

**M.Sc. ORGANIC CHEMISTRY  
SYLLABUS**

**(For Vikrama Simhapuri University and Its Affiliated Colleges)**

**(Effective from the Academic Year 2020-2021)**



**DEPARTMENT OF CHEMISTRY  
VIKRAMA SIMHAPURI UNIVERSITY  
NELLORE – 524320  
FEBRUARY 2021**

**VIKRAMA SIMHAPURI UNIVERSITY :: NELLORE**

**M.Sc. ORGANIC CHEMISTRY  
COURSE PATTERN AND SCHEME OF EXAMINATION  
(w.e.f. Academic Year 2020-21)**

Semester	Paper Code	Title of the Theory Paper	Credit Points	Exam. Marks			
				External	Internal	Total	
<b>I</b>	CHE 101	Inorganic Chemistry- I	4	70	30	100	
	CHE 102	Organic Chemistry - I	4	70	30	100	
	CHE 103	Physical Chemistry -I	4	70	30	100	
	CHE 104	General Chemistry- I	4	70	30	100	
	CBCS	Human Values and Professional Ethics	0	70	30	100	
	<b>Practicals</b>						
		<b>Paper Code</b>	<b>Title of the Practical Paper</b>	<b>Credit Points</b>	<b>Experiment</b>	<b>(Record + Viva-Voce)</b>	<b>Total</b>
		CHE	Inorganic Chemistry Lab-I	2	50	10+7	67
		CHE	Organic Chemistry Lab-I	2	50	10+7	67
		CHE	Physical Chemistry Lab-I	2	50	10+6	66
<b>TOTAL</b>			<b>22</b>			<b>600</b>	
<b>II</b>		<b>Paper Code</b>	<b>Title of the Theory Paper</b>	<b>Credit Points</b>	<b>Exam. Marks</b>		
					<b>External</b>	<b>Internal</b>	<b>Total</b>
		CHE	Inorganic Chemistry- II	4	70	30	100
		CHE	Organic Chemistry - II	4	70	30	100
		CHE	Physical Chemistry –II	4	70	30	100
		CHE	General Chemistry- II	4	70	30	100
		CBCS	Personality enhancement and Leadership	0	70	30	100
	<b>Practicals</b>						
		<b>Paper Code</b>	<b>Title of the Practical Paper</b>	<b>Credit Points</b>	<b>Experiment</b>	<b>(Record + Viva-Voce)</b>	<b>Total</b>
		CHE	Inorganic Chemistry Lab -II	2	50	10+7	67
	CHE	Organic Chemistry Lab- II	2	50	10+7	67	
	CHE	Physical Chemistry Lab-II	2	50	10+6	66	
<b>TOTAL</b>			<b>22</b>			<b>600</b>	

Semester	Paper Code	Title of the Theory Paper	Credit Points	Exam. Marks			
				External	Internal	Total	
III	CHE 301	Organic Synthesis - I	4	70	30	100	
	CHE 302	Organic Synthesis – II	4	70	30	100	
	CHE 303	Bioinorganic and Physical Chemistry	4	70	30	100	
	CHE 304	Organic Spectroscopy and Its applications	4	70	30	100	
	<b>Practicals</b>						
		<b>Paper Code</b>	<b>Title of the Practical Paper</b>	<b>Credit Points</b>	<b>Experiment</b>	<b>(Record + Viva-Voce)</b>	<b>Total</b>
		CHE 305	Practical –I (Multistep Synthesis)	4	80	10+10	100
		CHE 306	Practical –II (Estimations)	4	80	10+10	100
<b>TOTAL</b>			<b>24</b>			<b>600</b>	
IV	<b>Paper Code</b>	<b>Title of the Theory Paper</b>	<b>Credit Points</b>	Exam. Marks			
				External	Internal	Total	
		CHE 401	Organic Synthesis - III	4	70	30	100
		CHE 402	Heterocyclic Compounds and Natural products	4	70	30	100
		CHE 403	Bio Medicinal Chemistry	4	70	30	100
	CHE 404	General Organic Chemistry	4	70	30	100	
<b>Practicals</b>							
	<b>Paper Code</b>	<b>Title of the Practical Paper</b>	<b>Credit Points</b>	<b>Experiment</b>	<b>(Record + Viva-Voce)</b>	<b>Total</b>	
	CHE 405	Practical –I (Spectral Problems)	4	80	10+10	100	
	CHE 406	Practical –II (Dissertation (Inorganic/Organic/Physical))	4	80	20 (ppt)	100	
<b>TOTAL</b>			<b>24</b>			<b>600</b>	

**VIKRAMA SIMHAPURI UNIVERSITY: NELLORE**  
**M.Sc. ORGANIC CHEMISTRY**

**SEMESTER – I**

<b>Paper –I</b> <b>CHE 101</b>	<b>INORGANIC CHEMISTRY – I</b> Unit I : Co ordination Complexes Unit II : Reaction Mechanisms of Metal Complexes Unit III : Chemistry of Non Transition Elements Unit IV : Metal Carbonyls and Nitrosyls
<b>Paper –II</b> <b>CHE 102</b>	<b>ORGANIC CHEMISTRY – I</b> Unit I : Aromaticity Unit II : Reaction Mechanism-I (Substitution Reactions) Unit III : Reactive Intermediates Unit IV : Heterocyclic Compounds
<b>Paper – III</b> <b>CHE 103</b>	<b>PHYSICAL CHEMISTRY – I</b> Unit I : Thermodynamics - I Unit II : Quantum Chemistry-I Unit III : Chemical Kinetics -I Unit IV : Electrochemistry-I
<b>Paper - IV</b> <b>CHE 104</b>	<b>GENERAL CHEMISTRY – I</b> Unit I : Mathematical Concepts and Computers Unit II : Polymers Unit III : Electro Chemical Batteries Unit IV : Solid State Chemistry
<b>PRACTICALS</b>	
<b>Paper - V</b> <b>CHE 105</b>	Inorganic Chemistry Lab – I
<b>Paper - VI</b> <b>CHE 106</b>	Organic Chemistry Lab - I
<b>Paper - VII</b> <b>CHE 107</b>	Physical Chemistry Lab – I

## M.Sc. ORGANIC CHEMISTRY

### SEMESTER – II

<b>Paper –I CHE 201</b>	<b>INORGANIC CHEMISTRY – II</b> Unit I : Magnetochemistry of Transition Metal Complexes UnitII: Electronic Spectroscopy of Transition Metal Complexes Unit III: Mossbauer and NQR Spectroscopy Unit IV: Metal - Ligand Equilibrium in Solution
<b>Paper –II CHE 202</b>	<b>ORGANIC CHEMISTRY – II</b> Unit I : Reaction mechanism-II (Elimination & Addition Reactions) Unit II : Stereo Chemistry Unit III : Alkaloids Unit IV : Terpenoids
<b>Paper – III CHE 203</b>	<b>PHYSICAL CHEMISTRY – II</b> Unit I : Statistical Thermodynamics Unit II : Quantum Chemistry-II Unit III : Symmetry and Group Theory Unit IV : Electrochemistry-II
<b>Paper - IV CHE 204</b>	<b>GENERAL CHEMISTRY – II</b> Unit I : Treatment of Analytical Data Unit II: Flame Emission and Atomic Absorption Spectroscopy Unit III : Electron Spin Resonance Spectroscopy Unit IV : Catalysis
<b>PRACTICALS</b>	
<b>Paper - V CHE 205</b>	Inorganic Chemistry Lab –II
<b>Paper - VI CHE 206</b>	Organic Chemistry Lab - II
<b>Paper - VII CHE 207</b>	Physical Chemistry Lab – II

**M.Sc. ORGANIC CHEMISTRY****SEMESTER – III**

<b>Paper –I CHE 301</b>	<b>ORGANIC SYNTHESIS –I</b> Unit I : Oxidations Unit II: Reductions Unit III: Rearrangements Unit IV: Modern Synthetic Reactions
<b>Paper –II CHE 302</b>	<b>ORGANIC SYNTHESIS –II</b> Unit I : Non-metallic Reagents in Organic synthesis Unit II Reagents in Organic Synthesis Unit III : Photochemistry Unit IV : Pericyclic Reactions
<b>Paper – III CHE 303</b>	<b>BIOINORGANIC AND BIOPHYSICAL CHEMISTRY</b> Unit I : Bioinorganic Chemistry Unit II : Organometallic Chemistry Unit III : Biophysical Chemistry Unit IV : Applications of Group Theory
<b>Paper - IV CHE 304</b>	<b>ORGANIC SPECTROSCOPY AND ITS APPLICATIONS</b> Unit I : UV, ORD and CD Unit II: Infrared Spectroscopy Unit III : $^1\text{H}$ NMR and $^{13}\text{C}$ NMR Unit IV : Mass Spectrometry
<b>PRACTICALS</b>	
<b>Paper - V CHE 305</b>	Practical I (Multistep Synthesis)
<b>Paper - VI CHE 306</b>	Practical II (Estimations)

**M.Sc. ORGANIC CHEMISTRY****SEMESTER – IV**

<b>Paper –I CHE 401</b>	<b>ORGANIC SYNTHESIS -III</b> Unit I : Synthetic Strategies - I Unit II: Synthetic Strategies - II Unit III: Asymmetric Synthesis Unit IV: Synthetic Polymers
<b>Paper –II CHE 402</b>	<b>HETEROCYCLIC COMPOUNDS AND NATURAL PRODUCTS</b> Unit I : Heterocyclic Compounds (5 membered) Unit II : Benzofused Heterocyclics Unit III : Steroids & Hormones Unit IV : Flavonoids & Isoflavonoids
<b>Paper – III CHE 403</b>	<b>BIOMEDICINAL CHEMISTRY</b> Unit I : Carbohydrates Unit II : Bio molecules Unit III : Vitamins & Prostaglandins Unit IV : Antimalarials & Antibiotics
<b>Paper - IV CHE 404</b>	<b>GENERAL ORGANIC CHEMISTRY</b> Unit I : Green Chemistry Unit II: Newer Methods in Organic Synthesis Unit III : Drug Discovery & Principles of Drug Design Unit IV : Nanomaterials
<b>PRACTICALS</b>	
<b>Paper - V CHE 405</b>	Practical I (Spectral Problems)
<b>Paper - VI CHE 406</b>	Practical II (Dissertation (Inorganic/Organic/Physical))

## SEMESTER-I

### CHE-101: INORGANIC CHEMISTRY - I

#### UNIT – I: CO ORDINATION COMPLEXES

15 hrs

Introduction to Crystal field theory, Types of ligands, Spectrophotometric series, Salient features of CFT, CFSE and its calculation, Pairing Energy, Splitting of d orbital's in octahedral, square planar, tetrahedral, square pyramidal and trigonal bipyramidal geometries. High spin and low spin octahedral complexes. Factors affecting the magnitude of crystal field splitting. Jahn-Teller effect, Applications of CFT, OSSE, site selection in spinels and limitations of CFT.

#### UNIT - II: REACTION MECHANISMS OF METALCOMPLEXES

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 and factors affecting acid hydrolysis. Base hydrolysis, conjugate base mechanism, Anation reactions, Substitution reactions in square planar complexes - Trans effect, Mechanisms of trans effect, Theories of trans effect - Polarization theory and  $\pi$ -bonding theory. Electron transfer reactions - Inner sphere and outer sphere mechanisms, Marcus theory.

#### UNIT – III: CHEMISTRY OF NON TRANSITION ELEMENTS

15 hrs

General characteristics of non transition elements, Special features of individual elements, Synthesis, Properties and structure of their halides and oxides, Polymerization of Carbon, Phosphorous and Sulphur. Synthesis, Properties and Structure of Boranes, Carboranes, Borazines, Silicates, Carbides, Sulphur-Nitrogen Compounds. Electron counting in Boranes, Wades rules (Polyhedral skeletal electron pair theory), Isopropyl and Hetero poly acids.

#### UNIT – IV: METAL CARBONYLS AND NITROSYLS

15 hrs

**Metal Carbonyls** – Synthesis of metal carbonyls, Structure 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 CO ligand, (ii) Determination of molecular symmetry and (iii) Determination of



bond angles in metal carbonyls, Synergistic effect, EAN and 18- electron rule as applied to metal carbonyls, Electron counting methods – (i) Oxidation State method and (ii) Neutral Atom method.

**Metal Nitrosyls:** Synthesis of metal Nitrosyls, Bonding, Electron donation by nitric oxide, Principles of Stoichiometry, Modes for NO bonding – (i) Covalent model and (ii) Ionic models, Structures of Metal nitrosyls (1)  $[\text{IrCl}(\text{PPh}_3)(\text{CO})(\text{NO})]^+$ , (2)  $[\text{RuCl}(\text{PPh}_3)_2(\text{NO})_2]^+$ , (3)  $[(\text{Cp})\text{CrCl}(\text{NO})_2]$ , (4)  $[(\text{Cp})_2\text{Cr}_2\text{Cl}(\text{NO})_4]$ , Applications of Metal Nitrosyls.

### Books suggested

1. Inorganic Chemistry, J. E. Huheey, E. A. Keiter and R. L. Keiter, 4<sup>th</sup> edition, Harper Collins College Publishers.
2. Concepts and models of Inorganic Chemistry, B.E. Douglas, D.H. McDaniel and J.J. Alexander, 3<sup>rd</sup> edition, John-Wiley.
3. Inorganic Chemistry, D.F. Shriver and P.W. Atkins, 3<sup>rd</sup> edition, Oxford.
3. Advanced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, 6<sup>th</sup> edition, Wiley Interscience.
4. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, 3<sup>rd</sup> edition, Low Price edition.
5. Inorganic Chemistry, K.F. Purcell and J.C. Kotz, Holt – Saunders International Edition.
6. Coordination Chemistry, F. Basolo and R. Johnson, Benjamin Inc.
7. Concise Inorganic Chemistry, J. D. Lee, Blackwell Science.
8. Metal complexes in aqueous solutions, A.E. Martell and R.D. Hancock, Plenum Press.
9. Chemistry of complex equilibria, M.R. Beck, Von Nostrand Reinhold.
10. Homogeneous catalysis by metal complexes, Volumes I & II, M.M. Taquikhan and A.E. Martell, Academic Press.
11. Coordination Chemistry, D. Banerjee.
12. Metal ions in reaction mechanisms, K. Veera Reddy, Golgotia Publications (P) Ltd.

## CHE102: ORGANIC CHEMISTRY-I

### UNIT-I: AROMATICITY

15hrs

Huckle's rule and the concept of aromaticity, aromaticity in benzenoid and non benzenoid compounds, alternant and non-alternant hydrocarbons. Metallocenes-preparations and properties of ferrocene, azulenes, annulenes, fulvenes. Anti-aromaticity, pseudo-aromaticity, homo-aromaticity.

### UNIT-II: REACTION MECHANISMS-I (Substitution Reactions)

15hrs

**Aliphatic Nucleophilic Substitutions:** The  $S_N2$ ,  $S_N1$ , mixed  $S_N1$  and  $S_N2$ , Definition and types of ambident nucleophiles, SET mechanisms. The neighbouring group mechanism, neighbouring group participation by  $\sigma$  and  $\pi$ - bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements—primary, secondary and tertiary. The  $S_N1^i$  mechanism, Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate, attacking nucleophile, leaving group and reaction medium.

**Aromatic Nucleophilic Substitution:** The  $S_NAr$ ,  $S_N1$ , benzyne mechanisms. The von Richter, Sommelet-Hauser and Smiles rearrangements.

### UNIT-III: REACTIVE INTERMEDIATES

15 hrs

Types of reactions and mechanisms, thermodynamic and kinetic requirements, kinetic and thermodynamic control, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.

Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes and arynes.

### UNIT-IV: HETEROCYCLIC COMPOUNDS

15hrs

Introduction and importance. Replacement and systematic nomenclature (Hantzsch-Widman) for three, four, five, six membered, fused and bridged heterocycles.

**Three and four membered heterocycles:** Synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes.

### 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. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry C.K.Ingold, Cornell University Press.
5. Organic Chemistry, R.T Morrison and R.N. Boyd, Prentice - Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C Norman and J. M. Coxon, Blackie Academic & Professional.
8. Reaction Mechanism in Organic Chemistry, P.S. Kalsi, New Age International
9. Heterocyclic chemistry Vol. 1-3, R.R. Gupta, M.Kumar and V. Gupta, Springer Verlag.
10. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
11. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical.
12. An Introduction to the Heterocyclic Compounds, R.M. Acheson, John Wiley.
13. Text book of Organic Chemistry, Fessendon and Fessendon.
14. Text book of Organic Chemistry, T.W. Solomon,
15. Organic Chemistry, Vol I, I.L.Finar, ELBS Eds.
15. A primer to mechanism in organic chemistry, Peter Sykes, PSN Education.
16. Mechanism and theory in organic chemistry, Thomas H Lowry, Addison Wesley Longman
17. Introduction to organic chemistry, Andrew Streitwieser, and Elaton H Heath cock, Prentice Hall
18. Advanced Organic Chemistry : Reactions and mechanisms, Bernord Miller.
19. Chemistry for changing times, 8<sup>th</sup> ed. John W. Hill, Doris K. Kolb. Printice Hall.
20. Principles of Modern Heterocyclic Chemistry, L.A. Paquett.

## **CHE103: PHYSICAL CHEMISTRY-I**

### **UNIT I: THERMODYNAMICS-1**

Thermodynamic system-Surroundings-Types of systems-Thermodynamic variables (or) State variables. Thermodynamic process. Exact and inexact differentials.

Internal energy- Nature of work and heat- Zeroth law of Thermodynamics-First law of Thermodynamics- Mathematical formulation of the first law of Thermodynamics. Heat changes- Heat content (Enthalpy) – Heat Capacity- Heat Capacity at constant volume and Heat capacity at constant Pressure. Applications of first law of Thermodynamics :  $C_p - C_v = R$  derivation – Maxwell Relations – chemical potential – derivation of Gibb's Duhem equation – Fugacity and its determination

### **UNIT II: QUANTUM CHEMISTRY-I**

Photoelectric effect-black-body radiation- Plank's equation- wave particle duality and uncertainty principle- Hydrogen emission spectrum- Bohr's model of the atom.

Operators Algebra operator Addition- subtraction-multiplication operators. Commutator operator- Commutative property of operator linear operator- operator's  $\nabla$  and  $\nabla^2$  – derivation of Schrodinger wave equation - Eigen values and Eigen functions-Hermitian property of operators- properties of Hermitian operator- derivation of operator for momentum and energy - well behaved functions-Normalized function- orthogonality condition-degeneracy.

### **UNIT-III: CHEMICAL KINETICS- I**

Rate- Rate laws – order of reaction- molecularity of reaction- difference between order of reaction and molecularity. Theories of reaction rates: Collision Theory of bimolecular reactions- Collision Theory of unimolecular reactions.

Theories of absolute reaction rates- Transition state theory- mathematical treatment of transition state theory, Lindeman's Theory of unimolecular reactions, RRKM theory.

Chain reactions: Reaction kinetics of hydrogen-bromine reaction- reaction kinetics of Hydrogen- chlorine reactions.  $H_2O_2$  explosion reactions.

## **UNIT-IV: ELECTROCHEMISTRY-I**

Thermodynamic and kinetic derivation of Nernst equation-chemical and concentration cells with and without transference- liquid junction potential- derivation of the expression liquid junction potential- it's determination and elimination- Applications of conductance Measurements (i) solubility product(ii) pH determination (iii) potentiometric titrations Conductance, resistance, specific conductance and conductometric titrations. Classification of electrochemical cells. Selection and characterization of electro chemical cells.

### **Books suggested**

1. Thermodynamics for Chemists by Glasstone.
2. An introduction to Thermodynamics by Rastogi and Misra.
3. Thermodynamics for students of chemistry by J.Kuriakose and Rajaram.
4. Basic Thermodynamics by Gupta.
5. Chemical Kinetics by K. J.Laidler.
6. Kinetics and mechanisms of Chemical transformations by J.Kuriakose and Rajaram.
7. Introduction to Electrochemistry by S. Glasstone.
8. Modern Electrochemistry by J.O.M.Bockris and A.K.N.Reddy.
9. Soviet Electrochemistry by C.Ansvipov.
10. Quantum Chemistry by A.K.Chandra.

## **CHE104: GENERAL CHEMISTRY-I**

### **UNIT I : MATHEMATICAL CONCEPTS AND COMPUTERS**

#### **(A) Mathematical Concepts**

Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like  $k_x$ ,  $e^x$ ,  $x^n$ ,  $\sin x$ ,  $\log x$ ; maxima and minima, partial differentiation and reciprocity relations. Integration of some useful/relevant functions; permutations and combinations. Factorials. Probability.

#### **(B) Computers**

General introduction to computers, different components of a computer, hardware and software, input-output devices; binary numbers and arithmetic; introduction to computer languages. Programming, operating systems.

### **UNIT II : POLYMERS**

Classification based upon polymerization mechanism- classification based upon polymer structure-Thermoplastics and Thermo sets- polymerization techniques: Bulk polymerization, solution polymerization and suspension polymerization, emulsion polymerization and plasma polymerization. The management of plastics in the environment: (1) Recycling (2) Incineration (3) Biodegradation- conductive polymers- photoconductive polymers in Biomedical Engineering and drugs delivery- kidney dialysis- Applications in Electronics.

### **UNIT-III : ELECTRO CHEMICAL BATTERIES**

Introduction- primary batteries- secondary batteries lead storage batteries- dry-cell batteries Nickel- Cadmium batteries- Nickel-metal hydride batteries Lithium and Lithium –ion batteries and its Applications. Fuel-cells- $H_2$ - $O_2$  Fuel cell- Direct methanol fuel cell Proton Exchange Membrane (PEM) fuel cells and its applications. Solar- cells.

### **UNIT IV : SOLID STATE CHEMISTRY**

Introduction to solid state materials –bonding in solids-Ionic,covalent,metallic,hydrogen and Vander Waals(molecular) bondings-cohesive energy –defects in crystals-imperfections in solids-line defects-surface imperfections-twin boundary volume defects, crystal systems and X- ray diffraction. Electrode potential –oxidation and reduction potential-electrolyte – electrolysis-catalyst

Physical Vapour Deposition, chemical bath deposition -advantages-limits-DSSCs(dye-sensitized solar cells)-Organic solar cell, XRD (X-ray diffraction) –principal-application-Optical absorption spectroscopy –Raman and IR spectroscopy –XPS (X-ray Photo electron Spectroscopy) –SEM(Scanning Electron Microscopy).

### **Books Suggested**

1. Physical Methods in Chemistry.- Russell S Drago, Reinhold Publications Co ,1965
2. Chemical Structure and Bonding.- R.L.Decock and H.B Gray.
3. Fundamentals of Molecular Russell S Drago –C.N.Banwell & E.A. Mc Cash, 4<sup>th</sup> Ed.
4. Molecular Structure and Spectroscopy – G. Aruldhas.
5. Co ordination Chemistry ; Experimental Methods –K.Burger, London Butter Worths, 1973.
6. Physical Methods in Chemistry; Russell S Drago, W.B. Saunders, Co 1997.
7. Modern Spectroscopy-J.M.Hoilas, John Willey.
8. Introduction to Molecular Spectroscopy – G.M. Barrow, Mc Graw Hill.

## PRACTICALS

### CHE-105 INORGANIC CHEMISTRY LAB - I

#### 1. Preparation of metal complexes

- (i) Hexaammine Nickel(II) chloride  $[\text{Ni}(\text{NH}_3)_6] \text{Cl}_2$
- (ii) Tetraammine Copper(II) sulphate. monohydrate  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$
- (iii) Pentaamminechlorocobalt(III) chloride  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
- (iv) Potassium trioxalatoferrate(III)  $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$

#### 2. Analysis of individual metal ions and inorganic mixture

- (i) Reactions of rare earth metals (Mo, V, Zr, W, Se, Ce, Te, Li)
- (ii) Systematic semi micro qualitative analysis of an inorganic mixture - I
- (iii) Systematic semi micro qualitative analysis of an inorganic mixture - II
- (iv) Systematic semi micro qualitative analysis of an inorganic mixture - III
- (v) Systematic semi micro qualitative analysis of an inorganic mixture - IV

#### Books suggested

1. Vogel's Text Book of Qualitative Inorganic analysis.
2. Inorganic semi micro qualitative analysis, V.V. Ramanujam, The National Publishing Company.
3. Practical Inorganic Chemistry, G. Marr and B.W. Rockett, Van Nostrand Reinhold Company.
4. Practical Inorganic Chemistry. G. Pass and H. Sutcliff, 2<sup>nd</sup> edition, John – Wiley & Sons.

### CHE 106 : ORGANIC CHEMISTRY LAB - I

#### A. Give a brief introduction on

(a) Recrystallization (b) Sublimation (c) Distillation (d) Melting point and boiling point

#### B. Single step preparations

1. Preparation of *p*-nitroacetanilide
2. Preparation of Aspirin
3. Preparation of Nerolin
4. Preparation of Phthaliimide



5. Preparation of chalcone
6. Preparation of *p*-bromoaniline

### **Books Suggested**

1. Vogel's Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J. D. Barnes and M. J. Thomas, 4th & 6th Ed. (Pearson Education Asia).
2. Vogel's Text Book of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, 5 Ed. (Longman Scientific & Technical)

### **CHE 107 PHYSICAL CHEMISTRY LAB - I**

1. Preparation of Solutions (1M HCl, 1M acetic acid, 1M H<sub>2</sub>SO<sub>4</sub>, 1M NaOH) and Calibration of volumetric apparatus and statistical analysis of the data.
2. Preparation of reagents any five (Starch solution, Chromic acid, Schiff's reagent, Tollen's reagent, Fehling's solution, Phenolphthalein indicator)
3. Preparation of Standard solution: i). To prepare 0.05M solution of oxalic acid in 250ml of volumetric flask. ii). To prepare 0.05M standard sodium carbonate solution in 250ml volumetric flask.
4. Determination of Eutectic composition and temperature of binary system
5. Determination of distribution coefficient of benzoic acid between water and benzene.
6. Study the adsorption of acetic acid on charcoal and analysis of the data on the basis of Langmuir and Freundlich adsorption isotherms.
7. Determination of rate constant of acid hydrolysis of an ester and investigate the effect of catalyst concentration, reactant concentration and temperature.

### **Books suggested**

1. Senior Practical Physical Chemistry – B.D.Khosla, G.C.Garg
2. Vogel's Textbook of Quantitative Chemical Analysis, Revised by G.H.Jeffery, J.Bassett, J.Mendham, R.C.Denney, ELBS

## M.Sc. ORGANIC CHEMISTRY

### SEMESTER II

#### CHE201: INORGANIC CHEMISTRY-II

##### UNIT – I: MAGNETOCHEMISTRY OF TRANSITION METAL COMPLEXES

15 hrs

Introduction to Magneto Chemistry, Magnetic Induction, Permeability, Types of magnetism - Dia, para, ferro and anti ferromagnetism, Curie law and Curie-Weiss law. Behaviour Dia, para, ferro and antiferromagnetic substances with temperature. Temperature Independent Paramagnetism (TIP), Magnetic exchange behaviour in copper (II) acetate, Magnetic susceptibility and determination of magnetic susceptibility by Guoy's method.

##### UNIT – II : ELECTRONIC SPECTROSCOPY OF TRANSITION METAL COMPLEXES

15 hrs

Free ion Terms and Energy Levels: Configurations, Terms, States and Microstates. Calculation of Microstates for  $p^2$  and  $d^2$  configurations, L-S (Russel-Sanders) Coupling Schemes, J-J Coupling Scheme, derivation of terms for  $p^2$  and  $d^2$  configuration. Hole formulation, Energy ordering of terms (Hund's rules), Selection rules: Laporte orbital selection rule, Spin selection rules, Splitting of energy levels and spectroscopic states. Orgel diagrams of  $d^1$  to  $d^9$  metal complexes. Interpretation of electronic spectra of aquo complexes of Ti(III), V(III), Cr(III), Mn(II), Fe(II), Fe(III), Co(II), Ni(II) and Cu(II). Tanabe-Sugano diagrams for  $d^2$  and  $d^6$  octahedral complexes. Charge transfer ( $L \rightarrow M$  and  $M \leftarrow L$ ) spectra of metal complexes.

##### UNIT – III: MOSSBAUER AND NQR SPECTROSCOPY

15 hrs

**Mossbauer spectroscopy** – Principles and Instrumentation. Presentation of Mössbauer spectrum, Factors influencing absorption of  $\gamma$ -rays by nucleus – Isomeric shift, quadrupole interactions and magnetic interactions. Application of the technique in the study of iron and tin compounds with respect to a) spin nature b) structural elucidation c) nature of metal-ligand bonding d) oxidation states and e) electronegativity of groups.

**Nuclear quadrupole resonance spectroscopy** – Principle, Instrumentation, Quadrupole nuclei, Quadrupole moments, Electric field gradient and Applications.

## **UNIT –I V: METAL – LIGAND EQUILIBRIA IN SOLUTION**

**15 hrs**

Stability of metal complexes-thermodynamic stability and kinetic stability. Types of stability constants - Concentration, conditional, stepwise and overall stability constants. Relation between stepwise and overall stability constants of a metal complex. Trends in step wise stability constants. Factors influencing the stability of metal complexes with reference to metal and the ligand. Chelate effect and Macrocyclic effect. HSAB rule and its application to stability of complexes and metal-ligand interaction in biological systems. Determination of stability constants of metal complexes by spectrophotometric and pH-metric methods.

### **Books suggested**

1. Inorganic Chemistry, J. E. Huheey, E. A. Keiter and R. L. Keiter, 4<sup>th</sup> edition, Harper Collins College Publishers.
2. Concepts and models of Inorganic Chemistry, B.E. Douglas, D.H. McDaniel and J.J. Alexander, 3<sup>rd</sup> edition, John-Wiley.
3. Inorganic Chemistry, D.F. Shriver and P.W. Atkins, 3<sup>rd</sup> edition, Oxford.
4. Advanced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, 6<sup>th</sup> edition, Wiley Interscience.
5. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science.
6. Magnetochemistry, R.L. Carlin, Springer-verlag.
7. Elements of magnetochemistry, R.L. Dutta and A. Syamal, Affiliated East-west.

## CHE 202: ORGANIC CHEMISTRY-II

### UNIT-I: REACTION MECHANISMS II (Addition and Elimination reactions)

15 hrs

**Addition reactions** : Stereoselective addition to carbon – carbon double bond, anti addition – Bromination and epoxidation followed by ring opening. Hydroboration. Michael reaction, Aldol condensation, Cannizaro reaction, Knoevenagel reaction and Dieckmann reaction.

**Elimination reaction:** E<sub>1</sub>, E<sub>2</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.

### UNIT-II: STEREOCHEMISTRY

15 hrs

**Optical isomerism:** Molecular Symmetry and Chirality - Stereoisomers - Classification - Configuration - *R*, *S* - nomenclature - Axial Chirality - Stereochemistry of allenes, spiranes, biphenyl derivatives and atropisomerism - Planar chirality - Ansa compounds and *trans* - Cycloalkenes - Helicity.

**Geometrical isomerism:** *E*, *Z* – nomenclature, Physical and Chemical methods of determining the configuration of geometrical isomers - Stereoisomerism in cyclic compounds.

**Conformational analysis:** Conformations of disubstituted cyclohexane - Compounds having intramolecular hydrogen bonding- Ethylene glycol, butane 2,3- diol, Amino alcohols, halohydrin.

### UNIT- III :ALKALOIDS

15 hrs

Occurance, isolation, general methods of structural elucidation and physiological action, Classification based on nitrogen heterocycle ring, Structural elucidation and Synthesis of the following – Atropine, Papaverine and Quinine.

## UNIT- IV: TERPENOIDS

15 hrs

Definition and classification – Occurrence, isolation and general methods of structural determination. Isoprene and special isoprene rule. Structural elucidation and Synthesis of the following –  $\alpha$ - Terpinen ol, Farnesol and Zingiberene.

### 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. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry C.K.Ingold, Cornell University Press.
5. Organic Chemistry, R.T Morrison and R.N. Boyd, Prentice - Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C Norman and J. M. Coxon, Blackie Academic & Professional.
8. Reaction Mechanism in Organic Chemistry, P.S. Kalsi, New Age International
9. Stereochemistry to Organic Compounds, E.L. Eliel and others, John Wiley.
10. Stereochemistry to Organic Compounds, D. Nasipuri, New Age International.
11. Stereochemistry, P.S.Kalsi, Wiley Eastern.
12. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge University Press.
13. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
17. Introduction to Flavonoids, T.A. Geissman.
18. Chemistry of Natural Products P.S. Kalsi, Kalyani Publishers
19. Chemistry of Organic Natural Products, O.P. Agarwal, Vols., 1 & 2, Goel Pub
20. Natural Products Chemistry K.B.G. Torrsell, John Wiley, 1983.

## **CHE 203: PHYSICAL CHEMISTRY-II**

### **UNIT-I : STATISTICAL THERMODYNAMICS**

Entropy, Probability- Relationship between entropy and probability, Thermodynamic probability- microstate-macro-state system-assembly and ensemble- classification of ensembles, configuration-distribution-Distribution number

Derivation of Boltzmann distribution law- partition function- physical significance of partition function. factorization of partition function-translation-rotational-vibrational and electronic and nucleus partition. Relation between partition function and Thermodynamic functions (internal energy, enthalpy, work function, entropy, equilibrium constant). The sacur-tetrode equation derivation.

### **UNIT-II: QUANTUM CHEMISTRY-II**

Postulates of quantum mechanics: postulate-I(physical interpretation of wave function)-postulate-II(observables and operators)postulate-III( measurability of observables)-postulate-IV(average values of observables) postulates-V (Time dependent and independent Schrodinger equation).

Solution of Schrodinger wave equation to particle in one-dimensional box- three dimensional box, quantization of energy- Harmonic oscillator- zero point energy.

Application of Schrodinger wave equation to hydrogen atom - variation Theorem, Linear variation principle, perturbation Theory (first Order and non-degenerate).

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

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**

Concept of activity –activity of a gas – concept of activity coefficient-activity and activity coefficient of solution-activity and activity coefficient of strong electrolytes

meanactivity and meanactivity coefficient- Debye- Huckel-limiting law-verification of Debye- Huckel-limiting law- Experimental determination of activity coefficient of electrolytes: solubility method- EMF method.

Corrosion and its examples- theories of corrosion, dry corrosion –wet corrosion-factors affecting corrosion-protection against corrosion–sacrificial anodic protection- Impressed current cathodic protection.

### **Books Suggested**

1. Symmetry and Spectroscopy Molecules- K.Veera Reddy, New Age Publications , New Delhi.
2. Chemical Applications of Group Theory by Bhattacharya.
3. Group Theory by Habl Bishop.
4. Vogel Text book of Quantitative Chemical Analysis revised by G.H. Jeffrey et al, (5<sup>th</sup> EDITION ELBS Longman Group, New York).
5. Instrumental Methods of Analysis ,6<sup>th</sup> EDITION - Willard, Merritt, Dean, Settle, CBS Publications, 1986

## CHE 204: GENERAL CHEMISTRY-II

### UNIT-1: TREATMENT OF ANALYTICAL DATA

15 hrs

Precision and accuracy- Mean and Median values, Standard deviation, Co efficient 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,  $\chi^2$  – test. Correlation co-efficient and coefficient of determination, Limit of detection, Limit of determination, Sensitivity and selectivity of an analytical methods.

### UNIT-2: FLAME EMISSION AND ATOMIC ABSORPTION SPECTROSCOPY

15 hrs

**Flame Emission Spectroscopy:** Principles, Chemical reactions in flame, Interferences, Instrumentation, Types of emission spectra, Applications, Advantages and disadvantages of Emission Spectroscopy.

**Atomic Absorption Spectroscopy:** Principle, Instrumentation, Sources of radiation (HCL &EDL), Different types of burners, Interferences- Physical, chemical, spectral and back ground correction, Differences and comparison between AAS & FES, Advantages and disadvantages of Atomic Absorption Spectroscopy.

### UNIT – III: ELECTRON SPIN RESONANCE SPECTROSCOPY

15 hrs

Principles of ESR spectroscopy, Instrumentation. Presentation of ESR spectrum. Spectroscopic splitting factor (g value) and its significance, factors affecting g value. Hyperfine coupling. ESR spectrum of hydrogen atom, ESR spectra of organic and inorganic radicals: methyl, ethyl, t-butyl, tropylium, benzene, naphthalene, p-benzosemiquinone radicals. Application of ESR spectroscopy to transition metal complexes having one unpaired electron. Zero field splitting and Kramer's degeneracy.

### UNIT – IV: CATALYSIS

15 hrs

Homogeneous catalysis, Metal ion catalyzed reactions – Redox potentials and processes – Mechanisms 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,  $H_2O_2$  –  $S_2O_2$  reactions.



### **Books Suggested**

- 1 Vogel Text book of Quantitative Chemical Analysis revised by G.H. Jeffrey et al, (5<sup>th</sup> EDITION ELBS Longman Group, New York).
2. Instrumental Methods of Analysis ,6<sup>th</sup> EDITION - Willard, Merritt, Dean, Settle, CBS Publications, 1986.
3. Chemical Structure and Bonding.- R.L.Decock and H.B Gray.
4. Fundamentals of Molecular Russell S Drago –C.N.Banwell & E.A. Mc Cash, 4<sup>th</sup> Ed.
5. Molecular Structure and Spectroscopy – G. Aruldas.
6. Co ordination Chemistry ; Experimental Methods –K.Burger, London Butter Worths, 1973.

## **PRACTICALS**

### **CHE – 205: INORGANIC CHEMISTRY LAB -II**

#### **1. Analysis of two component mixtures**

- (i) Determination of Zn (III) and Fe(III)
- (ii) Determination of Cu (II) and Zn(II)
- (iii) Determination of Ca(II) and Mg(II)
- (iv) Determination of Cu (II) and Ni(II)

#### **Books suggested**

1. Vogel's Text Book of Qualitative Inorganic analysis.
2. Inorganic semi micro qualitative analysis, V.V. Ramanujam, The National Publishing Company.
3. Practical Inorganic Chemistry, G. Marr and B.W. Rockett, Van Nostrand Reinhold Company.
4. Practical Inorganic Chemistry. G. Pass and H. Sutcliff, 2<sup>nd</sup> edition, John – Wiley & Sons.

## CHE- 206 ORGANIC CHEMISTRY LAB –II

Systematic qualitative analysis of an organic mixture containing two compounds (Identification, method of separation and the functional group (s) present in each of them and preparation of one solid derivative for the confirmation of each of the functional group (s))

1. Acid + neutral
2. Base + Neutral
3. Phenol + Neutral
4. Neutral + Neutral

### Books suggested

1. Practical organic chemistry, Vogel
2. Practical organic chemistry, Mann and Saunders

## CHE - 207 PHYSICAL CHEMISTRY LAB - II

1. Determination of distribution coefficient of iodine between water and  $\text{CCl}_4$ .
2. **Conductometry**
  - a. Determination of cell constant
  - b. Verification of Onsager equation
  - c. Determination of dissociation constant of a weak acid
  - d. Titration of a strong acid with a strong base
  - e. Titration of a weak acid with a strong base
3. **Potentiometry**
  - a. Titration of a strong acid with a strong base
  - b. Titration of a weak acid with a strong base
  - c. Redox titration
4. **Colorimetry:** Verification of Beer's Law, Estimation of Potassium dichromate, Estimation of Potassium permanganate, Estimation of Manganese, Estimation of Iron.
5. **pH metry:** Strong acid, Strong base titrations.
6. Determination of critical solution temperature of phenol-water system and study the effect of electrolyte on CST.

### Books Suggested

1. Senior Practical Physical Chemistry – B.D.Khosla, G.C.Garg
2. Vogel's Textbook of Quantitative Chemical Analysis, Revised by G.H.Jeffery, J.Bassett, J.Mendham, R.C.Denney, ELBS

## M.Sc. ORGANIC CHEMISTRY

### SEMESTER III

#### ORGANIC SYNTHESIS - I

##### UNIT-I: OXIDATIONS

- (a) Alcohols to carbonyl compounds – Chromium (iv) oxidants, Dimethyl sulfoxide (DMSO) oxidation, Periodate oxidation, Oppenauer oxidation,  $\text{MnO}_2$ ,  $\text{Ag}_2\text{CO}_3$  (Fetizon's reagent)
- (b) Alkenes to epoxides – peroxide induced epoxidation
- (c) Alkenes to diols – oxidation with  $\text{KMnO}_4$ ,  $\text{OsO}_4$ , Prevost oxidation.
- (d) Oxidative cleavages of carbon-carbon double bonds – cleavage of glycols, lead tetraacetate, periodic acid.
- (e) Oxidation of alkyl or alkenyl fragments : Selenium dioxide

##### UNIT- II: REDUCTIONS

- (a) Nucleophilic metal hydrides : Reduction with  $\text{LiAlH}_4$ ,  $\text{NaBH}_4$ , Red  $-\text{Al}$  and alkoxy aluminates.
- (b) Electrophilic metal hydrides : Boron aluminium hydride and derivatives
- (c) Catalytic hydrogenation
- (d) Dissolving metal reductions – Birch reduction and Clemmensen reduction
- (e) Non metallic reductions : Diimide reduction, Wolf-Kishner reduction.

##### UNIT- III: REARRANGEMENTS

**Rearrangements involving electron deficient Carbon:** Pinacol-Pinacolone rearrangement, Wagner-Meerwein rearrangement, Demjanov rearrangement, Dienone-phenol rearrangement, Stevens rearrangement.

**Rearrangements involving electron deficient Nitrogen:** Beckmann rearrangement, Curtius rearrangement, Schmidt rearrangement.

**Rearrangements involving electron deficient Oxygen:** Baeyer-Villiger rearrangement, Dakins rearrangement, Benzil-Benzilic acid Rearrangement,

**Rearrangements involving electron rich Carbons:** Favorskii rearrangement and Neber rearrangement

**Aromatic and sigmatropic rearrangements :** Fries rearrangement and Claisen rearrangement

#### **UNIT –IV: MODERN SYNTHETIC REACTIONS**

**(a) Multicomponent reactions :** Ugi reaction, Biginelli and Mannich reactions

**(b) C-C formation reactions :** McMurry reaction, Julia-Lythgoe olefination, Baylis Hillmann reaction, Mitsunobu reaction, Shapiro reaction, Mukayama aldol reaction

**(c) Pd catalyzed reactions :** Heck reaction, Suzuki coupling, Sonogshira coupling

**(d) Metathesis :** Grubbs catalyst and their applications

**(e) Click chemistry :** Click reaction and its applications

#### **Books Suggested**

1. Some modern methods of Organic Synthesis W. Carruthers, Third Edition Cambridge University Press, Cambridge, 1988.
2. Organic Synthesis by Micael B. Smith. McGraw Hill International Editions.
3. Principles of Organic Synthesis by Richard O.C Norman. Raymond Bonnett, James M. Coxon, Edition: 3, illustrated published by CRC Press 1993.
4. Organic Chemistry, by Jonathan Clayden, Nick Greeves, Steurt Warren, Peter Wothers Contributor Jonathan Clayden Edition: reprint illustrated by Oxford University press, 2001.
5. Making Organic Molecules: An Introduction to Organic Synthesis by Jonathan Clayden Published by pearson Education, Limited, 2006

- 6 .Modern Synthetic Reactions, Herbert O. House, Second Edition, W.A. Benzamine Inc. Menio Park, California, 1972.
8. Advanced Organic Chemistry part A and B – F.A. Carey and R.J. Sundberg, 4<sup>th</sup> Edition, Plenum Publishers (2000).
9. Organic Synthesis by Robert E Ireland.
10. Organic Synthesis by C Willis and M Willis.
11. Organic Chemistry Claydon and others 2005.
12. Reagents for organic synthesis, by Fieser & Fieser, Vol 1-11 (1984).
13. Handbook of reagents for organic synthesis by Reich and Rigby, Vol. IV.
14. Advanced Organic Chemistry by Jerry March.
15. Organic Synthesis – Ahluwalia, Agarwal.
16. Name reactions: Jie jack lie; Springer publications.
17. Strategic applications of named reactions in organic synthesis: Laszlo Kurti & Barbara Czako; Elsevier Academic Press.
18. Tandem Organic Reactions by Tse-Lok Ho.

## CHE 302: ORGANIC SYNTHESIS-II

### UNIT – I : NONMETALLIC REAGENTS IN ORGANIC SYNTHESIS

Electronic structure and bonding in boron, phosphorus, sulphur and silicon compounds – Their reactivity and applications in organic synthesis.

**(a) Boron Reagents :**

Hydroboration, Organoboranes in the formation of C-C bonds, alcohols, amines, halogen and carbonyl compounds. Free radical reactions of organo boranes.

**(b) Phosphorus reagents:**

Formation of C-C double bonds (Wittig reaction, Horner-Wadsworth-Emmons reaction), Functional group transformations, Reactivity of nucleophiles and electrophiles. Reactions of quaternary phosphonium compounds.

**(c) Sulphur Reagents:**

Sulphur Ylides, Stabilized and non-stabilized, preparation and reactivity, Sulphonyl carbanions.

**(d) Silicon Reagents:**

Petersons Olefination, Influence of trialkyl, silyl reagents in electrophilic reactions, allyl silanes, alkenyl silanes, alkynyl silanes allyl silanes.

### UNIT – II : REAGENTS IN ORGANIC SYNTHESIS

Use of the following reagents in organic synthesis

Anhydrous Aluminium chloride, Boron trifluoride, DDQ, Dithianes, Diazomethane, N-Bromosuccinimide, Dicyclohexylcarbodiimide, Ziegler-Natta catalysts, Merrifield resin.

### UNIT – III : PHOTOCHEMISTRY

Photochemical energy, Frank-Condon principle, Jablonskii diagram, singlet and triplet state.

**Photochemistry of carbonyl compounds :** Norrish type – I and Norrish type – II reactions, Paternobuchi reaction, Photoreduction, Photochemistry of  $\alpha$ ,  $\beta$  – unsaturated ketones and *p*- benzoquinones.

**Photochemistry of unsaturated systems (olefins):** Cis-Trans isomerisation and Dimerization reactions, Photochemistry of 1,3-butadiene, Di- $\Pi$  methane and Oxa Di - $\Pi$  methane rearrangements.

**Photochemistry of aromatic compounds :** Isomerizations, Photo-Fries rearrangement and Barton reaction.

#### **UNIT – IV : PERICYCLIC REACTIONS**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-Hexatriene and allyl system, Classification of pericyclic reactions.

**Electrocyclic reactions :** Con rotatory and Dis rotatory mode of electrocyclization in  $4n$   $\Pi$  and  $4n+2$   $\Pi$  electron, allyl systems under thermal and photochemical conditions. FMO and PMO approach, Woodward-Hoffmann Correlation diagrams and Woodward-Hoffmann selection rules of electrocyclic reactions.

**Cycloadditions:** Antarafacial and suprafacial additions in  $4n$  ( $2+2$  cyclo addition) and  $4n+2$  ( $4+2$  cyclo addition) systems, FMO and PMO approach, Woodward-Hoffmann Correlation diagrams and Woodward-Hoffmann selection rules of cyclo addition reactions,  $2+2$  addition of ketene, 1,3-dipolar cycloadditions and cheletropic reactions.

**Sigmatropic rearrangements :** 1,3 and 1,5 suprafacial and antarafacial shifts of H and C, FMO and PMO approach and Woodward-Hoffmann selection rules of sigmatropic rearrangements, 3,3 and 5,5-sigmatropic rearrangements - Claisen, Cope and oxy-Cope rearrangements, Ene reaction.

#### **Books Suggested**

1. Some modern methods of Organic Synthesis W. Carruthers, Third Edition Cambridge University Press, Cambridge, 1988.
2. Organic Synthesis by Micael B. Smith. McGraw Hill International Editions.
3. Principles of Organic Synthesis by Richard O.C Norman. Raymond Bonnett, James M. Coxon, Edition: 3, illustrated published by CRC Press 1993.
4. Organic Chemistry, by Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers Contributor Jonathan Clayden Edition: reprint illustrated by Oxford University press, 2001.
5. Making Organic Molecules: An Introduction to Organic Synthesis by Jonathan Clayden Published by pearson Education, Limited, 2006
6. Modern Synthetic Reactions, Herbert O. House, Second Edition, W.A. Benzamine Inc. Menio Park, California, 1972.

7. Organic Synthesis viz Boranes, Herbert C. Brown Gray, W. Kratner Alan B. Levy and M. Mark Midland John Wiley & Sons, New York, 1975.
8. Advanced Organic Chemistry part A and B – F.A. Carey and R.J. Sundberg, 4<sup>th</sup> Edition, Plenum Publishers (2000).
9. Photochemistry and Pericyclic reactions, Jagdamba singh and Jayasingh, Second Edition, NewAge International.



## **CHE 303: BIOINORGANIC AND BIOPHYSICAL CHEMISTRY**

### **UNIT – I: BIOINORGANIC CHEMISTRY**

**15 hrs**

i) Essential and trace elements in biology : Classification, Concept of essentially, Evaluation of essentially trace elements, Role of bulk (structural) elements and minerals, working of essential trace elements, Deficiency signs and specific function of essentially trace elements (Fe, Cu, Co, Ni, Zn, F, I, Se). ii) Oxygen uptake proteins structural and functional aspects of Haemoglobin(Hb), Myoglobin(Mb), Haemoerithrin(He) and Haemocyanin(Hc).

### **UNIT – II: ORGANOMETALLIC CHEMISTRY**

**15 hrs**

Hapticity-based classification and nomenclature of organometallic compounds. Synthesis and properties of Li, Zinc, Copper, Mercury, Cadmium, Palladium, Rhodium, Aluminium and Nickel organometallic compounds. Synthesis of Grignard's reagent and its properties. Alkene hydrogenation, Hydroformylation, Monsanto acetic acid processes and Wacker Process. Biological applications of organometallic compounds in medicine, agriculture and horticulture.

### **UNIT III – BIOPHYSICAL CHEMISTRY**

**15 hrs**

Standard free energy change in biochemical reactions, exergonic and endergonic reactions, hydrolysis of ATP, thermodynamics of biopolymer solutions, chain configuration of bio polymers, calculation of average dimensions. Membrane equilibrium, ion transport through cell membrane, dialysis and its function.

### **UNIT IV – APPLICATIONS OF GROUP THEORY**

**15 hrs**

Construction of reducible and irreducible representations, Determination of Character Coordinate of  $C_{2v}$  point group based on  $3N - 6$  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  $CO_2$ .

**Books suggested**

1. Principles of Bioinorganic Chemistry, S. J. Lippard and Berg.
2. Bioinorganic chemistry, I. Bertini, H.B. Gray, S.J. Lippard and S.J. Valentine, Viva Low-Priced Student edition.
3. Organometallic Chemistry, R. C. Mehrotra and A. Singh, New Age International Publications.
4. Physical Methods in Chemistry; Russell S Drago, W.B. Saunders, Co 1997.
5. Physical Chemistry by Atkins.

## **CHE 304: ORGANIC SPECTROSCOPY AND ITS APPLICATIONS**

### **UNIT I : UV, ORD and CD**

**UV Spectroscopy:** Various electronic transitions, Factors affecting the position of UV band, Woodward –Fieser rules for calculating absorption maximum in conjugated Dienes,  $\alpha,\beta$  – unsaturated carbonyl compounds, Aromatic and Heterocyclic compounds, steric effect in biphenyls

**ORD and CD :** Optical rotator dispersion and circular dichroism: phenomenon of ORD and CD, Classification of ORD and CD curves, Cotton effect curves and their application to stereochemical problems,  $\alpha$  – axial haloketone rule and Octant rule – applications of these rules in the determination of absolute configuration of cyclohexanones, decalones, cholestanones.

### **UNIT II: INFRARED SPECTROSCOPY**

**IR Spectroscopy:** Instrumentation, Sample handling, Characteristic Group vibrational frequencies of organic molecules and Interpretation of spectra-alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, amines, carbonyl compounds, esters, amides, acids, anhydrides, lactones, lactams. Effect of hydrogen bonding and solvent effect on vibrational frequencies. Overtones, Combination bands and Fermi Resonance, FT-IR.

### **UNIT- III : $^1\text{H}$ NMR SPECTROSCOPY & $^{13}\text{C}$ NMR SPECTROSCOPY**

Nuclear spin, nuclear resonance, principles of NMR, shielding of magnetic nuclei, deshielding, chemical shifts and its measurements, factors influencing chemical shift, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines and amides), spin-spin interactions, coupling constant (J): Types and classification (ABX, AMX, ABC etc.) of coupling constants, factors influencing coupling constants, Karplus curve variation of coupling constant with dihedral angle, complex spin-spin interaction between two, three, four and five nuclei (First order spectra), virtual coupling, chemical exchange, effect of deuteration, hindered rotation, Simplification of complex spectra: nuclear magnetic double resonance (spin decoupling), contact shift reagents, Nuclear Overhauser effect (NOE).

**<sup>13</sup>CNMR Spectroscopy** : General considerations, Chemical shift (aliphatic, olefinic, alkynyl, aromatic, heteroaromatic and carbonyl carbon)coupling constants.

#### **UNIT – IV: MASS SPECTROMETRY**

Introduction, Principle, Instrumentation, Single & Double focusing Mass Spectrometers, Ionization Methods: EI, CI, FDI, PDI, LDI, FAB, TSI and ESI, Mass Analyzers, Molecular-ion peak, Nitrogen rule, Base peak, Metastable ion, isotopic abundance, High resolution mass spectrometry (HRMS), General methods of mass spectral fragmentation, Mc. Lafferty rearrangement, Ortho effect, Factors affecting fragmentation, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

#### **Books Suggested**

1. Organic spectroscopy, W. Kemp, 5th Ed., (ELBS.2)
2. Spectroscopy of organic compounds, R.M. Silverstein and others, 5th Ed., (John Wiley)
3. Spectrometric Identification of organic compounds, R.M. Silverstein, F.X. Webster and D.J Kiemle, 7th Ed., (Wiley)
4. Introduction to Spectroscopy, A guide for students of organic chemistry, Donald L. Pavia, Gary M. Lamp man and George S. Kriz, 3rd Ed., (Thomson).
5. Spectroscopic methods in Organic Chemistry, DH Williams & I Flemming, (TMH)
6. Spectroscopy of organic compounds, P. S. Kalsi, (Wiley)
7. Nuclear Magnetic Resonance Spectroscopy An introduction to Principles, Applications and experimental methods, Joseph B. Lambert and Eugene P. Mazzola, (Pearson Education Inc. Prentice – Hall).
8. A Complete Introduction to Modern NMR Spectroscopy, Roger S. Macomber, (John Wiley & Sons, Inc.).

### **CHE 305 : PRACTICAL –I (MULTISTEP SYNTHESIS)**

1. Preparation of Benzanilide
2. Preparation of *p*-Nitroaniline
3. Preparation of Symmetric tribromo benzene
4. Preparation of benzopinacol
5. Preparation of *o*-Chlorobenzoic acid
6. Preparation of Chalcone epoxide

### **CHE 306 : PRACTICAL –II (ESTIMATIONS)**

1. Estimation of Phenol
2. Estimation of Glucose
3. Estimation of Aspirin
4. Estimation of Primary amine

## M.Sc. ORGANIC CHEMISTRY

### IV SEMESTER

#### CHE 401 ORGANIC SYNTHESIS – III

##### UNIT – I: SYNTHETIC STRATEGIES: I

15 hrs

###### (A) Disconnection Approach

Synthetic Strategies; Introduction, Terminology: target, synthon, synthetic equivalent, functional group interconversion (FGI), functional group addition, functional group elimination. Linear and convergent synthesis. Retrosynthetic analysis and synthesis involving chemoselectivity, regioselectivity and stereoselectivity. Reversal of polarity (umpolung) and cyclization reactions. Importance of order of events in organic synthesis- examples. One group C-X disconnections and two group C-X disconnections

###### (B) Protecting Groups

Principles of protection of alcohol, amine, carbonyl and carboxyl groups

##### UNIT-II: SYNTHETIC STRATEGIES -II

15 hrs

###### (A) One Group C-C Disconnections

Alcohols and carbonyl compounds, Regioselectivity, Alkene synthesis, use of acetylenic compounds in organic synthesis.

###### (B) 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 – III : ASYMMETRIC SYNTHESIS

15 hrs

###### (A) Introduction and terminology

**Topicity in molecules :** Homotopic, stereoheterotopic (enantiotopic and diastereotopic),

**Prochirality nomenclature:** Substitution and addition criteria. Pro-R, Pro-S, Re and Si faces.

**Stereoselective reactions:** Enantioselectivity and diastereoselectivity.

**Optical purity:** Enantiomeric excess and diastereomeric excess.

## **(B) Strategies in Asymmetric Synthesis**

**i. Chiral substrate controlled asymmetric synthesis:** Nucleophilic additions to chiral carbonyl compounds. 1, 2- asymmetric induction, Cram's rule and Felkin-Anh model.

**ii. Chiral auxiliary controlled asymmetric synthesis:**  $\alpha$ -Alkylation of chiral enolates, imines. Use of chiral auxiliaries in Diels-Alder reaction.

**iii. Chiral reagent controlled asymmetric synthesis:** Asymmetric reductions using BINAL-H. Asymmetric hydroboration using  $\text{IPC}_2\text{BH}$  and  $\text{IPC}\text{BH}_2$ .

**iv. Chiral catalyst controlled asymmetric synthesis:** Sharpless and Jacobsen asymmetric epoxidations. Asymmetric hydrogenations using chiral Wilkinson biphosphine and Noyori catalyst. Enzyme mediated enantioselective synthesis.

## **UNIT – IV : SYNTHETIC POLYMERS**

**Polymer reactions:** Additions and condensation polymerization process – Bulk, Solution, Suspension and Emulsion polymerization.

**Stereospecific polymers:** Preparation and significance – Classification of polymers based on physical properties – Thermoplastics – Thermosetting plastics – Fibres and Elastomers – General applications.

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 and Ion exchange resins.

### **Books suggested**

1. Some modern methods of Organic Synthesis W. Carruthers.
2. Guidebook to organic synthesis by R K Meckie, D M Smith & R A Atken.
3. Organic Synthesis by O House
4. Organic Synthesis by Michael B Smith
5. Reagents for organic synthesis, by Fieser & Fieser, Vol 1-11 (1984).
6. Total Synthesis of natural products: the Chiron approach by S.Hanessian
7. Organic Chemistry Claydon and others 2005
8. Name Reactions by Jie Jack Lie

9. Reagents for organic synthesis, by B.P. Mundy and others.
10. Tandem Organic Reactions by Tse-Lok Ho
11. Organic Synthesis by Robert E Ireland
12. Organic Synthesis – The disconnection approach by S Warren
13. Organic Synthesis by C Willis and M Willis
14. Handbook of reagents for organic synthesis by Reich and Rigby, Vol. IV.
15. Problems on organic synthesis by Stuart Warren.



## **CHE 402 : HETEROCYCLIC COMPOUNDS AND NATURAL PRODUCTS**

### **UNIT – I: HETEROCYCLES (Five membered) 15 hrs**

**Five membered heterocycles :** Synthesis and reactions including applications of Pyrazole, Imidazole, Oxazole, Thiazole, Isoxazole, Isothiazole.

### **UNIT – II : BENZOFUSED HETEROCYCLES 15 hrs**

**Benzofused five membered heterocycles :** Synthesis and reactions including applications of Benzimidazole, Benzoxazole and Benzothiazole

**Benzofused six membered heterocycles :** Synthesis and reactions including applications of Quinoline and Isoquinoline

### **UNIT – III: STEROIDS AND HORMONES 15 hrs**

Occurance, Nomenclature, Basic Skeleton, Diels Hydrocarbon and Stereochemistry. Isolation, Structure determination of Cholesterol (Total synthesis not expected), Bile acids, Androsterone, Testosterone, Oestrone, Progesterone. Biosynthesis of steroids.

### **UNIT – IV: FLAVONOIDS AND ISOFLAVONOIDS 15 hrs**

Occurance, 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.

#### **Books Suggested**

1. Heterocyclic chemistry Vol. 1-3, RR Gupta, M.Kumar and V. Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry, J.A. Joule, K. Mills and G.F.Smith, Chapman and Hall.
4. Heterocyclic chemistry – T.L. Gilchrist, Longman Scientific Technical.
5. Contemporary Heterocyclic chemistry, G.R. Newkome and W.W. Paudler, Wiley – Inter Science
6. An introduction to the Heterocyclic Compounds. R.M. Acheson, John Wiley.

7. Comprehensive Heterocyclic chemistry, A.R. Katritzky and C.W. Rees, Eds. Pergamon Press.
8. Principles of Modern Heterocyclic chemistry, L.A. Paquette.
9. Natural Products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
10. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
11. Stereoselective Synthesis: A practical approach, M. Nogradi, VCH.
12. Introduction to Flavonoids, T.A. Geissman.
13. New Trends in Natural Products Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publisher.
14. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, ELBS.
15. Chemistry of Natural Products P.S. Kalsi, Kalyani Publishers.
16. Biosynthesis of steroids, terpenes and acetogenins, J.H. Richards & J.R. Hendrieson.
17. The biosynthesis of secondary metabolites, R.D. Herbert, Chapman & Hall.
18. Chemistry of Organic Natural Products, O.P. Agarwal, Vols, 1&2, Goel Pubs.
19. Natural Products Chemistry K.B.G. Torssell, John Wiley, 1983.
20. The biosynthesis of secondary metabolites, R.D. Herbert, Second Edn. Chapman & Hall.

## CHE 403: BIOMEDICINAL CHEMISTRY

### UNIT – I: CARBOHYDRATES

**Carbohydrates and lipids:** Structure and biological functions, Mucopolysaccharides, Glycoproteins and Glycolipids, Role of sugar in biological recognition, blood group substances.

**Fatty acids:** Essential fatty acids- structure and function of triglycerols, Glycerophospholipids, cholesterol, bile acids, prostaglandins – composition and functioning of lipo proteins – properties of lipids aggregates – liposomes and their biological functions.

### UNIT – II: BIOMOLECULES

**Proteins :** Acid and enzymatic hydrolysis of proteins. Determination of aminoacids, Sequence in poly peptides by end group analysis. Chemical synthesis of di and tri peptides.

**Enzymes:** Definition, Classification based on mode of action. Mechanism of enzyme catalysis. Lock and key model and Induced fit model. Factors affecting enzyme catalysis. Enzyme inhibition- Reversible and Ireversible Inhibition. Enzymes in organic synthesis. Immobilized enzymes.

**Nucleic acids:** Primary, Secondary and Teritiary structure of DNA, Types of RNA, mRNA, tRNA and rRNA. Replication, Transcription, Translation and Genetic code.

### UNIT – III: VITAMINS AND PROSTAGLANDINS

**Vitamins :** Definition, Occurance, Structural formulae, Physiological functions and synthesis of vitamins. Structure determination and synthesis of Retinol( A), Thiamine (B<sub>1</sub>), Riboflavin (B<sub>2</sub>), Pyridoxine (B<sub>6</sub>), Biotins (H) and Nicotinic acid.

**Prostaglandins:** Occurance, Nomenclature, Classification, Physiological effects of prostaglandins, Structure and synthesis of PG E<sub>1</sub>, PG E<sub>2</sub>.

### UNIT – IV: ANTIMALARIALS AND ANTIBIOTICS

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

**Antibiotics** : General characterization – structure –activity relationships, Synthesis and activity of Penicillin G, Cephalosporin C and Streptomycin.

### **Books Suggested**

1. Chemical Aspects of Biosynthesis, John Man, Oxford University Press, Oxford, 1996.
2. Chemistry of Natural Products: A Unified Approach, N.R. Krishnaswamy, University Press (India) Ltd., Orient Longman Limited, Hyderabad, 1999.
3. Introduction to Organic Chemistry, A Streitweiser, CH Heathcock and E.M. Kosover IV Edition, McMillan, 1992. (For Merrifield synthesis of peptides and also for other aspects of Unit IV)
4. Bio-organic Chemistry, H. Dugas and C. Penney, springer, New York. 1981.
5. Details of Primary literature: Nomenclature: Structure: Dolastatin – 10: JACS, 1987, 109, 6883 (structure), ibdi, 1989, 111, 5463, JCS, Parkin I. 1996, 859 (synthesis).
6. Textbook of organic chemistry, Vol II by I. L. Finar
7. Chemistry of Natural Products, Vol 12, by Atta-Ur-Rahman
8. An introduction to the chemistry of terpenoids and steroids, by William Templeton
9. Systematic identification of flavonoid compounds by Mabry & Markham
10. Steroids by Fieser and Fieser
11. Alkaloids by Manske
12. The Terpenes by Simenson
13. Alkaloids by Pelletier
14. Total Synthesis of Natural Products by Apsimon Vol 1-5
15. Biosynthesis by Geismann
16. Principles of organic synthesis 3<sup>rd</sup> Ed. ROC Norman and JM Coxen
17. One and two dimensional NMR Spectroscopy by Atta Ur-Rahman.
18. Classics in total synthesis K C Nicolaou and E J Sorenson.
19. Chemistry of Natural Products, N. R. Krishnaswamy.
20. Chemistry of Natural Products, S.V. Bhat, B.A. Nagasampagi and M. Siva kumar.

## CHE 404 GENERAL ORGANIC CHEMISTRY

### UNIT-I: GREEN CHEMISTRY

15 hrs

Concept of green chemistry, principles of green chemistry and green synthetic methods –

**Use of green reagents in green synthesis:** Dimethyl carbonate, Polymer supported reagents – peracids, chromic acid, PNBS, Polymer supported peptide coupling reagents.

**Use of green catalysts in green synthesis:** Acid catalysts, oxidation catalysts, Basic catalysts, polymer supported catalysts.

**Organic reactions in aqueous media:** Advantages and applications in Pinacol coupling, Mukaiyama aldol reaction.

**Ionic liquids in organic synthesis:** Introduction, composition, and application of ionic liquids – acid catalyzed reactions, catalysis, hydrogenation and oxidations.

### UNIT – II: NEWER METHODS IN ORGANIC SYNTHESIS

Solid-solid, Solid-liquid systems – Mechanism of catalytic action, Types of catalysts, Application in few important reactions :

**Enamine mediated reactions:** Formation, role of enamines as synthons for the synthesis of organic molecules.

**Microwave reduced reactions:** Principle, conditions, advantages over conventional heating methods – applications.

### UNIT –III: DRUGDISCOVERY AND PRINCIPLES OF DRUG DESIGN

#### (A) Basic principles of Pharmacology

**Definitions:** Disease, drug, bioassay, pharmacokinetics and pharmacodynamics. Stages involved in drug discovery. **Pharmacokinetics (ADME):** Routes of drug administration, Absorption, Distribution, Metabolism and Excretion of drugs. **Pharmacodynamics:** Nature of drug – receptor interactions, Theories of drug action: Occupancy theory, Rate theory, Induced-fit theory. Drug toxicity, clinical trials.

#### (B) Drug design

Lead discovery, Existing drugs as leads, Pharmacophore, Principles of design of agonists (e.g. Salbutamol), antagonists (e.g. cimetidine) and enzyme inhibitors (e.g. captopril). Drug discovery without lead – serendipity-Penicillin and Librium as examples.

## UNIT – IV: NANOMATERIALS

Definition, Introduction, classification and properties of nano particles, Preparation of nano particles (a) Physical / Aerosol methods – Vapour condensation method, Spray pyrolysis (b) Chemical methods – Sol-gel Micelles/reverse microemulsion method. Characterization of nano particles using X-Ray diffraction (XRD), Scanning Electron Microscopy (SEM) and Transmission electron microscopy (TEM). Applications of carbon nano particles.

### Books Suggested

1. Organic Synthesis in water by Paul A. Grieco Blackie.
2. Green Chemistry, Theory and Practical, Paul T. Anastas and John C. Warner.
3. New trends in Green Chemistry by V.K. Ahulwalia and M.Kidwai.
4. Organic Synthesis: Special techniques, by V.K. Ahulwalia and Renu Aggarwal.
5. Burger's medicinal chemistry and drug discovery by Manfred E. Wolf
6. Introduction to Medicinal Chemistry by Patrick.
7. Introduction to drug design by R Silverman.
8. Comprehensive Medicinal Chemistry, Vol1-5 by Hanzsch.
9. Principles of Medicinal Chemistry by William Foye
10. Biochemical approach to medicinal chemistry, Ythomas Nogrady.
11. Organic drug synthesis, Daniel Ledneicer.
12. Introduction to nanotechnology, Charles P. Poole Jr, Frank J. Owens, Wiley India Pvt. Ltd.
13. Solid State Chemistry and its applications, A.R. West, Plenum
14. Nanoscale materials in chemistry, Kenneth J. Klabunde, Wiley Interscience.
15. Self-Assembled Nanostructures, Jin Z. Zhang, Zhang-lin Wang, Jun Liu, Shaowei Chen, Gang-Yu Liu, Kluwer Academic Plenum publishers.

### CHE 405 : PRACTICAL –I (SPECTRAL PROBLEMS)

Spectral Identification of Organic Compounds (UV, IR,  $^1\text{H}$  and  $^{13}\text{C}$  NMR, MASS).  
A minimum of 15 representative examples should be studied.

### CHE406 : PRACTICAL –II DISSERTATION (Inorganic / Organic /Physical)

**M.Sc DEGREE EXAMNATIONS**

**Branch II (A): Chemistry**

**MODEL QUESTION PAPER FOR ALL SEMESTERS (I, II, III & IV)**

**FOR ALL PAPERS**

**TITLE OF THE PAPER**

**(Revised Syllabus for Non-CBCS with effect from 2020-2021)**

**Time: 3 hours**

**Max Marks: 70**

**PART-A**

Answer any **Four** of the following All questions carry equal marls

(Marks 4x5=20)

1. From **UNIT-I**
2. From **UNIT-I**
3. From **UNIT-II**
4. From **UNIT-II**
5. From **UNIT-III**
6. From **UNIT-III**
7. From **UNIT-IV**
8. From **UNIT-IV**

**PART-B**

Answer ALL question All question carry equal marks (Marks: 4x12<sup>1/2</sup>=50)

9. (a), (b) OR (c), (d) From **UNIT-I ( With internal Choice )**
10. (a), (b) OR (c), (d) From **UNIT-II ( With internal Choice )**
11. (a), (b) OR (c), (d) From **UNIT-III ( With internal Choice )**
12. (a), (b) OR (c), (d) From **UNIT-IV ( With internal Choice )**

**For paper setter: In part – A Two questions will be set from each unit**

**In part – B One question from each unit with internal choice**