic reagents											
<b>CO3</b>	To understand diastereoselectivity, stereoselectivity and substrate controlled auxillary controlled reactions											
<b>CO4</b>	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.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	2	2	-	2	1	2	2	1
<b>CO2</b>	3	2	2	3	2	2	1	2	1	1	2	2
<b>CO3</b>	3	2	2	3	2	2	1	-	2	-	-	2
<b>CO4</b>	3	2	2	3	2	2	-	2	1	2	2	2

### CHE-OC-301Core-Theory Organic Chemistry III

#### UNIT I: REAGENTS IN ORGANIC SYNTHESIS

**15 Hrs**

Use of the following reagents in organic synthesis: Anhydrous AlCl<sub>3</sub>, 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.

<b>CHE-OC 302</b>	<b>Organic Spectroscopy and Applications</b>	<b>L-5,T-1,P-0</b>	<b>4Credits</b>									
<b>Pre-requisite:</b> Understanding of Organic Spectroscopy and Applications												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Familiarize with the instrumentation of UV and visible spectroscopy, applications of identifying the structures of the molecules.</li> <li>Understand IR spectrometry and applications to ascertain the fundamental groups by observing absorption bands</li> <li>Study on the applications of NMR spectroscopy in ascertaining the stereochemical structures of the molecules.</li> <li>Understand the working principle and fragmentation rules of different molecules in Mass spectroscopy</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able to												
<b>CO1</b>	To get experience to calculate $\lambda$ max values for dienes, enones, polyenes, aromatic and heteroaromatic compounds.											
<b>CO2</b>	To familiarize with the absorption bands of the molecules with specific functional groups											
<b>CO3</b>	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											
<b>CO4</b>	To acquire knowledge about specific fragmentation rules of different molecules which are unique.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	2	2	1	-	1	2	2	1
<b>CO2</b>	3	2	2	3	2	2	1	2	1	2	2	-
<b>CO3</b>	3	2	2	3	2	2	1	2	-	2	2	2
<b>CO4</b>	3	2	2	3	2	2	-	2	1	2	2	1

## **CHE-IC 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

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

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

**<sup>13</sup>C NMR spectroscopy:** General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimensional NMR spectroscopy-COSY.

### UNIT-IV: MASS SPECTROMETRY

15Hrs

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

#### Books suggested:

1. Organic spectroscopy, W. Kemp 5<sup>th</sup> Ed, ELBS
2. Spectroscopy of organic compounds, RM Silversteen and others, 5<sup>th</sup> 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 Flemm.

<b>CHE OC 303 &amp; 304</b>	<b>Core practical I: Organic Estimations - Practical</b>				<b>L-5,T-1,P-0</b>				<b>4 Credits</b>			
<b>Pre-requisite:</b> Understanding of Organic Chemistry - Practical.												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>• Estimation of phenol, glucose, primary amine and ketone</li> <li>• Estimation and percentage purity of aspirin and paracetamol.</li> <li>• Multistep preparations of biologically important organic molecules.</li> <li>• Familiarize to identify the synthesized compounds by spectral methods.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able												
<b>CO1</b>	To gain knowledge about the estimation/percent purity of different organic molecules.											
<b>CO2</b>	To get hands-on-experience with the synthesis and determination of concentrations and purity.											
<b>CO3</b>	To acquire knowledge in handling of toxic chemicals in multi step preparation of biologically important											
<b>CO4</b>	To gain experience in the proposal of synthetic routes to functionalized derivatives.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	2	2	1	2	1	-	2	-
<b>CO2</b>	3	2	2	3	2	2		2	1	2	2	2
<b>CO3</b>	3	2	2	3	2	-	1	2	-	-	-	2
<b>CO4</b>	3	2	2	3	2	1	-	2	1	2	-	2

#### **CHE-OC-303 Core-Practical Organic Estimations PRACTICAL –I**

- 1) Estimation of phenol
- 2) Estimation of glucose
- 3) Estimation of primary amine
- 4) Estimation of ketone
- 5) Estimation of percentage purity of aspirin
- 6) Estimation of percentage purity of paracetamol.

#### **CHE-OC-304 Core-Practical Multistep preparations PRACTICAL –II**

- 1) Preparation of benzilic acid
- 2) Preparation of benzanilide
- 3) Preparation of o-chlorobenzoic acid
- 4) Preparation of symmetric tribromobenzene

<b>CHE-OC-305 A</b>	<b>Inorganic Spectroscopy and Thermal Methods of Analysis</b>	<b>L-5,T-1,P-0</b>	<b>4Credits</b>									
<b>Pre-requisite:</b> Understanding of Basic Inorganic Spectroscopy and Thermal Methods of Analysis												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>• Gain knowledge on thermal methods of analysis and principles and applications to inorganic materials.</li> <li>• Familiarize with basics of Mossbauer and NQR spectroscopy.</li> <li>• Learn the properties like g-factor, nuclear spin, hyperfine coupling constants</li> <li>• Study the ESR instrumentation, various applications and photoelectron spectroscopy.</li> </ul>												
<b>Course Outcomes :</b> At the end of the course, the student will be able												
<b>CO1</b>	To know the basic principles of instrumental methods of analysis.											
<b>CO2</b>	To gain knowledge on chemistry of alloys.											
<b>CO3</b>	To Understand the complexity, theory and working principle of colourimetry											
<b>CO4</b>	To familiarize with laws of colorimetric titrations.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	1	-	3	2	2	3	2	1	-	1	-
<b>CO2</b>	3	2	2	3	2	2	3	2	2	1	1	2
<b>CO3</b>	3	1	3	3	2	2	-	2	-	2	1	-
<b>CO4</b>	3	2	2	3	2	1	1	2	1	1	-	2

### CHE-OC- 305 A: 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, Quadrapole effects, Magnetic effects. Instrumentation, spectral parameters and spectrum display.

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

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

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

**15 Hrs**

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

## UNIT –IV: PHOTO ELECTRON SPECTROSCOPY

15 Hrs

Photoelectric effect, Koopmans's theorem, ionization energy.

**X-ray photoelectron spectroscopy (ESCA):** Principle, Binding energies, Chemical shift, Applications of XPES to Qualitative analysis, to surface studies and structural analysis. Ultraviolet photoelectron spectroscopy- Principle, application of UPES in studying the molecular orbitals of O<sub>2</sub> and N<sub>2</sub> 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 fingerprint tool.

### Books Suggested

1. F.A. Cotton and G. Wilkinson, Advanced Inorganic 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 (4<sup>th</sup> Ed.) (Addison-Wesley)
3. Gary Wulfsberg: Inorganic Chemistry (5<sup>th</sup> 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-OC- 305B	Physical Chemistry III				L-5,T-1,P-0				4 Credits			
<b>Pre-requisite:</b> Understanding of graduate level Physical Chemistry												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Learn applications of Group Theory, symmetry criteria and symmetry restrictions.</li> <li>Applications of X-ray Diffraction and Electron Diffraction on solid state chemistry.</li> <li>Familiarize with the applications of Microwave spectroscopy, infrared spectroscopy and Raman spectroscopy.</li> <li>Get knowledge on concept of Thermodynamics of polymer dissolution and Flory-Huggins theory of polymer solutions.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able to												
<b>CO1</b>	To know the determination of Character Co-ordinate of $C_{2V}$ point group based on 3N Coordinates and to learn the Mutual exclusion Principle.											
<b>CO2</b>	To learn the Bragg conditions-Miller Indices- Laue method, Bragg method, Debye Scherrer method of X-ray structural analysis of crystals.											
<b>CO3</b>	To study the rigid rotator model, stark effect, vibration-rotation spectroscopy, PQR branches, selection rules and Vibrational- rotational Raman spectroscopy.											
<b>CO4</b>	To study the concepts on heat of dissolution, regular solution theory, Hildebrand solubility parameter, concept of Flory-Huggins theory of polymer solutions											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	2	3	-	2	1	1	1	-	2	1
<b>CO2</b>	3	2	2	3	2	2	1	-	2	2	1	-
<b>CO3</b>	3	2	2	3	2	2	2	2		2	-	2
<b>CO4</b>	3	2	2	3	-	2	1	1	1	2	2	2

### CHE-OC-305B 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, and 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, Morse 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 anti-stokes 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.

<b>CHE OC 306 (A)</b>	<b>Spectral Techniques</b>	<b>L-5,T-1,P-0</b>	<b>4 Credits</b>									
<b>Pre-requisite:</b> Understanding of Spectral Techniques												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>• Familiarize with the instrumentation of UV and visible spectroscopy, applications of identifying the structures of the molecules.</li> <li>• Understand IR spectrometry and applications to ascertain the fundamental groups by observing absorption bands.</li> <li>• Study on the applications of flame atomic absorption spectroscopy.</li> <li>• Understand the working principle and fragmentation rules of different molecules in Mass spectroscopy.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will able												
<b>CO1</b>	To know the basic principles of spectroscopy.											
<b>CO2</b>	To familiarize with the analysis of various functional groups by using different spectroscopic techniques.											
<b>CO3</b>	To Understand the applications of AAS.											
<b>CO4</b>	To gain knowledge about Mass spectral fragmentation of organic compounds and common functional groups.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	1	1	3	-	2	3	2	-	1	1	1
<b>CO2</b>	3	2	2	3	2	2	3	2	-	1	-	2
<b>CO3</b>	3	2	-	2	2	2	2	-	2	-	1	-
<b>CO4</b>	3	2	2	3	-	2	1	2	1	1	1	2

### CHE : OC : 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 5<sup>th</sup> Ed, ELBS .2.
2. Spectroscopy of organic compounds, RM Silversteen and others 5<sup>th</sup> 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



<b>CHE OC 306 (B)</b>	<b>Chromatographic Techniques</b>	<b>L-5,T-1,P-0</b>	<b>4Credits</b>									
<b>Pre-requisite:</b> Understanding of graduate level Chromatographic Techniques												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Familiarize with Classification of Chromatographic methods.</li> <li>Understand Demonstration experiment in TLC.</li> <li>Study on the applications of High-Performance Liquid Chromatography (HPLC).</li> <li>Understand the working principle of gas chromatography.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will able to												
<b>CO1</b>	To know the stationary and mobile phases in chromatographic techniques.											
<b>CO2</b>	To familiarize applications of different chromatographic methods.											
<b>CO3</b>	To Understand the principle of chromatographic techniques.											
<b>CO4</b>	To gain knowledge on the normal phase and reverse phase.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	1	-	3	1	2	3	2	2	1	1	-
<b>CO2</b>	3	2	2	3	2	2	3	2	2	1	-	2
<b>CO3</b>	3	2	-	2	2	-	2	-	2	-	1	-
<b>CO4</b>	3	2	2	3	2	2	-	1	-	1	1	2

### CHE OC 306 (B) : Chromatographic Techniques

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

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

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

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

#### Reference Books:

- Analytical chemistry: G L David Krupadanam, D. Vijaya prasad, K. Varaprasad Rao, KLN Reddy, C. Sudhakar.
- Analytical chemistry: Skoog West Holler.
- Modern Analytical Chemistry : David Harvey DePauw University.
- J.G. Dick. Analytical Chemistry, Mc Graw Hill, New Delhi, (1973).

<b>CHE-OC- 401</b>	<b>Organic synthesis I</b>	<b>L-5,T-1,P-0</b>	<b>4Credits</b>									
<b>Pre-requisite:</b> Understanding of Organic synthesis												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>• Acquire knowledge in the applications of Boron, Phosphorus, Sulfur and Silicon reagents in organic synthesis and their special behavior.</li> <li>• Study photochemical reactions of olefins, carbonyl compounds, aromatic compounds, rearrangements and stereochemistry of the products.</li> <li>• Understand the concept of pericyclic reactions, determination of allowed and forbidden transitions and prediction of stereochemistry of the products.</li> <li>• Study different polymer reactions, Stereospecific polymers, Thermoplastics, Fibers, Elastomers and Ion exchange resins.</li> </ul>												
<b>Course Outcomes :</b> At the end of the course, the student will be able to												
<b>CO1</b>	Familiarize with the unique reactivity of Boron, Phosphorus, Sulfur and Silicon reagents											
<b>CO2</b>	Learn about photolytic reactions of carbonyl compounds, conjugated carbonyl derivatives, olefins, conjugated dienes CO <sub>3</sub> :To gain knowledge in the determination of allowed or forbidden of chemical reactions viz., cycloaddition and											
<b>CO3</b>	Learn the methods of preparation, properties, and industrial applications of various addition and condensation											
<b>CO4</b>	Familiarize with the unique reactivity of Boron, Phosphorus, Sulfur and Silicon reagents											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3	3	-	3	-	2	-	2	-	1
<b>CO2</b>	3	3	3	3	3	2	-	1	-	2	-	3
<b>CO3</b>	3	3	3	3	3	2	-	1	-	-	1	3
<b>CO4</b>	3	3	3	2	-	2	-	-	2	2	1	2

#### CHE OC-401: CORE THEORY: ORGANIC SYNTHESIS-I

##### UNIT-I: Chemistry of Organo Boran, Phosphorus, Sulfur and Silicon reagents 15Hrs

Electronic structure and bonding in Boron, Phosphorus, Sulphur and Silicon compounds-Their reactivity and applications in Organic Synthesis.

**Boron Reagents**-Hydroboration-Organoboranes in the formation of C-C bonds, alcohols, amines, halogen and carbonyl compounds-Free radical reactions of organoboranes.

**Phosphorus Reagents**- Formation of carbon-carbon double bonds-Functional group transformations – deoxygenation reactions-reactivity as electrophiles- conversion of alcohols to alkyl halides, Wittig reaction and nucleophiles - Corey-Winters reaction, Michaelis-Arbusov reaction-Perkow reaction and Mitsunobu reaction.

**Sulphur Reagents**- Sulphur ylides, stabilized and non-stabilized – Preparation and reactivity Pummerer reaction – sulphonyl carbanions-Julia reaction

**Silicon reagents**-Peterson's olefination, influence of trialkyl silyl reagents in electrophilic reactions, aryl silanes, alkenyl silanes, alkynyl silanes, allyl silanes.

##### UNIT-II: PHOTOCHEMISTRY

15Hr

Photochemical energy, photochemical excitations, Franck-Condon principle, electronic transitions, Jablonski diagram, singlet and triplet states, energy transfer in photochemical reactions - photosensitization reactions and quantum yield.

Photochemistry of carbonyl compounds - Norrish Type-I and Norrish Type-II reactions, Photo Reduction and Paterno-Buchi reaction. Photochemistry of  $\alpha,\beta$ -unsaturated ketones, enones, dienones and p-benzoquinones.

Photochemistry of unsaturated systems (olefins), cis-trans isomerization and dimerization reactions, Photochemistry of conjugated dienes - 1,3-butadiene, aromatic compounds, Photoaddition (1,2- & 1,4- additions) and Photosubstitution reactions of benzene derivatives. Photo-Fries rearrangement and Barton reaction.

**UNIT III: PERICYCLIC REACTIONS****15 Hrs**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3 butadiene, 1,3,5-hexatriene and allyl and pentadienyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO (Möbius-Hückel) approach. Electrocyclic reactions-Conrotatory and disrotatory.  $4n$ ,  $4n+2$  and allyl systems. Cycloadditions-antarafacial and suprafacial additions,  $4n$  and  $4n+2$  systems,  $2+2$  addition of ketene, 1,3 dipolar cycloadditions and cheletropic reactions. Sigmatropic rearrangements - Suprafacial and antarafacial shifts of H, Sigmatropic shifts involving carbon moieties, 3,3 and 5,5 Sigmatropic rearrangements. Claisen, Cope and Oxy-Cope rearrangements. Ene reaction

**UNIT IV: SYNTHETIC POLYMERS****15 Hrs**

Polymer Reactions-Addition and condensation polymerization processes- Bulk, Solution, Suspension and Emulsion polymerization.

Stereospecific Polymers-Preparation and significance- classification of polymers based on physical properties- Thermoplastics-Thermosetting plastics-Fibers and elastomers- General applications.

Preparation of Polymers-Preparation of Polymers based on different types of monomers Industrial applications-olefin polymers-Diene polymers-nylons-Glyptal resins-Urea-formaldehyde, phenol-formaldehyde and melamine resins- Epoxy resins - Ion exchange resins.

**Book References:**

1. Modern Synthetic Reactions, H.O. House, W.A Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge University Press.
3. Advanced Organic Chemistry, F.A. Carey and R.J Sundberg, Plenum.
4. Principles of Organic Synthesis, R.O.C. Norman and J.M Coxon, Blackie
5. Advanced Organic Chemistry Part A & B, F.A Carey and R. J Sunderg, Plenum Press.
6. Structure and Mechanism in Organic Chemistry C.K. Ingold, Cornell University Press.
7. Reaction Mechanism in Organic Chemistry, P.S. Kalsi, New Age International.
8. Modern Synthetic Reactions, H.O. House, W.A. Benjamin.
9. Chemistry of Organic Natural Products, O.P. Agrawal, Vols., 1 & 2, Goel Pubs.
10. Natural Products Chemistry K.B.G. Torssell, John Wiley, 1983.
11. Principles of biochemistry, A.L. Lehninger worth publishers
12. A Text book of Biochemistry, A.V.S.S. Rama Rao

<b>CHE-OC 402</b>	<b>Organic Synthesis II</b>	<b>L-5,T-1,P-0</b>	<b>4Credits</b>									
<b>Pre-requisite:</b> Understanding of Organic Synthesis												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>• Use disconnection approach and retrosynthetic analysis and control of stereochemistry to design efficient multi-step syntheses involving different types of disconnection approaches</li> <li>• Applications to synthesis complex naturally occurring compounds</li> <li>• Familiarize with synthesis and pharmacological properties of antimalarials and antibiotics</li> <li>• Understand structure and synthesis of proteins and nucleic acids</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able to												
<b>CO1</b>	Familiarize with functionalization and interconversion of functional groups and the concept of organic synthesis by retrosynthetic approach.											
<b>CO2</b>	Gain knowledge in the formulation of synthetic routes for naturally occurring drugs.											
<b>CO3</b>	Understand quinoline, acridine and guanidine group of alkaloids as antimalarials and to familiarize with the role of functioning of broad spectrum antibiotics.											
<b>CO4</b>	Acquire knowledge about the classification, properties, structure & conformation and biological functions of peptides/proteins.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3	3	2	-	1	-	-	1	-	3
<b>CO2</b>	3	3	3	3	2	1	-	-	-	1	-	2
<b>CO3</b>	3	3	3	3	2	-	-	2	-	1	1	3
<b>CO4</b>	3	3	3	3	2	2	-	2	-	-	2	3

### CHE OC-402: CORE THEORY: ORGANIC SYNTHESIS-II

#### UNIT-I: DESIGNING OF ORGANIC SYNTHESIS

**15 Hrs**

**Disconnection Approach**-Classification of organic reactions. Functionalisation and interconversion of functional groups, formation of carbon-carbon single and double bonds, general strategy, disconnection and synthon approach, retrosynthetic analysis, key intermediates and starting materials in designing a synthesis, linear and convergent synthesis, reconnections. The importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, amine synthesis.

**Protecting Groups**-Principles of protection of alcohol, amine, carbonyl and carboxyl groups.

**One Group C-C Disconnections**-Alcohols and carbonyl compounds, regioselectivity. Alkene synthesis, use of acetylenic compounds in organic synthesis.

**Two Group C-C Disconnections**-Diels-Alder reaction, 1,3-difunctionalised compounds, unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael addition and Robinson annulation.

#### UNIT II: MULTI STEP SYNTHESIS

**15 hrs**

Multi step synthesis of some complex naturally occurring compounds involving through retrosynthetic analysis and control of stereochemistry, Longifolene, Taxol, Juvabione, Fediricamycine A.

#### UNIT III: ANTIMALARIALS AND ANTIBOTICS

**15 hrs**

Antimalarials: Synthesis and activity of Quinoline group – Quinine, Plasmoquine and Chloroquine – Acridine group – Quinacrine – Guanidine group – Paludrine.

Antibiotics: Synthesis and activity of Penicillin, Chloramphenicol and Streptomycin – Broad spectrum antibiotics – Tetracyclines, Novobiocin.

Chemotherapy: Structure – activity relationships.

#### UNIT-IV: BIOMOLECULES

**15 Hrs**

Peptides and Proteins-Methods of peptide synthesis, sequence determination, structure of oxytocin, proteins-classification, structure, conformation and properties. Nucleic acids- Nucleosides, Nucleotides, DNA and RNA, structure and conformations, replication, translation of genetic material, genetic code, gene expression, gene mutation, protein synthesis.

**Book References:**

- 1) Modern Synthetic Reactions, H.O. House, W.A Benjamin.
- 2) Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge University Press.
- 3) Advanced Organic Chemistry, F.A. Carey and R.J Sundberg, Plenum.
- 4) Principles of Organic Synthesis, R.O.C. Norman and J.M Coxon, Blackie
- 5) Advanced Organic Chemistry Part A & B, F.A Carey and R. J Sunderg, Plenum Press.
- 6) Structure and Mechanism in Organic Chemistry C.K. Inglood, Cornell University Press.
- 7) Reaction Mechanism in Organic Chemistry, P.S. Kalsi, New Age International.
- 8) Modern Synthetic Reactions, H.O. House, W.A. Benjamin.
- 9) Chemistry of Organic Natural Products, O.P. Agrawal, Vols., 1 & 2, Goel Pubs.
- 10) Natural Products Chemistry K.B.G. Torssell, John Wiley, 1983.
- 11) Principles of biochemistry, A.L. Lehninger worth publishers
- 12) A Text book of Biochemistry, A.V.S.S. Rama Rao

<b>CHE OC 403</b>	<b>Core practical I: Spectral Identification of Organic Compounds</b>				<b>L-5,T-1,P-0</b>	<b>4 Credits</b>						
<b>Pre-requisite:</b> Understanding of Spectral identification of organic compounds												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Spectral identification of organic compounds by UV by calculating <math>\lambda</math> max values</li> <li>Identification of absorption bands by IR and ascertain to the functional groups</li> <li>Unambiguous assignment of structures by interpreting NMR values</li> <li>Predict the characteristic cleavage processes by Mass.</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able to												
<b>CO1</b>	Calculate $\lambda$ max values.											
<b>CO2</b>	Ascertain functional groups.											
<b>CO3</b>	Interpret the spectral data to the structure and stereochemistry of the molecules.											
<b>CO4</b>	Analyse the fragmentation pattern of the molecules.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3	3	3	-	-	2	-	-	2	3
<b>CO2</b>	3	3	3	3	-	2	-	2	-	2	-	3
<b>CO3</b>	3	3	-	3	-	3	-	2	-	3	-	3
<b>CO4</b>	3	-	3	-	3	2	-	-	-	2	-	3

#### CHE OC 403: PRACTICAL-I

Spectral identification of organic compounds by UV, IR, NMR ( $^1\text{H}$  &  $^{13}\text{C}$ ) & Mass spectroscopy.

##### 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  $\text{F}^-$ ,  $\text{S}^{2-}$  and  $\text{CN}^-$  in effluents using ion selective electrode meter.
- 5 Polarography and Anode stripping voltametry
- (a) Polarography and Anode stripping voltametry – behavior of Cd, Zn, Pb in a mixture.
- (b) Determination of Pb and Cd in samples using Anode stripping voltametry
- 6 Gas chromatography- Determination of pesticides
- 7 HPLC- Determination of pesticides
- 8 NMR
  - a). Demonstration of NMR spectrometer and study of hydrogen bonding in a given alcohol or phenol.
  - b). Interpretation of NMR chemical shifts of ethyl benzene, ethyl alcohol
- 9 TGA, DTA, DSC – Demonstration of TG, DTA and DSC and study of decomposition of calcium oxalate, calcium carbonate, copper sulfate, oxalic acid.
- 10 pH metry
  - a) Determination of alkalinity in a colored effluent using pH metric end point.
  - b) Determination of purity of commercial  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_3\text{PO}_4$  and  $\text{CH}_3\text{COOH}$  using pH metric end point

<b>CHE OC 404</b>	<b>Practical II: Project Work</b>				<b>L-5,T-1,P-0</b>				<b>4 Credits</b>			
<b>Pre-requisite: Organic Chemistry Project Work</b>												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>• Identification of problem by literature survey</li> <li>• Ability to carry out independently with competency in research design and synthesis</li> <li>• Interpretation of spectral data to the structures of the molecules</li> <li>• Communication of research results through presentations and preparation of dissertation</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able to												
<b>CO1</b>	Identify the problem, to collect the literature and understanding parameters to design the problem.											
<b>CO2</b>	Perform experiments to synthesize the molecules with desired stereochemistry adopting modern techniques.											
<b>CO3</b>	Collect and interpretation of the data to the structures.											
<b>CO4</b>	Presentation of the data in the form of dissertation.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	2	3	-	2	2	2	-	2	2	3
<b>CO2</b>	3	3	3	3	3	2	2	2	-	2	2	3
<b>CO3</b>	3	3	3	3	3	3	3	2	-	2	-	3
<b>CO4</b>	3	3	3	3	3	2	3	2	-	-	2	3

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

<b>CHE-OC-405A</b>	<b>Heterocycles and Natural Products</b>	<b>L-3,T-1,P-2</b>	<b>4 Credits</b>									
<b>Pre-requisite:</b> Understanding of Heterocycles and Natural Products												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>Familiarize with Hantzsch-Widmann nomenclature of Fused heterocycles. Synthesis and reactivity of five membered heterocycles with two hetero atoms</li> <li>Understand synthesis and reactivity of benzofused five membered and six membered heterocycles</li> <li>Gain knowledge on structural elucidation, synthesis and biosynthesis of steroids and hormones</li> <li>Familiarize with on structural elucidation, synthesis and biosynthesis of flavonoids and isoflavonoids</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able to												
<b>CO1</b>	Familiarize with the synthetic routes of five membered heterocycles with two heteroatoms and to justify the site of											
<b>CO2</b>	Acquire knowledge on the synthetic methodologies of benzofused and six membered heterocycles and the effect of											
<b>CO3</b>	Familiarize with the structural elucidation and synthesis of naturally occurring steroids and hormones											
<b>CO4</b>	Know about isolation, structural determination and synthesis of flavonoids and isoflavonoids.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3	3	2	2	-	2	-	2	-	3
<b>CO2</b>	3	3	3	3	2	2	-	2	-	2	1	3
<b>CO3</b>	3	3	3	3	2	-	-	2	-	-	1	3
<b>CO4</b>	3	3	3	3	2	-	-	2	-	-	1	3

### **CHE : OC-405(A) : (GENERIC ELECTIVE): HETEROCYCLES AND NATURAL PRODUCTS**

#### **UNIT-I: NOMENCLATURE AND FIVE MEMBERED HETEROCYCLES 15 HRS**

Systematic nomenclature (Hantzsch-Widman nomenclature) for fused and bridged heterocycles, Five membered heterocycles with two heteroatoms: Synthesis and reactions of pyrazole, imidazole, isoxazole, oxazole, isothiazole and thiazole

#### **UNIT-II: BENZOFUSED FIVE MEMBERED AND SIX MEMBERED HETEROCYCLES**

**15 HRS**

Benzofused five membered heterocycles: Synthesis and reactions of Benzopyrazoles, Benzimidazoles and Benzoxazoles

Six Membered heterocycles with two or more heteroatoms: Synthesis and reactions of diazines (pyridazine, pyrimidine & pyrazine) and triazines (1,2,3-, 1,2,4- 1,3,5- triazines)

#### **UNIT-III: STEROIDS AND HORMONES**

**15 HRS**

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol (total synthesis not expected), Bile acids, Androsterone, Testosterone, Estrone, Progesterone. Biosynthesis of steroids.

#### **UNIT-IV: FLAVONOIDS AND ISOFLAVONOIDS**

**15 Hrs**

Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Kaempferol, Quercetin, Butein, Daidzein, Biosynthesis of flavonoids and isoflavonoids: Acetate Pathway and Shikimic acid Pathway. Biological importance of flavonoids and isoflavonoids.

#### **Reference Books:**

- Heterocyclic chemistry Vol. 1-3, R.R. Gupta, M.Kumar and V. Gupta, Springer Verlag.
- The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
- Heterocyclic Chemistry, J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
- Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical.
- Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Paudler, Wiley-Inter Science.
- An Introduction to the Heterocyclic Compounds, R.M. Acheson, John Wiley.
- Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, eds. Pergamon Press.
- Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
- Introduction to Flavonoids TA Geissman.



(Compulsory Foundation)

<b>CHE-OC-405B</b>	<b>Bioinorganic, Bioorganic, Biophysical Chemistry</b>	<b>L-5,T-1,P-0</b>	<b>4 Credits</b>									
<b>Pre-requisite:</b> Understanding of Bioinorganic, Bioorganic, Biophysical Chemistry												
<b>Course Objectives:</b> <ul style="list-style-type: none"><li>• Highlighten metal complexes as oxygen carriers and electron transfer in biology.</li><li>• Metal ion transport and storage in biological systems and importance of trace metals in biology.</li><li>• Learn physiological functions of carbohydrates, lipids, enzymes classification, stereospecificity.</li><li>• The basic concepts of biophysical chemistry in biochemical reactions, exergonic and endergonic reactions.</li></ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able to												
<b>CO1</b>	Gain knowledge on metallo proteins in electron transfer processes.											
<b>CO2</b>	Know the applications of trace metal ions and metal ions as chelating agents in medicine.											
<b>CO3</b>	Achieve and develop highly stereoselective synthesis of organic compounds and drugs by adopting environmentally.											
<b>CO4</b>	Understand thermodynamics of biopolymer reactions and to correlate free energy and biopolymer parameters.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3	2	3	3	3	2	-	2	-	3
<b>CO2</b>	3	3	3	3	3	2	3	-	-	-	3	3
<b>CO3</b>	3	3	3	3	3	3	-	2	-	2	-	3
<b>CO4</b>	3	3	3	3	3	3	2	2	-	3	3	3

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

#### **UNIT-I: BIO-INORGANIC CHEMISTRY- I**

**15 Hrs**

Metal complexes as oxygen carriers –Heme proteins –Hemoglobin and myoglobin –Non heme proteins –hemerythrin and hemocyanin – model synthetic complexes of iron, cobalt and copper.Co-enzymes Vitamin B<sub>12</sub>,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 2<sup>nd</sup> 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. Torrsell, John Wiley, 1983.
11. Burger's Medicinal Chemistry, M.E. Wolff, John Wiley
12. Medicinal Chemistry, A. Kar, New Age International

CHE OC 406A	Drug Chemistry	L-3,T-1,P-2	4Credits									
<b>Pre-requisite:</b> Understanding of Drug Chemistry												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>To learn about the natural products as leads for new drugs</li> <li>Determination of cardiovascular drugs</li> <li>To study Autacoids</li> <li>Interpretation of Antipyretics</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will be able to												
<b>CO1</b>	Know about natural products.											
<b>CO2</b>	Know Interpretation of cardiovascular drugs.											
<b>CO3</b>	Know the Analyzing about prostaglandins.											
<b>CO4</b>	Know the Definition, Classification, Nomenclature, Structure and Synthesis of anti-inflammatory drugs.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3	3	3	-	-	2	-	-	2	3
<b>CO2</b>	3	3	3	3	-	2	-	2	-	2	-	3
<b>CO3</b>	3	3		3	-	3	-	2	-	3	-	3
<b>CO4</b>	3	-	3	-	3	2	-	-	-	2	-	3

**CHE : OC : 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 PGE<sub>1</sub>, PGE<sub>2</sub>; Synthesis and biosynthesis of PGE<sub>2</sub>, PGF<sub>2α</sub>.

Structure and Biosynthesis of Thromboxane A<sub>2</sub> and Prostacyclin (synthesis not expected).

**UNIT – IV: ANTI-INFLAMMATORY DRUGS**

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

**Books suggested:**

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

CHE OC 406B	Electroanalytical Techniques	L-5,T-1,P-0	4 Credits									
<b>Pre-requisite:</b> Understanding of Electroanalytical Techniques												
<b>Course Objectives:</b>												
<ul style="list-style-type: none"> <li>To learn about the classification of electroanalytical methods</li> <li>Determination of types of currents</li> <li>Principle, instrumentation, reversible and irreversible cyclic voltammograms..</li> <li>Interpretation of Ion selective electrodes</li> </ul>												
<b>Course Outcomes:</b> At the end of the course, the student will able to												
<b>CO1</b>	Ability to interpret potentiometry and conductometry											
<b>CO2</b>	Interpretation of results while adhering to DC Polarography.											
<b>CO3</b>	Analysing and compiling the data and results in polarography.											
<b>CO4</b>	Familiarize Types of ion sensitive electrodes.											
<b>Mapping of course outcomes with the program outcomes</b>												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	3	3	3	-	-	2	-	-	2	3
<b>CO2</b>	3	3	3	3	-	2	-	2	-	2	-	3
<b>CO3</b>	3	3	-	3	-	3	-	2	-	3	-	3
<b>CO4</b>	3	-	3	-	3	2	-	-	-	2	-	3

### CHE : OC : 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).
- G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denny. Vogel's Text Book of Quantitative Chemical Analysis (ELBS).
- D.A. Skoog and D.M. West: Principles of Instrumental Analysis (Holt, Rinehart and Wilson).
- J.G. Dick : Analytical Chemistry (Mc Graw Hill).