

MOTHERHOOD UNIVERSITY, Roorkee

ENLIGHTENING WORLD

A

STUDY AND EVALUATION SCHEME

OF

**Master of Science in Chemistry
M.Sc. (Chemistry)**

[w.e.f. Academic Session 2015-16]



**Roorkee-Dehradun Road, Village Karoundi,
Post Bhagwanpur, Tehsil-Roorkee
Pin -247661
Distt-Haridwar
(Uttarakhand)**

SUMMARY

Programme	M.Sc. (Chemistry)
Duration	Two year full time (four Semesters)
Medium	English
Maximum Credits	72

MOTHERHOOD UNIVERSITY, ROORKEE
MASTER IN SCIENCE (CHEMISTRY)

SEMESTER-I

Sr. No.	Subject Code	Subject Name	Effective Teaching			Credit	Evaluation Scheme		
			L	T	P		Internal Assessment	End Term	Total Marks
			Hours/week						
THEORY									
1	MUMCH 101	Inorganic Chemistry-I	3		-	3	40	60	100
2	MUMCH 102	Organic Chemistry-I	3	-	-	3	40	60	100
3	MUMCH 103	Physical Chemistry-I	3		-	3	40	60	100
4	MUMCH 104	Group Theory & Spectroscopy	3	-	-	3	40	60	100
5	MUMCH 151	Laboratory Course IA	-	-	6	3	40	60	100
6	MUMCH 152	Laboratory Course IB	-	-	6	3	40	60	100
Total			12	-	12	18	240	360	600

Motherhood University, Roorkee

Master in Science (Chemistry)

Semester-II

Sr. No.	Subject Code	Subject Name	Effective Teaching			Credit	Evaluation Scheme		
			L	T	P		Internal Assessment	End Term	Total Marks
			Hours/week						
THEORY									
1	MUMCH 201	Inorganic Chemistry-II	3	-	-	3	40	60	100
2	MUMCH 202	Organic Chemistry-II	3	-	-	3	40	60	100
3	MUMCH 203	Physical Chemistry-II	3	-	-	3	40	60	100
4	MUMCH 204	Spectroscopy and Separation Methods	3	-	-	3	40	60	100
5	MUMCH 251	Laboratory Course IIA	-	-	6	3	40	60	100
6	MUMCH 252	Laboratory Course IIB	-	-	6	3	40	60	100
Total			12	-	12	18	240	360	600

Motherhood University, Roorkee

Master in Science (Chemistry)

Semester-III

Sr. No.	Subject Code	Subject Name	Effective Teaching			Credits	Evaluation Scheme		
			L	T	P		Internal Assessment	End Term	Total Marks
			Hours/week						
THEORY									
1	MUMCH 301	Organic Synthesis and Photochemistry	3	-	-	3	40	60	100
2	MUMCH 302	Organometallic Reagents and Organic Synthesis	3	-	-	3	40	60	100
3	MUMCH 303	Medicinal Chemistry	3	-	-	3	40	60	100
4	MUMCH 304	Bioinorganic, Bioorganic & Biophysical Chemistry-I	3	-	-	3	40	60	100
5	MUMCH 351	Laboratory Course Org. IIIA	-	-	6	3	40	60	100
6	MUMCH 352	Laboratory Course- Org. III B	-	-	6	3	40	60	100
Total			12	-	12	18	240	360	600

Motherhood University, Roorkee

Master in Science (Chemistry)

Semester-IV

Sr. No.	Subject Code	Subject Name	Effective Teaching			Credit	Evaluation Scheme		
			L	T	P		Internal Assessment	End Term	Total Marks
			Hours/week						
THEORY									
1	MUMCH 401	Natural Products	3	-	-	3	40	60	100
2	MUMCH 402	Heterocyclic Chemistry	3	-	-	3	40	60	100
3	MUMCH 403	Environmental Chemistry	3	-	-	3	40	60	100
4	MUMCH 404	Bioinorganic, Bioorganic, Biophysical Chemistry-II	3	-	-	3	40	60	100
5	MUMCH 451	Laboratory Course Org. VIA	-	-	6	3	40	60	100
6	MUMCH 452	Six Months Project	-	-	-	3	40	60	100
Total			12	-	6	18	240	360	600

SEMESTER-I

MUMCH 101:Inorganic Chemistry-I

Credits-3

Unit-I

Stereochemistry and Bonding in Metal Group Compounds

VSEPR model and its shortcomings. Hybridization and three centre bonds. Bent's rule and energetic of hybridization

Walsh's diagrams for tri and tetraatomic molecules, $p\pi-p\pi$ and $p\pi-d\pi$ bonding.

Unit-II

Metal-Ligand Equilibria in Solution

Thermodynamic and Kinetic stability of complexes. Stepwise and overall formation constants and their interaction. Trends in K value Irving-Williams series. Chelate effect and its thermodynamic origin. Factors affecting the stability of metal complexes with reference to the nature of the metal ion and ligand. Detection of complexes in solution. Determination of binary formation constants by pH-metry and spectrophotometric method.

Unit-III

Reaction Mechanism of Transition Metal Complexes

Energy profile of a reaction and reactivity of metal complexes, Inert and labile complexes ligand substitution reactions in octahedral complexes i.e. SN^1 , SN^2 and SN^1 CB mechanism. Anation reactions without metal ligand bond cleavage. Electron transfer reactions (Redox reactions). Outer and inner sphere mechanism (OSM and ISM). Reactions of coordinated ligands. Substitution reactions in square planar complexes, Trans and Cis effect.

Unit-IV

Theory of coordination compounds

Crystal field theory, factors affecting the magnitude of Δ_o . Consequences of crystal field splitting merits and limitation of CFT, Jahn-Teller distortion and its consequences on complex formation.

Evidence of covalent character in Metal-Ligand bonding, Molecular orbital theory as applied to octahedral, tetrahedral and square planar complexes.

Books suggested

1. Advance Inorganic Chemistry Vth Ed, F.A. Cotton and G. Wilkinson John Wiley (1988)
2. Advanced Inorganic Chemistry VIth Ed, F.A. Cotton, G. Wilkinson, C.A. Murillo and M. Bochmann, John Wiley (1999).
3. Inorganic Chemistry J.E. House Academic Press (2008).
4. Inorganic Chemistry A United Approach, 2nd Ed W. W. Porterfield Academic Press (1993)
5. Coordination Chemistry 3rd Ed., Banerjee, Asian Book Pt. Ltd. (2009).
6. Inorganic Chemistry, 3rd Ed., G. L. Miessler and D. A. Tarr, Pearson Education, Inc. (2004).
7. Concise Inorganic Chemistry J.D. Lee, 5th Ed., Chapman & Hall (1996).
8. Inorganic Chemistry, 3rd Ed., Shriver & Atkins, Oxford (1999).

Unit-I**Nature of Bonding in Organic Molecules**

Hyperconjugation bonding in fullerenes tautomerism.

Aromatic in benzenoid and non benzenoid compounds alternant and non alternant hydrocarbons. Huckel's rule, energy level of π molecular orbitals, annulenes, antiaromaticity, homo-aromaticity, PMO approach.

Bonds weaker than covalent, crown ether complexes and cryptands, inclusion compounds, cyclodextrin, catenanes and rotaxanes.

Unit-II**Stereochemistry**

Conformational analysis cycloalkane, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding, optical purity enantiotopic and diastereotopic atoms groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis, chirality due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

Unit-III**Reaction Mechanism Structure and Reactivity**

Types of mechanism, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammonds postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.

Effect of structure on reactivity-resonance and field effects, steric effect, quantitative treatments. Hammett equation and linear free energy relationship substituent and reaction constants. Taft equation.

Unit-IV**Aliphatic Nucleophilic Substitution**

S_N1 , S_N2 and mixed S_N1 and S_N2 mechanism. The neighbouring group mechanism, neighbouring group participation (by π and σ bonds). Anchimeric assistance. S_N1 mechanism—Nucleophilic substitution at an allylic aliphatic trigonal and vinylic carbon. Reactivity effects of substrate structure, attacking nucleophilic group, leaving group and reaction medium, ambient nucleophile.

Unit-V**Aliphatic Electrophilic Substitution**

Bimolecular mechanism $SE2$ and SEi , The $SE1$ mechanism, electrophilic substitution accompanied by double bond shift. Effect of substrates leaving group and the solvent polarity on the reactivity.

Books Suggested-

1. Advanced Organic Chemistry, Reaction, Mechanism and Structure, Jerry March, 6th Ed. John Wiley.
2. Advanced Organic Chemistry, Carey and Sundberg, Springer Verlag, Germany
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
5. Organic Chemistry, Boyd and Morrison, Prentice Hall of India.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, Norman and Coxon Blackwell.
8. Reaction Mechanism in Organic Chemistry, Mukherji and Singh, Macmillan
9. Stereochemistry of Organic Compounds D. Nasipuri, New Age International
10. Stereochemistry of Organic Compounds P.S. Kalsi, New Age International

Unit-I**Quantum Chemistry****A. Introduction to Exact Quantum Mechanism Results:**

The Schrodinger's equation and the postulates of quantum mechanism. Discussion of solutions of the Schrodinger's equation to some model systems viz. particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

B. Approximate Methods

The variation theorem, linear variation principle, perturbation theory (first order and non degenerate). Applications of variation method and perturbation theory to the Helium atom.

C. Angular Momentum

Ordinary angular momentum, generalized angular momentum, eigen functions of angular momentum, operator using ladder operators, addition of angular momentum, spin, antisymmetry and Pauli exclusion principle.

D. Electronic structure of Atoms

Electronic configuration, Russell-Saunders terms and coupling schemes, Slater-Condon parameters, term separation energies of the l^2 configuration, term separation energies for the

l^2 configuration, magnetic effects, spin orbit coupling and Zeeman splitting, Introduction to the methods of self-consistent field, the virial theorem.

Unit-II**Thermodynamics****A. Classical Thermodynamics**

Brief resume of concepts of laws, thermodynamics, free energy, chemical potential and entropies, partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significance, Determination of these quantities. concept of fugacity and determination of fugacity.

Non ideal systems: Excess functions for non-ideal solutions. Activity, activity coefficient. Debye Huckel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficient, Ionic strength (Application of phase rule to three component systems, second order phase transitions)

Unit-III**Surface Chemistry****A. Adsorption**

Surface tension, capillary actions, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equations), surface films on liquids (Electro-kinetic phenomenon), catalytic activity at surfaces.

B. Micelles

Surface active agents, classification of surface active agent, micellization, hydrophobic interaction, critical micellar concentration (CMC), Factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of, micellization-phase separation and mass action models, solubilization, micro emulsion reverse micelles.

C. Macromolecules

Polymer-definition, types of polymers, electrically conducting fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization, Molecular mass number and mass average molecular mass, molecular mass determination (osmometry, viscometry, diffusion and light scattering methods sedimentation) chain configuration of macromolecules, calculation of average dimensions of various chain structures.

Book suggested

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Quantum Chemistry by Donald A. McQuarie, Viva Books.
3. Introduction to Quantum Chemistry, A.K. Chandra Tata Mc Graw Hill.
4. Micelles: Theoretical and Applied Aspects, V. Moroi, Plenum.
5. Chemical Kinetics, K.J. Laidler McGraw Hill
6. Kinetic and Mechanism of chemical Transformations, J. Rajaraman and J.Kuriacose, MacMillan

Unit I**Symmetry and Group Theory in Chemistry**

Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroups, conjugacy relation and classes. Point Symmetry group, Schonflies symbols, representations of groups by matrices (representation for the C_n , C_{nv} , C_{nh} , D_{nh} etc. group to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use in spectroscopy.

Unit II**Unifying Principles**

Electromagnetic radiation, interaction of electromagnetic radiation with matter. Absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering. Uncertainty relation and natural line width and natural line broadening, transmission probability, result of the time dependent perturbation theory, transition moment, selection rules, intensity of spectral lines, Born-oppenheimer approximation, rotational and electronic energy levels.

Unit III**Atomic Electronic Spectroscopy**

Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atom and alkali metal atoms.

Unit IV**Microwave Spectroscopy:**

Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor, Stark effect, nuclear and electron spin interaction and effect of external field and applications.

Unit V**Infrared Spectroscopy**

Review of harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, Force constant and bond strengths, Anharmonicity, Morse potential energy diagram, Vibration-rotation spectroscopy, P,Q,R branches, selection rules, normal modes of vibration, group frequency, Overtones, Hot bands, factors affecting the band positions and intensities, Far IR region, metal-ligand vibration.

Books suggested

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Physical Methods for Chemistry, R.S. Drago, Saunders Company.
3. Chemical Applications of Group Theory, F.A. Cotton.
4. Introduction Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
5. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
6. Symmetry and Spectroscopy of Molecules, K. Veera Reddy, New Age International.

Inorganic Chemistry

Qualitative Analysis

Qualitative analysis of mixtures by semi-micro methods containing not more than six cations and anions including

- i) Rare earth elements
- ii) Anions which have not been done in under graduate practicals.
- iii) Insoluble

Organic Chemistry

Qualitative Analysis

Separation purification and identification of compounds of binary mixture (solid–solid or liquid and solid) using TLC and paper Chromatography Chemical tests and spectroscopic analysis.

Physical Chemistry

Chemical Kinetics

- 1-Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (C) ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions
- 2-Determination of the rate constant of hydrolysis of an ester
- 3-Determination of the rate constant for the oxidation of iodide by hydrogen peroxide studying the kinetics of the reaction
- 4-Following clock reactions (Ref. Experiment in Physical Chemistry by Showmaker)
- 5-Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion).

Inorganic Chemistry

Chromatography

Separation of cations and anions by-

Paper Chromatography

Thin Layer Chromatography

Ion Exchange Chromatography

Organic Chemistry

Organic Synthesis

Acetylation: Acetylation

Oxidation: adipic acid by Chromic acid of cyclohexanol.

Grignard reaction: Synthesis of triphenylmethanol from benzoic acid.

Sandmeyer reaction: p-Chloretholene from p-toluene.

Physical Chemistry

Electrochemistry

Conductometry

1. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethylacetate by sodium hydroxide conductometrically.
2. Determination of solubility and solubility product of sparingly soluble salts (e.g., PbSO_4 , BaSO_4) conductometrically.

SEMSTER-II

MUMCH 201: Inorganic Chemistry-II

Credits-4

Unit-I

Electronic Spectra & Magnetic Properties of Transition Metal Complexes.

Types of absorption spectra terms. Russell-Saunders states. Selection rules for electronic transition in complexes. Width of absorption spectra bands, Terms generated in ligand fields. Orgel and Tanabe-Sugano correlation diagrams for d^1 to d^9 states. Racah parameters. Charges transfer spectra. Magnetic moments, magnetic exchange coupling and spin crossover.

Unit-II

Metal - π -Complexes and Organometallic Compounds.

Metal carbonyl complexes. Preparation, properties and uses. Nature of bonding in metal carbonyls and carbon monoxide analoges i.e. nitrosyls and dinitrogen complexes. Evidence for back bonding in complexes

Nature of M-C bond synthesis bonding and uses of organometallic compounds, two electron ligands (olefinic and acetylenic complexes), three electron ligands (allylic complexes), four electron ligand (butadiene and cyclobutadiene complexes), five electron ligand (ferrocene complexes)

Unit-III

Metal cluster

Polyhedral boranes and borane anions. Synthesis reactivity, bonding and topology of boranes. Wade's metal carbonyls and halides cluster Metal carbonyl hydride.

Unit-IV

Silicates

Principles of silicates, Structure and Classification of silicates. Asbestos, Zeolites and Ultramarines as silicate materials. Silicates in technology.

Books suggested:

- 1-Advanced Inorganic Chemistry Vth Ed. F.A. Cotton and G. Wilkinson, John Wiley (1988).
- 2-Advanced Inorganic Chemistry VIth F.A. Cotton G Wilkinson C.A. Murillo and M. Bochman John Wiley (1999).
- 3-Inorganic Chemistry, J.E. House, Academic Press (2008).
- 4-Inorganic Chemistry A Unified Approach, IIth Ed., W.W. Porterfield, Academic Press (1993).
- 5-Coordination Chemistry, IIIrd Ed., D Banerjee, Asian book Pt. Ltd, (2009)
- 6-Inorganic Chemistry 3th Ed., G L Miessler and D.A. Tarr, Pearson Education, Inc (2004).
- 7-Concise Inorganic Chemistry J.D. Lee 5th Ed. Chapman & Hall (1996).

Unit-I**Aromatic Electrophilic Substitution**

Orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrate and electrophiles. Diazonium coupling Vilsmeier Haack reaction, Gatterman –Koch reactions.

Unit-II**Aromatic Nucleophilic Substitution**

The S_NAr, S_NI, benzyne and S_{RN}1 mechanisms. Reactivity-effects of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet –Hauser, and Smiles rearrangements

Unit-III**Free Radical Reactions**

Types of free radical reactions, free radical substitution mechanism, Mechanism of an aromatic substrate, neighboring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity.

Allylic halogenations (NBS), oxidation of aldehydes to carboxylic acids auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

Unit-IV**Addition to Carbon-Carbon Multiple Bonds**

Mechanism and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, region- and chemoselectivity and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

Unit-V**Additional to Carbon-Hetero Multiple Bonds**

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Wittig reaction.

Mechanism of condensation reactions involving enolates- Knoevenagel, Claisen, Mannich benzoin, Perkin and Stobbe reactions.

Hydrolysis of ester and amides, ammonolysis of esters.

Unit-VI**Elimination reactions**

The E₂, E₁ and E_{1c}B Mechanism and their stereochemistry. Orientation of the double bond. Reactivity-effects of substrate structure, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

Unit-VII

Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1, 3-butadiene, 1, 3, 5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward - Hoffmann Correlation diagrams, FMO and PMO approach. Electrocyclic reactions-conrotatory and suprafacial additions, $4n$, and $4n+2$ systems. Cycloadditions-antarafacial and suprafacial additions, $4n$ and $4n+2$ systems. $2+2$ addition of ketenes, 1, 3 dipolar cycloadditions and cheletropic reactions. Sigmatropic rearrangement-suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic rearrangements. Claisen, cope and aza - Cope rearrangements. Fluxional tautomerism .Ene reaction

Book Suggested:

1. Advance Organic Chemistry- Reaction, Mechanism and Structure Jerry March John Wiley.
2. Advance 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 Reactins, H.O. House, Benjamin.
7. Principles of Organic synthesis, R.O.C. Norman and J.M. Coxo, Black Well.
8. Pericyclic Reactions, S.M. Mukherji, Machimillan, India.

Unit-I**Chemical Dynamics**

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory. Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetics and thermodynamic control of reaction, treatment of unimolecular reactions.

Photochemical (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane). (Belousov-Zhabotinsky reaction), homogeneous catalysis kinetics of enzymes reaction, general feature of fast reaction study of fast reaction by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method.

Unit-II**Statistical Thermodynamics.**

Concept of distribution thermodynamic probability and most probable distribution, Ensemble averaging postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws- (using Lagrange's method of undetermined multipliers).

Partition functions- translational, rotational, vibrational and electronic partition functions.

Calculation of thermodynamics properties in terms of partition functions. Applications of partition functions.

Heat capacity behavior of solids- chemical equilibria and chemical equilibrium constant in terms of Bose-Einstein statistics-distribution law and application to helium.

Non-Equilibrium Thermodynamics.

Thermodynamics criteria for non Equilibrium states entropy production and entropy flow, entropy balance equations for different irreversible process (e.g. heat flow, chemical reaction etc)

Transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations microscopic reversibility and Onsager's reciprocity relations, electrokinetic phenomena diffusion electric conduction, irreversible thermodynamics for biological systems coupled reactions.

Unit-III**Electrochemistry.**

Electrochemistry of solutions, Debye-Huckel, Onsager treatment and its extension, ion solvent interactions. Thermodynamics of electrified interface equations. Structure of electrified interfaces. Guoy Chapman, Stern. Over potentials, exchange current density, derivation of Butler-Volmer equation, Tafel plot.

Semiconductor interface-theory of double layers at semiconductor electrolyte solution interfaces electrode. Bioelectrochemistry, threshold membrane phenomena. Paleography theory ilkovic equation half wave potential and its significance. Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion, monitoring and prevention methods

Books Suggested

1. Physical chemistry, P.W. Atkins ELBS.
2. Coulson's Valence R. Mc Weeny ELBS
3. Modern Electrochemistry Vol. I & II, J.O.M. Bockris Reddy plenum
4. Introduction to Quantum Chemistry A K. Chandra, Tata Mc Graw Hill
5. Quantum Chemistry Ira N. Levine Prentice Hall

Unit-I**Molecular Electronic Spectroscopy.**

Energy levels, molecular orbitals, vibronic transitions vibrational progressions and geometry of excited states, Franck-Condon principle, Dissociation and pre-dissociation electronic spectra of polyatomic molecules, Emission spectra radiative and non radiative decay, internal conversion.

Unit-II**Raman Spectroscopy.**

Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational rotational Raman spectroscopy, selection rules, mutual exclusion principle. Resonance Raman spectroscopy coherent anti Stokes Raman spectroscopy (CARS).

Unit-III**Magnetic Resonance Spectroscopy.**

Nuclear Magnetic Resonance Spectroscopy

Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurement, factor influencing chemical shift, deshielding spin-spin interaction, factors influencing coupling constant 'J'. Classification (ABX, AMX, ABC, A₂B₂ etc.), spin decoupling basic ideas about instrument, NMR studies of nuclei other than proton ¹³C, ¹⁹F and ³¹P. FT NMR, advantage of FT NMR, use of NMR in medical diagnostics.

Unit-IV**Chromatographic Methods.**

Principle, instrumentation of gas liquid chromatography and HPLC. Ion exchange chromatography cationic and anionic exchanges and their applications. Van-Deemter equation (no derivation), concept about HEPT-plate theory and rate theory applications.

Unit-V**Radio Analytical Methods.**

Basic principles and types of measuring instruments, isotope dilution : principle of operations and uses and applications.

Book Suggested.

- 1-Modern Spectroscopy, J.M. Hollas, John Wiley.
- 2-NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry . R.V. Parish Ellis Horwood.
- 3-Physical Method for Chemistry, R.S. Drago, Saunders Company.
- 4-Introduction of Molecular Spectroscopy , G.M. Barrow, McGraw Hill.
- 5-Basic principles of Spectroscopy, R. Chang, Mc Graw Hill.
- 6-Theory and Application of Uv Spectroscopy, H.H. jaffe and M. Orchin, IBH-Oxford.
- 7-Introduction to Magnetic Resonance A. Carrington, A.D. Maclachalan, Harper & Row.
- 8-High Performance Liquid Chromatography, Heinz Engelhardt.
- 9-Instrumental Methods of Chemical Analysis Willard, Meritt, Dean & settle (Wiley Eastern).

Inorganic Chemistry

Quantitative Analysis.

Quantitative Analysis of mixtures of metal ions involving Volumetric (by complexometric titration using masking and demasking agents) and gravimetric analysis.

Organic Chemistry

Organic Synthesis.

Acetoacetic ester Condensational : Synthesis of ethyl-n-butylacetoacetate A.E.E. condensation.

Cannizzaro reaction: 4- Chlorobenzaldehyde as substrate.

Aromatic electrophilic Substitutions: Synthesis of p-nitroaniline and bromoaniline. The products may be characterized by Spectral Techniques where possible.

Physical chemistry

Solutions

1. Determination of the molecular weight of non-volatile and non-electrolyte/electrolyte by cryoscopy method and to determine the activity coefficient of an electrolyte.
2. Determination of the degree of dissociation of the weak electrolyte and to study the deviation from ideal behavior that occurs with a strong electrolyte.

Preparations

Preparations of selected inorganic compounds

Vo (acac)₂

TiO (C₉H₈NO)₂ 2H₂O

Cis-K[Cr(C₂O₄)₂ (H₂O)₂]

Na [Cr(NH₃)₂ (SCN)₄]

Mn (acac)₃

K₃ [Fe(C₂O₄)₃] 3H₂O

Prussian Blue Turnbull's Blue

Co [(NH₃)₆] Cl₃

[Cu (en)₂ (H₂O)₂] I₂

Cu₂HgI₄

[Co (Py)₂Cl₂]

[Ni (NH₃)₆] Cl₂

Tris-(thiourea) copper (I) sulphate [Cu (tu)₃] SO₄ 2H₂ O

K₃[Cr (C₂O₄)₃]

Organic Chemistry**Quantitative Analysis**

Determination of the percentage or number of hydroxyl groups in a organic compound by acetylation method.

Estimation of aniner pneols using bromated solutiom/or acetylation method.

Determination of Iodine and Saponification values of an oil sample.

Determination of DO, COD AND BOD of water sample.

Physical Chemistry**Electrochemistry****Potentiometry/Ph-metry**

1- Determination of strengths of halides in a mixture potentiometrically.

2- Determination of the valency of mercurous potentiometrically.

3- Determination of the strength of strong and weak acids in a given mixture using a potentiometer/Ph meter.

4- Determination of temperature dependence of EMF of a cell.

5- Determination of the formational constant of silver-ammonia complex and stiochiometry of the complex potentiometrically.

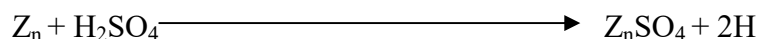
6- Acid-base titration in a non –aqueous meida using a Ph Meter.

7- Determination of activity and activity coefficient of electrolytest.

8- Determination of the disassociation aonstant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.

9- Determination of the dissociation constant of monobasic/dibasic by Albert-Serjeant method.

10- Determination of the thermodynamic constants ΔG, ΔS, And H for the reaction by e.m.f. method.



SEMSTER-III

MUMCH 301:Organic Synthesis and Photochemistry

Credits-4

Unit I :-Disconnection Approach

An introduction to synthons and synthetic equivalents disconnection approach, functional group interconversions, the importance of order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions and amine synthesis.

Unit II :-Protecting Groups

Principle of protection of alcohols, amine, carbonyl and carboxyl groups

Unit III :-One Group and Two Group C-C Disconnections

Alcohols and carbonyl compounds regioselectivity. Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis. Diels-Alder reaction, 1,3-difunctional compounds, α,β -unsaturated carbonyl compounds, control in carbonyl condensations. Micheal addition and Robinson annelation.

Unit IV:- Determination of Reaction Mechanism

Classification, rate constants and life times of reactive energy states-determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions, photo-dissociation, gas-phase photolysis.

Unit V:- Photochemical Reactions

Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4-and 1,5-dienes.

Intramolecular reactions of carbonyl compounds-saturated cyclic and acyclic, β,γ -unsaturated and α,β -unsaturated compounds. Cyclohexadienones.

Intramolecular cycloaddition reactions-dimerisation and oxetane formation.

Isomerisation, additions and substitutions.. Photo-Fries rearrangement, Barton reaction.

Books Suggested:

1. Modern Synthetic Reactions, H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March, John Wiley.
4. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Advanced Organic Chemistry Part B, F.A. Carey and R.J. Sundberg, Plenum Press.
6. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.

Unit I

Principles, preparations, properties and applications of the following in organic synthesis with mechanistic details.

Group I and II metal organic compounds

Li and Hg compounds.

Transition metals

Pd, Ni and Cr compounds.

Other elements

Si and B compounds.

Unit II :-Oxidation

Introduction. Different oxidative processes.

Hydrocarbons- alkenes, aromatic rings, saturated C-H groups (activated and inactivated).

Alcohols, diols, aldehydes, ketones, ketals and carboxylic acids.

Amines, hydrazines, and sulphides.

Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium (III) nitrate.

Unit III :-Reduction

Introduction. Different reductive processes.

Reduction of hydrocarbons- alkenes, alkynes and aromatic rings.

Reduction of carbonyl compounds (aldehydes, ketones, acids and their derivatives).

Epoxides.

Reduction of nitro, nitroso, azo and oxime groups.

Hydrogenolysis.

Unit IV :-Rearrangements

General mechanistic considerations-nature of migration, migratory aptitude, memory effects

A detailed study of the following rearrangements

Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis,

Neber, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction

Unit V:-Metallocenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds

General considerations, synthesis and reactions of some representative compounds

Books Suggested:

1. Modern Synthetic Reactions, H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March, 6th Edn., John Wiley.
4. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.

Unit I :-Drug Design

Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structure-activity relationship (SAR) factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial considerations. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors. Elementary treatment of drug receptor interactions. Physico-chemical parameters: lipophilicity, partition coefficient, electronic ionization constant, steric, Shelton and surface activity parameters and redox potentials. Free Wilson analysis, Hansch analysis, relationships between Free-Wilson and Hansch analysis. LD-50, ED-50 (Mathematical derivations of equations excluded).

Unit II:-Pharmacokinetics

Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process

Unit III:- Pharmacodynamics

Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, sulphonamides, membrane active drugs, drug metabolism, xenobiotic, biotransformation, significance of drug metabolism in medicinal chemistry.

Unit IV:-Antineoplastic Agents

Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurine. Recent development in cancer chemotherapy. Hormone and natural products.

Unit V:- Antibiotics

Cell wall biosynthesis inhibitors, β -lactam rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin G, penicillin V, ampicillin, amoxycillin, chloramphenicol, cephalosporin, tetracycline and streptomycin.

Books suggested

1. Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH.
2. Wilson and Gisvold's: Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed. Robert F. Dorge.
3. An Introduction to Drug Design, S.S. Pandeya and J.R. Dimmock, New Age International.
4. Burger's Medicinal Chemistry and Drug Discovery, Vol-I, Ed. M.E. Wolff, John Wiley.
5. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
6. The Organic Chemistry of Drug Design and Drug Action, R.B. Silverman, Academic Press.

(A) Bioinorganic Chemistry

- **Metal Ions in Biological Systems, Na⁺/K⁺ Pump**
Essential and trace metals. Role of metal ions in biological processes. Na⁺/K⁺ Pump.
- **Bioenergetics and ATP Cycles**
DNA polymerization, glucose storage, metal complexes in transmission of energy; chlorophylls, photo system I and photo system II in cleavage of water. Model system.
- **Transport and Storage of Dioxygen**
Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythrin, model synthetic complexes of iron, cobalt and copper.

(B) Bioorganic Chemistry

- **Enzymes & Mechanism of Enzyme Action**
Introduction and historical perspective, chemical and biological catalysis, properties of enzymes- catalytic power, specificity and regulation. Fischer's lock and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed, mutagenesis. Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots, reversible and irreversible inhibition. Transition-state theory, acid-base catalysis, covalent catalysis, strain of distortion. Examples of some typical enzyme mechanisms for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A
- **Kinds of Reactions Catalysed by Enzymes**
Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in isomerization reactions, α -cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

(C) Biophysical Chemistry**I. Biological Cell and its Constituents, Cell Membrane and Transport of Ions**

Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coil transition. Structure and functions of cell membrane, ion transport through cell membrane.

II. Bioenergetics

Standard free energy change in biological reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

Books Suggested

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
3. Bioinorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag.

4. Enzyme Chemistry: Impact and Applications, Ed. Colliins J Sucking, Chapman and Hall.
5. Enzymes Mechanism Ed, M.I. Page and A. Williams, Royal Society of Chemistry.
6. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press.
7. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, John Wiley.
8. Enzymatic Reaction Mechanism, C. Walsh, W.H. Freeman.
9. Enzymatic Structure and Mechanism, W.H. Freeman.
10. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
11. Biochemistry, L. Stryer, W.H. Freeman.
12. Biochemisty, J. David Rawn, Neil Patterson.
13. Biochemistry, Voet and Voet, John Wiley.
14. Outlines of Biochemistry, E.E. Conn and P.K. Stumpf, John Wiley.
15. Macromolecules: Structure and function, F. World, Prentice Hall.

- **Qualitative Analysis**

Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid, two solids and one liquid), using TLC for checking the purity of the separated compounds. Preparation of derivatives and spectral analysis.

Books Suggested

1. Introduction to Organic Laboratory Techniques (Third Edition), DL Pavia, GM Lampman and GS Kriz,
2. Saunders College Publishing, Philadelphia, New York.
3. Operational Organic Chemistry, A Laboratory Course, Second Edition, JW Lehman, Allyn & Bacon,
4. Microscale Organic Experiments KL Willianson, DC Health & Co. Le Xington.
5. Laboratory Manual of Organic Chemistry, RK Bansal, New Age International, Delhi

- **Multi-step Synthesis of Organic Compounds**

The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques.

- **Photochemical reaction**

1. Benzophenone →Benzpinacol →Benzpinacolone
2. Beckmann rearrangement: Benzanilide from benzene
Benzene→ Benzophenone→ Benzophenone oxime→ Benzanilide
3. Benzilic acid rearrangement: Benzilic acid from benzoin
Benzoin→ Benzil→ Benzilic acid

- **Synthesis of heterocyclic compounds**

Skraup synthesis: Preparation of quinoline from aniline. Fisher-Indole synthesis: Preparation of 2-phenyl indole from phenylhydrazine.

- **Enzymatic Synthesis**

Enzymatic reduction: Reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ethyl-3-hydroxybutanoate and determine its optical purity.
Biosynthesis of ethanol from sucrose

- **Synthesis using microwaves**

Alkylation of diethyl malonate with benzyl chloride.
Synthesis using phase transfer catalyst.
Alkylation of diethyl malonate or ethylacetoacetate with an alkyl halide.

Books Suggested

1. Introduction to Organic Laboratory Techniques (Third Edition), DL Pavia, GM Lampman and GS Kriz, Saunders College Publishing, Philadelphia, New York.
2. Operational Organic Chemistry, A Laboratory Course, Second Edition, JW Lehman, Allyn & Bacon, Inc. Boston.
3. Microscale Organic Experiments KL Willianson, DC Health & Co. Le Xington.
4. Laboratory Manual of Organic Chemistry, RK Bansal, New Age International

SEMSTER-IV

MUMCH 401: Natural Products

Credits-4

Unit I :- Terpenoids and Carotenoids

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule Structures of abietic acid and β -carotene.

Unit II :- Alkaloids

Isolation, structure and synthesis of ephedrine, quinine.

Unit III :-Steroids

Structure determination of cholesterol and bile acids (without synthesis). Chemistry of testosterone, estrone and progesterone.

Unit IV:-Pigments

(a) **Plant Pigments:** Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of cyanidin, and quercetin.

(b) **Porphyrins :**General Introduction of haemoglobin and chlorophyll. Chemistry of chlorophyll (without synthesis) Structure and synthesis of haem.

Unit V:- Prostaglandins

Occurrence, nomenclature, classification, biogenesis and physiological effects .Synthesis of Key intermediate, PGE₂ and PGF₂ □

Books Suggested:

1. Natural Products: Chemistry and Biological Significance, J.Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
2. Organic Chemistry, Vol 2, I.L. Finar, ELBS.
3. Stereoselective Synthesis: A Practical Approach, M. Nogradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt. Hostettmann, M.P. Gupta and A. Marston, Harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm, Harwood Academic Publishers.
7. New Trends in Natural product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers

Unit I :-Nomenclature of Heterocycles

Replacement and Systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocycles

Unit II :-Aromatic and Non-aromatic Heterocycles

General chemical behaviour of aromatic heterocycles, classification (structural type), Heteroaromatic reactivity and tautomerism in aromatic heterocycles
Strain –bond angle and torsional strains and their consequences in small ring heterocycles.
Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interactions.
Stereo-electronic effects, aromatic and related effects. Attractive interactions - hydrogen bonding and intermolecular nucleophilic, electrophilic interactions.

Unit III :-Small Ring Heterocycles

Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes

Unit IV :-Benzo-Fused Five-Membered Heterocycles

Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes

Unit V :-Six-Membered Heterocycles with One, Two or More Heteroatoms

Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pyridones
Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones
Synthesis and reactions of diazines, triazines, tetrazines and thiazines

Unit VI :-Seven-and Large-Membered Heterocycles

Synthesis and reactions of azepines, oxepines, thiepinines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines

Books Suggested:

1. Heterocyclic Chemistry Vol. 1 & 2, R.R. 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

Unit I :-Environment

Introduction, composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, vertical stability atmosphere. Biogeochemical cycles of C, N, P, S and O. Bio distribution of elements.

Unit II :-Hydrosphere

Aquatic pollution- inorganic, organic, pesticides, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters-dissolved oxygen, biochemical oxygen demand, solids, metals, content of chloride, sulphate, phosphate, nitrate and micro-organisms. Water quality standards. Analytical methods for measuring BOD, DO, COD, F, Oils, metals (As, Cd, Cr, Hg, Pb, Se etc.) residual chloride and chlorine demand. Purification and treatment of water

Unit III :-Soils

Composition, micro and macro nutrients, Pollution of fertilizers, pesticides and metals.

Unit IV :-Atmosphere

Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect, pollution by chemicals, petroleum, minerals chlorofluorohydrocarbons. Analytical methods for measuring air pollutants. Continuous monitoring instruments.

Unit V :-Industrial Pollution

Pollution from cement, sugar, distillery, drug; paper and pulp, thermal power plants, nuclear power plants, metallurgy, polymers and drugs etc

Unit VI :-Environmental Toxicology

Chemical solutions to environmental problems, biodegradability, principles of decomposition, better industrial processes

Books suggested

1. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
2. Environmental Chemistry, Sharma and Kaur, Krishna Publishers.
3. Environmental Chemistry, A.K. De, Wiley Eastern.
4. Environmental Pollution Analysis, S.M. Khopkar, Wiley Eastern.
5. Standard Method of Chemical Analysis, F.J. Welcher Vol. III, Van Nostrand Reinhold Co.
6. Environmental Toxicology, Ed. J. Rose, Gordon and Breach Science Publication.
7. Elemental Analysis of Airborne Particles, Ed. S. Landsberger and M. Creatchman, Gordon and Breach Science Publication.
8. Environmental Chemistry, C. Baird, W.H. Freeman.

Unit I :- Bioinorganic Chemistry**1. Electron Transfer in Biology**

Structure and function of metalloproteins in electron transport processes- cytochromes and iron-sulphur proteins, synthetic models.

2. Nitrogenase

Biological nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenases model systems.

Unit II:-Bioorganic Chemistry**1. Co-Enzyme Chemistry**

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes.

Structure and biological functions

of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD⁺, NADP⁺, FMN, FAD, lipoic acid, vitamin

B12. Mechanisms of reactions catalyzed by the above cofactors.

2. Enzyme Models

Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and

prochirality. Biomimetic chemistry, crown ethers, cryptates. Cyclodextrins,

cyclodextrin-based enzyme models,

calixarenes, ionophores, micelles, synthetic enzymes

3. Biotechnological Applications of Enzymes

Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, use of

enzymes in food and drink industry, brewing and cheese-making, syrups from corn starch, enzymes as targets for

drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA technology.

Unit III:-Biophysical Chemistry**1. Statistical Mechanism in Biopolymers**

Chain configuration of macromolecules, statistical distribution, end-to-end dimensions, calculation of average dimensions for various chain structures. Polypeptide and protein structures, introduction to protein folding problem.

2. Biopolymer Interactions, Thermodynamics of Biopolymer Solutions

Forces involved in biopolymer interactions. Electrostatic charge and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical system.

3. Biopolymers and their Molecular Weights

Evaluation of size, shape, molecular weight and extent of hydration of biopolymers by various experimental techniques. Sedimentation equilibrium, hydrodynamic methods, diffusion, sedimentation velocity, viscosity, electrophoresis and rotational motions.

Books Suggested

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
3. Bioinorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag.
4. Understanding Enzymes, Trevor Palmer, Prentice Hall.
5. Enzyme Chemistry: Impact and Applications, Ed. Colliins J Sucking, Chapman and Hall.
6. Enzymes Mechanism Ed, M.I. Page and A. Williams, Royal Society of Chemistry.
7. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press.
8. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, John Wiley.
9. Enzymatic Reaction Mechanism, C. Walsh, W.H. Freeman.
10. Enzymatic Structure and Mechanism, W.H. Freeman.
11. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
12. Biochemistry, L. Stryer, W.H. Freeman.
13. Biochemisty, J. David Rawn, Neil Patterson.
14. Biochemistry, Voet and Voet, John Wiley.
15. Outlines of Biochemistry, E.E. Conn and P.K. Stumpf, John Wiley.
16. Macromolecules: Structure and function, F. World, Prentice Hall

Extraction of Organic Compounds from Natural Sources

1. Isolation of caffeine from tea leaves.
2. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins).
3. Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported).
4. Isolation of nicotine dipicrate from tobacco.
5. Isolation of cinchonine from cinchona bark.
6. Isolation of piperine from black pepper.
7. Isolation of lycopene from tomatoes.
8. Isolation of β -carotene from carrots
9. Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid).
10. Isolation of eugenol from cloves.
11. Isolation of limonene from citrus fruits.

II. Paper Chromatography

Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

III. Column Chromatography

Separation and purification of Organic Compounds by Column Chromatography.

Books Suggested

1. Introduction to Organic Laboratory Techniques (Third Edition), DL Pavia, GM Lampman and GS Kriz, Saunders College Publishing, Philadelphia, New York.
2. Operational Organic Chemistry, A Laboratory Course, Second Edition, JW Lehman, Allyn & Bacon, Inc. Boston.
3. Microscale Organic Experiments KL Willianson, DC Health & Co. Le Xington.
4. Laboratory Manual of Organic Chemistry, RK Bansal, New Age International, Delhi.

MUMCH 452: Six Months Project**Credits-4**

Six months project is mandatory for the completion of Course. Students will do their project work in fourth semester along with Classes. Students are required to submit their project report before the completion of 4th semester. Students can do their project in inside & outside the University Campus (Research labs/ Research Institutes/ Industry)