



Department of Chemistry

PROGRAMME M.Sc. (Chemistry)

(Session: 2024-2025 Onwards)

➤ **Programme Structure**

➤ **Programme Outcomes (POs)**

➤ **Course Outcomes (COs)**

➤ **Detailed Syllabus (Course Contents)**

COURSE STRUCTURE WITH CREDITS DISTRIBUTION

(Subject: M.Sc. Chemistry)

(2024-2025 onwards)

UG SEMESTER-VII/PG SEMESTER-I

Course Code		Course Name	Maximum Credits (20)	CIE	ETE
B020701T	Core	Inorganic Chemistry-I	3 Credits	25	75
B020702P	Core	Chemistry Laboratory -I	1 Credits	25	75
B020703T	Core	Organic Chemistry -I	3 Credits	25	75
B020704P	Core	Chemistry Laboratory -II	1 Credits	25	75
B020705T	Core	Research Methodology	4 Credits	25	75
B020706T	Discipline Centric Elective (Select any one)	Physical Chemistry	4 Credits	25	75
B020707T		Polymer Chemistry			
B020708T	Discipline Centric Elective (Select any one)	Techniques of Chemistry -I	4 Credits	25	75
B020709T		Medicinal Chemistry			

**UG SEMESTER-VIII (for Four Year Undergraduate Programme who obtained above 75% Marks)/
PG SEMESTER- II (for Two Year Post Graduate Programme- lateral entry)**

Course Code		Course Name	Maximum Credits (20)	CIE	ETE
B020801T	Core	Inorganic Chemistry-II	03 Credits	25	75
B020802P	Core	Chemistry Laboratory -III	01 Credits	25	75
B020803T	Core	Organic Chemistry -II	03 Credits	25	75
B020804P	Core	Chemistry Laboratory -IV	01 Credits	25	75
B020805R	Research Project	Research Project	12 Credits	--	100

OR

**UG SEMESTER-VIII (for Four Year Undergraduate Programme who obtained below 75% Marks)/
PG SEMESTER- II (for Two Year Post Graduate Programme- lateral entry)**

Course Code		Course Name	Maximum Credits (20)	CIE	ETE
B020801T	Core	Inorganic Chemistry-II	3 Credits	25	75
B020802P	Core	Chemistry Laboratory -III	1 Credits	25	75
B020803T	Core	Organic Chemistry -II	3 Credits	25	75
B020804P	Core	Chemistry Laboratory -IV	1 Credits	25	75
B020805T	Discipline Centric Elective (select any one)	Chemistry of Natural Products	4 Credits	25	75
B020806T		Techniques of Chemistry -I I			
B020807T	Discipline Centric Elective (select any one)	Supra-molecular Chemistry and Strategy in Chemical Synthesis	4 Credits	25	75
B020808T		Heterocyclic Chemistry			
B020809T	Ability Enhancement Course (select any one)	Reagents in Organic Synthesis	4 Credits	25	75
B020810T		Analytical Chemistry			

Note: The Core Course will be same in the both of UG Semester-VIII and PG Semester-II.

PG SEMESTER-III/PG SEMESTER-I (One Year PG Programme-Lateral Entry)					
Course Code		Course Name	Maximum Credits (20)	CIE	ETE
B020901T	Core	Organic Spectroscopy	3 Credits	25	75
B020902P	Core	Chemistry Laboratory -V	1 Credits	25	75
B020903T	Core	Organometallic Chemistry	3 Credits	25	75
B020904P	Core	Chemistry Laboratory - VI	1 Credits	25	75
B020905T	Discipline Centric Elective (select any one)	Inorganic Spectroscopy	4 Credits	25	75
B020906T		Nano Materials & Solid State Chemistry			
B020907T	Discipline Centric Elective (select any one)	Photochemistry	4 Credits	25	75
B020908T		Quantum Chemistry			
B020909T	Ability Enhancement Course (select any one)	Name reactions & Rearrangements in Organic Synthesis	4 Credits	25	75
B020910T		Molecular Spectroscopy			

PG SEMESTER-IV/PG SEMESTER-II (One Year PG Programme)

Course Code		Course Name	Maximum Credits (20)
B021001D	MRP	MASTER DISSERTATION	20 Credits

Instrumental Methods of Analysis

M.Sc. Chemistry -Semester-I

Paper Name: Inorganic Chemistry -I (Paper-I)

Paper CODE: B020701T

Marks: 100 (ETE 75 & CIE 25)

I. Stereochemistry and Bonding in main group compounds:

VSEPR, Walsh diagrams (tri-and penta-atomic molecules), $d\pi-p\pi$ bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

II. Metal-Ligand Bonding in Transition Metal Complexes

Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π -bonding and molecular orbital theory and Jahn-Teller distortion.

III. Molecular symmetry and character tables

Symmetry elements and symmetry operations, symmetry groups, defining properties of a group, character tables and its applications.

Symmetry considerations in simple inorganic and coordination compounds.

IV. Chemistry of f-Block Elements

Comparative study of lanthanides and actinides. Electronic configuration, Oxidation state, Ionic radii (lanthanide contraction), complex formation, Structure of complexes, spectral properties and magnetic properties. General chemistry of actinides including E.M.F. diagrams, Extraction and metallurgy of thorium and uranium. Separation of transamericium elements.

V. Metal ligand equilibria in solution:

Stepwise and overall formation constant, trends in stepwise constant, factors affecting the stability of metal complex with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin.

M.Sc. Chemistry (Practical)-Semester-I

Paper Name: Chemistry Laboratory -I

Paper CODE: B020702P

Marks: 100 (ETE 75 & CIE 25)

Inorganic :

- a) **Qualitative Analysis :**
Qualitative mixture analysis for seven radicals including two rare elements (Mo, W, Ti, Zr, Th, Ce, V) in cationic and anionic forms.
- b) Quantitative separation and determination of the following pairs of metal ions using gravimetric & volumetric methods.
 - (i) Ni^{++} and Cu^{++}
 - (ii) Cu^{++} and Zn^{++}
 - (iii) Ag^+ and Cu^{++}
 - (iv) Ag^+ and Ca^{++}

Organic

- a) Separation and identification of organic compounds using chemical methods from binary mixture.
- b) Isolation of
 - (i) Caffeine from tea leaves
 - (ii) Eugenol from cloves
 - (iii) Casein from milk
 - (iv) Lycopene from Tomatoes

M.Sc. Chemistry -Semester-I

Paper Name: Organic Chemistry -I (Paper-II)

Paper CODE: B020703T

Marks: 100 (ETE 75 & CIE 25)

I- Nature of bonding in organic molecules:

Delocalised chemical bonding-conjugation, crossconjugation, resonance, hyperconjugation, Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, energy of pi-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity. Bonding in fullerenes.

II - Reaction Mechanism: Structure and Reactivity:

Generation, structure stability and fate of reaction intermediates: carbocation(including nonclassical carbocation, phenonium ion, and norbornyl system), carbanion (including enolate ions), carbene, nitrenes, free radicals(allylic halogenation) and arynes. Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates. Methods of determining mechanism-isotope effects, product analysis. Kinetic and stereochemical studies.

III. Stereochemistry

Conformational analysis of cycloalkanes-disubstitutedcyclohexanes, decalins, effect of conformation on reactivity.

Elements of symmetry, chirality, molecules with more than one chiral centre, threo and erythro isomers, optical purity, enantiotopic and diastereotopic atoms, group and faces, regiospecific, stereospecific and stereoselective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. R/S nomenclature, chiral centres and chiral molecules.

IV Aliphatic Nucleophilic Substitution

The S_N^1 , S_N^2 , mixed S_N1' , S_N2' , S_N^1 and SET mechanisms.

neighbouring group participation by pi and sigma bonds, anchimeric assistance. Nucleophilic substitution at allylic, aliphatic trigonal and vinylic carbon. Effects of substrate structure, attacking nucleophile, leaving group and reaction medium on reactivity. Phase transfer catalysis, ambident nucleophile and regioselectivity. Stereochemistry of S_N^1 and S_N^2 reactions.

V. Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy-profile diagrams. The ortho/para ratio, ipso attack. Diazonium coupling, Vilsmeier reaction, Gatterman-Koch reaction..

VI. Aromatic Nucleophile Substitution

The $ArSN^1$, $ArSN^2$ & $ArSN^1$ via benzyne mechanisms. Effect of substrate structure, leaving group and attacking nucleophile on reactivity. The Von Richter, Sommelet-Hauser and Smiles rearrangements.

M.Sc. Chemistry (Practical)-Semester-I

Paper Name: Chemistry Laboratory -II

Paper CODE: B020704P

Marks: 100 (ETE 75 & CIE 25)

Physical

Chemical Kinetics :

1. Kinetic studies of a reaction between acetone and iodine catalyzed by H^+ ions.
2. Kinetics of oxidation of reducing sugars by potassium ferricyanide in presence of ammonium hydroxide or sodium hydroxide.
3. Determination of rate constant and order of reaction between H_2O_2 and HI
4. Determination of velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
5. Determination of the effect of a) change of temperature, b) ionic strength of media, c) change of concentration of reactants and catalysts on the velocity constant of hydrolysis of an ester/ionic reaction.

Thermodynamics

1. Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.
2. Determination of the temperature dependence of the solubility of a compound in two solvents having similar inter molecular interactions and to calculate the partial molar heat of solution.

M.Sc. Chemistry-Semester-I

Paper Name: RESEARCH METHODOLOGY

Paper CODE: B020705T

Marks: 100 (ETE 75 & CIE 25)

Research Methodology

An Introduction, Meaning of Research, objective of research, motivation in research, types of research, research approaches, importance of knowing how research is done. Research processes - scientific research, formation of the topic, hypothesis, conceptual definitions, operational definition, gathering of data, analysis of data, revising of hypothesis, Conclusion. Literature survey - Journals, books and resources. Presentation and publication of research output.

Defining the research problems

What is the research problems, selecting the problems, necessity of defining the problem, technique involved in defining the problems, bring clarity and focus to your research problem, procedure for reviewing the literature existing literature. search for

Method of data collection

Collection of primary data, observation method, interview method, collection of data through questionnaires, collection of data through schedules, some other method of data collection, study design based on the nature of the investigation - experimental study, theoretical study, comparison.

The computer-its role in research

Introduction, the computer and computer technology, the computer system. General awareness of computer hardware, CPU, input and output devices, memory, other peripheral devices, auxiliary storage devices. Basic knowledge of computer systems, softwares - System softwares and application software's Programming languages: machine language, assembly language and high-level languages. Interpreter and compiler. Flow charts and Algorithms. General awareness of operating systems: Disk operating system, Windows, Macintosh, Linux. Applications and uses of common softwares in chemistry, Origin, Chems sketch, Chemdraw. Basic ideas on the use of Internet in Chemistry education.

M.Sc. Chemistry-Semester-I

Paper Name: Physical Chemistry

Paper CODE: B020706T

Marks: 100 (ETE 75 & CIE 25)

I

Partial Molar Properties, Nernst Heat Theorem (NHT) and Third Law of Thermodynamics:

Partial molar properties, Chemical potential and other thermodynamic functions, Fugacity of real gases, Nernst Heat Theorem and its application to non-condensed systems. Statement of the third law of thermodynamics. Derivation of unattainability of absolute zero. The relationship between entropy constant and Nernst chemical constant. Determination of entropy from the Third Law using the correction due to gas imperfections.

II

Chemical Kinetics: Thermodynamic formulation of rate constant. Comparison of collision and absolute reaction rate theories. Calculation of transmission coefficient. Transition State theory in solution. Primary and secondary salt effects in the light of mechanistic tests. The theory of Absolute reaction rates - for reactions between atoms and reactions between molecules in terms of partition function. Influence of ionic strength and dielectric constant. Explosive reactions.

III

Electrolytes: Limitation of Arrhenius theory of electrolytic dissociation. Role of solvent and inter-ionic forces. Activity and activity coefficients, determination of activity coefficients, Debye- Huckel Theory of the structure of dilute ionic solution, charge density and electrical potential. Properties of ionic cloud, activity coefficients from Debye-Huckel theory. Limiting law and its verification. Debye-Huckel theory to more concentrated solutions. Partial molar quantities of electrolytic solutions, determination of partial molar volume.

IV

Statistical Thermodynamics:

Quantum states and complexions. The combinatory rule, system with definite total energy. Degeneracy of energy levels, probability and most probable distribution, in distinguishability, Maxwell-Boltzmann statistics, partition function, translational, rotational, vibrational, nuclear and electronic partition functions. Internal energy and heat capacity in terms of partition function.

V

Chemistry of Macromolecules:

Introduction, type of polymers. Step polymerization, kinetics of step polymerization. Statistical approach to Gelation, Molecular weight distribution in linear poly condensation (Derivation of size distribution), Molecular weight averages. Methods of determining molecular weight by osmotic pressure, light scattering, sedimentation and viscosity methods. /

VI

Solid State: Crystal structures, Bragg's law and applications. Band structure of solid.

M.Sc. Chemistry-Semester-I

Paper Name: Polymer Chemistry

Paper CODE: B020707T

Marks: 100 (ETE 75 & CIE 25)

I. Basics

Importance of polymers, basic concepts :monomers, degree of polymerization. Linear branched and network polymers. Classification of polymers. Polymerization: condensation, addition/radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

II. Polymer Characterization

Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular-weights. Endgroup, viscosity, light scattering, osmotic and ultracentrifugation methods.

III. Analysis and testing of polymers

Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Thermal analysis and physical testing-tensile strength. Fatigue, impact tear resistance, hardness and abrasion resistance.

IV. Inorganic Polymers

A general survey and scope of inorganic polymers special characteristics, classification, homo and hetero atomic polymers. Structure, properties and applications of (1) Polymers based on boron-borazines, boranes and carboranes. (2) Polymers based on silicon, silicones, polymetalloxanes and polymetallosiloxanes, silazanes.

V. Structure, Properties and Application of

- a. Polymers based on Phosphorous-Phosphazenes, Polyphosphates.
- b. Polymers based on Sulphur-tetrasulphurtetranitride and related compounds.
- c. Co-ordination and metal chelate polymers.

M.Sc. Chemistry-Semester-I

Paper Name: Techniques of Chemistry -I

Paper CODE: B020708T

Marks: 100 (ETE 75 & CIE 25)

1. Data handling in Analysis:

Accuracy and precision. Errors, determinate and indeterminate errors, significant figures. Rounding off figures, standard deviation, regression analysis.

2. Separation Techniques:

Principles and applications of solvent extraction. Quantitative treatments of extraction equilibria. Solvent extraction of metals. Solid phase extraction.

3. Chromatography:

Introduction, principle, and experimental setup of chromatography. Partition and Adsorption chromatography: Principle of partition and adsorption chromatography. Mobile and stationary phases. liquid-liquid, gas-liquid, gas-solid and liquid-solid chromatography. Reversed phase partition chromatography, paper and thin layer chromatography Applications of partition and adsorption chromatography., HPLC.

4. Ion Exchange resins:

Mechanism of ion exchange. Factors affecting the selection of ion exchange resins. Techniques in ion exchange methods and analytical applications.

5. Spot tests:

Spot tests for metal ions, spot tests for identification of functional groups-hydroxyl, carboxylic, nitro, nitroso, azo and amino.

6. Thermal Methods of Analysis:

Principle, methodology and applications: Thermogravimetric and differential thermal Analysis, thermometric titrations. Thermal stability of polymers. Decomposition Pattern and decomposition reactions- examples.

M.Sc. Chemistry-Semester-I

Paper Name: Medicinal Chemistry

Paper CODE: B020709T

Marks: 100 (ETE 75 & CIE 25)

I. Drug Design

Development of new drugs, procedures followed in drug design, concept of lead compound and end modification, concepts of prodrugs and soft drugs, structure-activity relationship (SAR). Factors affecting bioactivity: Theories of drugs activity- occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR. Concepts of drugs receptors and drug receptors. Elementary treatment of drug interactions. Physico-chemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric, Shelton surface activity parameter and redox potentials. LD-50, ED-50 (Mathematical derivations of equations excluded). Basic ideas about Pharmacokinetics and Pharmacodynamics.

II. Antineoplastic Agents

Introduction, cancer chemotherapy. Role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitoptic inhibitors. Synthesis of mechlorethamine, mustards and 6- mercaptopurine. Recent developments in cancer chemotherapy.

III. Cardiovascular Drugs

Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function. Central intervention of cardiovascular output. Direct acting arteriolar dilators. Synthesis of amyl nitrate, hydrolaxine methyl dopa and diazoxide propanol.

IV. Local Anti-infective Drugs

Anti-tubercular drugs and Anti-malarial drugs: Introduction and general mode of action. Synthesis of sulphonamides, norfloxacin, dapson, chloroquin and primaquin.

V. Psychoactive Drugs-The Chemotherapy of mind

CNS depressants, general anesthetics, mode of action, hypnotics, sedatives, anti-anxiety drugs, benzodiazepines, antipsychotic drugs. Synthesis of diazepam, alprazolam and barbiturates.

VI. Antibiotics

General introduction, structure and synthesis of penicillin G & chloramphenicol.

VI. Metals in Medicines

Metal deficiency and diseases, toxic effects of metals, metals for diagnosis and chemotherapy.

M.Sc. Semester II (Chemistry) Syllabus

Paper Name: Inorganic Chemistry- II

Paper CODE: B020801T

Marks: 100 (ETE 75 & CIE 25)

I. Term Symbols and Basic Principles of Electronic Spectroscopy:

Frank - Condon principle, spin and Laporte selection rules, band intensities, bandwidth. Number of microstates and term symbols for gaseous atoms/ions. Spin-orbit coupling in spectroscopic ground state of p^2 , and d^2 configurations and energies of I levels.

II. Electronic Spectra of Transition Metal Complexes:

Interpretation of electronic spectra using, Orgel and Tanabe - Sugano diagram for 3d transition metal complexes. Calculations of crystal field and ligand field parameters (Dq , B and β parameters), nephelauxetic series and charge transfer spectra.

III. Reaction mechanism of transition metal complexes(octahedral):

Energy profile of reaction, reactivity of metal complexes, inert and labile complexes. Mechanism and kinetics of substitution reaction. Acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct indirect evidence in favour of conjugate mechanism.

IV. Reaction mechanism of transition metal complexes (square planer):

Mechanism and kinetics of substitution reaction. The trans effect, redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer-sphere type reactions, cross reactions and Marcus-Hush theory, inner-sphere type reactions.

V. Metal Clusters:

Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbonyls and halide clusters. Compounds with metal-metal multiple bonds

BOOKS SUGGESTED - (Paper CODE: B020801T)

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey. Harpes & Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetochemistry, R.L. Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry ed., G. Wilkinson, R.D. Gillars and J.A. McCleverty. Pergamon.

M.Sc. Semester II (Chemistry) Syllabus

Paper Name: Chemistry Laboratory-III

Paper CODE: B020802P

Marks: 100 (ETE 75 & CIE 25)

Any two experiments selecting at least one from each section

Section -I

- I. Ion exchange method of separation:
Separation of Zn^{++} and Mg^{++} on an ion exchanger.
Separation of Co^{++} & Ni^{++} on an ion exchanger.
- II. Spectrophotometric determinations:
Iron-phenanthroline complex: Job's Method
Manganese / chromium / vanadium in steel / water sample.

Section - II

- I. Paper chromatography: Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography & determination of R_f values.
- (i) Verification of Lambert-Beer's law and to determine concentration of unknown sample.

M.Sc. Semester II (Chemistry) Syllabus

Paper Name: Organic Chemistry- II

Paper CODE: B020803T

Marks: 100 (ETE 75 & CIE 25)

I. Addition to Carbon-Carbon Multiple Bonds:

Mechanistic and stereochemical aspect of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydroboration, Michael reaction, Sharpless asymmetric epoxidation, stereochemistry of epoxidation and halolactonisation.

II. Addition to Carbon-Hetero atom Multiple Bonds:

Generation of enolate ions and their Synthetic applications. Stereochemistry of Wittig reaction, Aldol condensation, Perkin reaction, Mannich reaction, Benzoin condensation, Robinson Annulation reaction and Stobbe condensation. Reaction mechanism of Hydrolysis of esters.

III. Elimination Reactions:

The E1, E2 and E1cB mechanisms, their stereochemistry and orientation. Effects of substrates, attacking base, the leaving group and the medium on reactivity. Mechanism and orientation in pyrolytic elimination. Peterson elimination, Stereochemistry of E2 reactions and pyrolytic eliminations.

IV. 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 disrotatory motions. $4n$, $4n+2$ and allyl systems. Cycloadditions - antarafacial and suprafacial additions, $4n$, $4n+2$ system, $2+2$ addition of ketenes, 1-3 dipolar addition and chelotropic reactions.

V. Sigmatropic rearrangement:

Suprafacial and antarafacial shift of H. sigmatropic shifts involving carbon moieties, retention and inversion of configuration. [3,3] and [5,5] sigmatropic rearrangements. Detailed treatment of Claisen and Cope-rearrangements. Fluxional tautomerism, Aza-Cope rearrangements. Introduction to Ene reaction. Simple problems on pericyclic reactions.

BOOKS SUGGESTED - (Paper CODE: B020803T)

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 Reaction H.O. House, Benjamin
7. Principles of Organic Synthesis, R.O.C. Normon and J.M. Coxon, Blackie Academic and professionla.
8. Perricyclic Reactions. S.M. Mukherji, Macmillan India. 9. Reaction Mecnanism in Organic Chemistry S.M. Mukherji and S.P. Singh, Macmillan.
9. Stereochemistry of Organic Compounds D. Nasipuri, New Age International. 11. Stereochemistry of Organic Compounds, P.S Kalsi, New Age International.
10. Advanced Organic Chemistry, J.Singh and L.D.S Yadav, Pragati Prakashan, India.

M.Sc. Semester II (Chemistry) Syllabus

Paper Name: Chemistry Laboratory-IV

Paper CODE: B020804P

Marks: 100 (ETE 75 & CIE 25)

Any two experiments selecting at least one from each section

Section -I

- I.** Separation & identification of organic' compounds using chemical methods from organic mixtures containing upto three components.
- II.** Thin layer chromatographic separation of cations like Ni. Mn, Co & Zn* etc. and determination of their R_f values.

Section - II

- I.** Flame emission photometric determination of ions e.g. sodium potassium etc.
- II.** Polari metric determination of rate constant for hydrolysis/inversion of sugar.
- III.** Polarimetric study of Enzyme kinetics-inversion of sucrose.

BOOKS SUGGESTED - (Paper CODE: B020802P and Paper CODE: B020804P)

1. Inorganic Experiments. J. Derek Woollin VCH
2. Microscale Inorganic Chemistry, Z Szafrsn R.M. Pike, M.M. Singh. Wiley.
3. Practical Inorganic Chemistry, G. Mar and B.W. Bookett. Van Nostrand.
4. The Systematic Identification of Organic Compounds R.L. Shnier and D.Y. Curtn.
5. Semimicro Qualitative Organic Analysis, N.D. Cheronis, J.B. Entnkin and E.M. Hodentt
6. Experimental Organic Chemistry, M.P. Doyte and W.S. Mungall.
7. Small Scall Scale Organic Preparations, P.J. Hili
8. Organometallic Synthesis, J.J. Fisch and R.B. King Academic Press.
9. Experimental Physical Chemistry. D.P. Shoemaker, C.W. Garland and J.W. Niber, McGraw, Hill Interscience.
10. Findlay's Practical Physical Chemistry, revised B.P. Lew Longman.
11. Experiments in Physical Chemistry, J.C. Ghose, Bharat Bhavan.
12. Vogel's Textbook of Quantitative Analysis. Revised, J.Bas set R.C. Denney. G.H. Jeffery and J. Mendham, ELBS.
13. Synthesis and Characterisation of inorganic compounds-W.L. Jolly, Prentice Hall.
14. Experiments and Techniques in Organic Chemistry-D Pasto, C. Johnson and M. Miller-Prentice Hall.
15. Systematic Qualitative Organic Analysis-H Middleton, Edward Arnold.
- 16 Handbook of Organic Analysis-H. Middleton, Edward Arnold.
17. Vogel's Textbook of Practical Organic Chemistry-A.R. Tatchell, John Wiley.
18. Practical Physical Chemistry - A.M. James and F.E. Prichard.
19. Findley's Practical Physical Chemistry-S.P. Levitt, Longman.
20. Experimental Physical Chemistry-R.C. Das and B. Behera, Tata McGraw Hill.

M.Sc. Semester II (Chemistry) Syllabus

(Discipline Centric Elective)

Paper Name: Chemistry of Natural Products

Paper CODE: B020805T

Marks: 100 (ETE 75 & CIE 25)

I. Terpenoids and Carotenoids:

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Stereochemistry and synthesis of the following representative molecules: α -Terpineol, camphor and Farnesol Biogenesis of Terpenoids & alkaloids.

II. Alkaloids:

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation. Classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry & synthesis of the following: Ephedrine, Nicotine and Morphine.

III. Steroids:

Occurrence, isolation and nomenclature. Diel's hydrocarbon. Basic skeleton and biological significance of sterols, bile acids, estrone, progesterone, aldosterone and testosterone. Photoproducts of ergosterol-vitamin D. Structure determination of cholesterol.

IV. Prostaglandins:

Occurrence, nomenclature, classification, and physiological effects. Syntheses of PGE₂ and PGF_{2a}.

V. Anthocyanins:

Methods of isolation, basic structural features of coumarins, flavones, chromones and isoflavones. Structural elucidation of quercetin.

BOOKS SUGGESTED -(Paper CODE: B020805T)

1. Natural Products: Chemistry and Biological Significance, J. Mann R.S. Davidson, J.B. Hobbs, D.V. Banthorpe 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 of Flavonoids, B.A. Bohm, Harwood Academic Publishers.
7. New Trends in Natural Product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.
9. Organic Chemistry, Vol.II, I.L. Finar, Longman.

M.Sc. Semester II (Chemistry) Syllabus

(Discipline Centric Elective)

Paper Name: Techniques of Chemistry-II

Paper CODE: B020806T

Marks: 100 (ETE 75 & CIE 25)

I. Interaction of electromagnetic radiation with matter:

Electromagnetic spectrum, mode of absorption of radiation by matter. Electronic, vibrational & rotational transitions.

II. Absorption Laws:

Grothus-Draperis Law, Einstein's Law of photochemical equivalence, Quantum efficiency, Reasons for low & high quantum yields, photoelectric cell & photosensitization Lambert-Beer's Law.

III. Spectrophotometric instrumentation:

Morochromators, sample cell, detectors types of instruments-single beam and double beam spectrophotometers. Applications of spectrophotometric methods in analysis.

IV. Conductometric methods:

Principle of analysis, measurement of conductance, analytical applications of conductrometry, conductometric titrations.

V. Sensors:

Chemical sensors: classification. sensitivity and limit of detection. Potentiometric sensors, gas sensors, Volta metric sensors.

Biosensors:

The enzyme electrode, biosensor based on ion-selective electrodes. Applications of enzyme electrodes. Biosensors based on plant and animal tissues. Applications of chemical and biosensors in agriculture, medicine and biochemical analyses.

BOOKS SUGGESTED - (Paper CODE: B020806T)

1. Visible And Ultraviolet Spectroscopy, R.C.Denney and R. Sinclair., Wiley, Chichester.
2. Elementary Organic Spectroscopy: Principles & Chemical Application, Y.R. Sharma.,S. Chand, Ram Nagar, New Delhi.
3. Theory and Applications of Ultraviolet Spectroscopy, H.H. Jaffe and M. Archin., Wiley, Newyork,
4. Vogel's Textbook of Quantitative Inorganic Analysis, Eds J. Basset, R.C. Denney, G.H. Jeffrey and J. Mendhem., Longman, London.
5. Chemical Sensors and Biosensors, Rene Lalauze., Wiley. 6. Chemical Sensors and Biosensors, Brian R. Eggins.,Wiley. 7. Biosensors, Rajmohan Joshi., Rediff books.

M.Sc. Semester II (Chemistry) Syllabus

(Discipline Centric Elective)

Paper Name: Supra-molecular Chemistry and Strategy in Chemical Synthesis

Paper CODE: B020807T

Marks: 100 (ETE 75 & CIE 25)

A. Supra molecular Chemistry:

- I. Molecular Recognition: Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of co receptor molecules and multiple recognition.
- II. Supramolecular reactivity and catalysis.
- III. Transport processes and carrier design.
- IV. **Supramolecular devices:** Supramolecular photochemistry, supramolecular electronic, ionic, and switching devices. Some examples of self-assembly in Supramolecular chemistry.

B. Strategies in Syntheses:

- I. **Disconnection Approach:** An introduction to synthons and synthetic equivalents. functional group inter conversions, the importance of the order of events in organic synthesis, chemo selectivity, reversal of polarity (Umpolung reactivity).
- II. One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity. alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.
- III. Three group C-C disconnections: Diels-Alder reaction, 1-3 difunctionalised compounds, a-B-unsaturated carbonyl compounds control in carbonyl condensations, 1-5- difunctionalised compounds.

C. Protecting Groups:

Principle of protection of alcohols and diols as acetals, amine, carbonyl, double bond, triple bond and carboxyl group.

BOOKS SUGGESTED -(Paper CODE: B020807T)

1. Designing organic Synthesis, S. Warren. Wiley.
2. Organic Synthesis-Concept, methods and Starting Materials, J.Fuhrhop and G. Penicillin. Verlage VCH.
3. Some modern methods of organic Synthesis. W. Carruthers Cambridge Univ. Press.
4. Modern Synthetic Reaction, H.O. House W.A. Benjamin.
5. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, J. March. Wiley.
6. Advanced Organic Chemistry Part B. F. A. Carey and R.J. Sundberg. Plenum Press.
7. Physical Organic Chemistry, N.S. Isaacs, ELBS. Longman.
8. Super molecular Chemistry: Concept and perspectives, J.M. Lehn, VCH
9. Bioinorganic, Bioorganic and Supramolecular Chemistry, P.S.Kalsi and J.P. Kalsi., New Age International.

M.Sc. Semester II (Chemistry) Syllabus

(Discipline Centric Elective)

Paper Name: Heterocyclic Chemistry

Paper CODE: B020808T

Marks: 100 (ETE 75 & CIE 25)

I. Nomenclature of Heterocyclic Compounds:

Replacement and systematic nomenclature (Hantzsch MCH-Widman system) for monocyclic, fused and bridged heterocyclic compounds.

Aromatic Heterocycles:

General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in HNMR spectra, empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Reactivity and tautomerism in aromatic heterocycles.

II. Small Ring Heterocycles:

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

IV. Benzo-Fused Five-Membered Heterocycles: Synthesis and reactions including medicinal applications of benzopyrroles, bezofurans and benzothiophenes.

V. Six-Membered Heterocycles with one Heteroatom: Synthesis their role in biological systems and reactions of Pyridium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pheridones. Synthesis and reactions of quinolinium and benzopyrylium salts, coumarins and chromones.

Six Membered Heterocycles with two or more Heteroatoms: Synthesis, their role in biological systems and reactions of diazines, triazines, tetrazines and thiazines.

VI. Seven-and large-membered heterocycles: Synthesis and reactions of azepines, oxepines, thiapines, diazepinesthiazepines, azocines, diazocines, dioxocines and dithiocines.

BOOKS SUGGESTED -(Paper CODE: B020808T)

1. "Heterocyclic Chemistry" Vol, 1-3 R.R. Gupta, M. Kumar and V.Gupta, Springer, Verlag.
2. The Chemistry of Heterocyclic, 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.

M.Sc. Semester II (Chemistry) Syllabus

(Ability Enhancement Course)

Paper Name: Reagents in Organic Synthesis

Paper CODE: B020809T

Marks: 100 (ETE 75 & CIE 25)

- I.** Use of following reagents in organic synthesis and functional group transformation.
- A. Organometallic reagents** –Organolithium reagents, Organomagnesium reagents, Organocopper, Organotitanium reagents, Organozinc, reagents, Organoboron reagents, Organosilicon reagents, Palladium-catalyzed Coupling Reactions: Stille, Suzuki and Sonogashira coupling, Heck reaction and Negishi coupling and their stereochemistry.
 - B.** DEAD, Tabbe's reagent, Hydrazine and phenylhydrazine, DCC, DDQ, Nucleophilic heterocyclic carbenes (NHC), 1,3-Dithiane (Umpolung reactivity), Lithium diisopropyl amide (LDA), Selenium dioxide, SmI_2 .
 - C.** Complex metal hydrides- NaBH_4 , LiAlH_4 and their derivatives, DIBAL, diborane, disoamylborane, tetrakis(hexamethylborane), 9-BBN, and isopinocampheylborane.
- II. Oxidation and Reduction:**
- A.** Oxidation of Aldehydes, ketones and carboxylic acids, amines. Oxidations with rutheniumtetraoxide, iodobenzene diacetate and thallium (III) nitrate.
 - B.** Reduction of Hydrocarbons—alkenes, alkynes and aromatic rings, Carbonyl Compounds: aldehydes, ketones, acids and their derivatives, Epoxides, nitro, nitroso, azo compounds, Hydrogenolysis.
- III. Organic Reagents in Inorganic Chemistry:**
- Chelation, factors determining the stability of chelates (effect of ring size, oxidation state of the metal, coordination number of the metal); Use of the following reagents in analysis:
- (a) Dimethylglyoxime (in analytical chemistry)
 - (b) EDTA (in analytical chemistry and chemotherapy)
 - (c) 8-Hydroxyquinoline (in analytical chemistry and chemotherapy)
 - (d) 1,10-Phenanthroline (in analytical chemistry and chemotherapy)

BOOKS SUGGESTED (Paper CODE: B020809T)

1. Reagents for Organic Chemistry, L.F. Fieser and M. Fieser., Wiley, New York.
2. Organometallic Chemistry, R.C. Mehrotra and A. Singh., Wiley, Eastern.
3. Organic Synthesis, J. Singh and L. D. S. Yadav, Pragati Edition
3. Organotransition Metal Chemistry, S.G. Davies, Pergamon Press, Oxford.
4. Modern Synthetic Reactions, H.O. House, W.A. Benjamin, California.
5. Organic Chemistry, vol. I and II, I.L. Finar, Longman.
6. Comprehensive Organic Chemistry, D. Barton and W.D. Wallis., Pergamon Press, Oxford.
7. Advanced Organic Chemistry-Reaction Mechanism & Structure. Jerry March., John Wiley.
8. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg., Plenum.
9. A Guide book to Mechanism in Organic Chemistry, Peter Sykes., Longman.
10. Structure and Mechanism of Organic Chemistry, C.K. Ingold., Cornell University Press.

M.Sc. Semester II (Chemistry) Syllabus

(Ability Enhancement Course)

Paper Name: Analytical Chemistry

Paper CODE: B020810T

Marks: 100 (ETE 75 & CIE 25)

I. Introduction:

Role of analytical chemistry. Classification of analytical methods-classical and instrumental. Types of instrumental analysis. Neatness and cleanliness. Laboratory operations and practices, analytical balance. Gravimetric techniques. Selecting and handling of reagents. Laboratory notebooks. Safety in the analytical laboratory.

II. Food Analysis:

Analysis of moisture, ash, crude protein, fat, crude fibre. carbohydrates. calcium, potassium, sodium and phosphate in food products. Food adulteration-common adulterants in food, contamination of food stuffs. Microscopic examination of foods for adulterants. Pesticide analysis in food products. Extraction and purification of sample. HPLC, Gas chromatography for organophosphates. Thin-layer chromatography for identification of chlorinated pesticides in food products.

III. Analysis of Water Pollution:

Origin of waste water, types water pollutants and effects. Sources of water pollution - domestic, industrial and agricultural. Soil and radioactive wastes as sources of pollution. Parameters for analysis -colour, turbidity total solids conductivity, hardness, chloride, sulphate. Metal/heavy metal pollution due to cadmium, chromium, copper, lead, zinc, manganese, mercury and arsenic. Measurements of DO, BOD and COD. Pesticides as water pollutants and analysis Water pollution laws and standards.

IV. Analysis of Soil:

Moisture, pH, total nitrogen, phosphorus, silicon, lime, magnesia, manganese, sulphur and alkali salts.

V. Analysis of Drug:

Narcotics and dangerous drugs. Classification of drugs. Screening by gas and thin-layer chromatography and (spectrophotometric) measurements.

BOOKS SUGGESTED - (Paper CODE: B020810T)

1. Analytical Chemistry, G.D. Christian, J.Wiley.
2. Fundamentals of Analytical Chemistry D.A. Skoog D.M. West and F.J. Holler W.B. Saunders.
3. Analytical Chemistry-Principles J.S. Kennedy, W.B. Saunders.
4. Analytical Chemistry-Principles and Techniques. L.G. Hargis Prentice Hall.
5. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary. W.B. Saunders.
6. Principles of Instrumental Analysis. D.A. Skoog. W.B. Saunders.
7. Quantitative Analysis, R.A. Day. Jr. and A.L. Underwood Prentice Hall.
8. Environmental Solution Analysis, S.M. Khopkar. Wiley Eastern.
9. Basic Concepts of Analytical Chemistry. S.M. Khopkar Wiley Eastern.
10. Handbook of Instrumental Techniques for Analytical Chemistry. F.Settle. Prentice Hall.

M.Sc. Chemistry-Semester-III

Paper Name: Organic Spectroscopy

Paper CODE: B020901T

Marks: 100 (ETE 75 & CIE 25)

- I. **Ultraviolet and Visible Spectroscopy:**
Various electronic transitions (185-800 nm). Beer-Lambert Law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fisher-Woodward rules for conjugated dienes and carbonyl compounds. Ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.
- II. **Infrared Spectroscopy:**
Vibrational transitions, modes of vibrations, selection rules. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies. Overtones, combination bands and Fermi resonance. FTIR.
- III. **Proton Magnetic Resonance Spectroscopy (^1H NMR) :**
General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, measurement of chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, spin-spin interaction and *J-J* coupling, dihedral angle, nuclear magnetic double resonance, solvent effects. Fourier transform technique, nuclear Overhauser effect (NOE).
Use of NMR in medical diagnostics.
- IV. **Carbon-13 NMR Spectroscopy:**
General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbon), coupling constants.
An Introduction to Two dimensional NMR spectroscopy - COSY, NOESY and INADEQUATE techniques.
- V. **Mass Spectrometry:**
Introduction, ion production . Factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds. Common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.
- VI. Structural problems based on UV, IR, ^1H NMR, ^{13}C NMR spectroscopy and mass spectrometry.

M.Sc. Chemistry (Practical)-Semester-III

Paper Name: Chemistry Laboratory -V

Paper CODE: B020902P

Marks: 100 (ETE 75 & CIE 25)

1. Ion exchange method of separation :
Separation of Zn^{++} and Mg^{++} on an ion exchanger.
Separation of Co^{++} & Ni^{++} on an ion exchanger.
2. Spectrophotometric determinations:
Iron-phenanthroline complex : Job's Method
Manganese / chromium / vanadium in steel / water sample.
3. Thin layer chromatographic separation of cations like Ni^{++} , Mn^{++} , Co^{++} & Zn^{++} etc. and determination of their R_f values.
4. Paper chromatography : Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography & determination of R_f values.

M.Sc. Chemistry-Semester-III

Paper Name: Organometallic Chemistry

Paper CODE: B020903T

Marks: 100 (ETE 75 & CIE 25)

- I. Organometallic Compounds of transition elements:**
General introduction of ligands, classification and nomenclature. 2-6 electron donor ligands with special reference to π -allyl, cyclopentadienyl and arenes.
- II. Synthesis, structure and bonding aspects of organometallic compounds with:**
(a) σ -bonded alkyl groups as ligands. (β -Hydride elimination, σ -bonded η^1 -aryl ligands)
(b) Olefinic and acetylic groups as ligands.
(c) Cyclic and acyclic polyenyl π -bonded ligands: (π -allyl, butadiene cyclobutadiene, cyclopentadienyl and arenes as ligands)
- III. Reactions in Organometallic Chemistry:**
Oxidative addition, Oxidative coupling, Reductive elimination, Migratory insertion reactions, Coupling reactions (Palladium catalysed C-C and C-N couplings, Stille coupling, Heck coupling, Suzuki-Miyaura coupling, Sonogashira coupling, Negishi coupling, Hiyama coupling)
- IV. Homogeneous and heterogeneous transition metal catalysis:**
General considerations, Reason for selecting transition metals in catalysis (bonding ability, ligand effects, variability of oxidation state and coordination number), Homogeneous hydrogenation of unsaturated compounds (alkenes, alkynes, aldehydes and ketones). Asymmetric hydrogenation. Phase transfer catalysis.
- V. Some important homogeneous and heterogeneous catalytic reactions:**
Ziegler Natta polymerization of ethylene and propylene, oligomerisation of alkenes by aluminium alkyl, Wacker acetaldehyde synthesis, hydroformylation of unsaturated compounds using cobalt and rhodium complexes, Monsanto acetic acid synthesis, carboxylation reactions of alkenes and alkynes using nickel carbonyl and palladium complexes. Carbonylation of alkynes (acetylene) using nickel carbonyls or Palladium complexes.
- VI. Metal-metal bonding in carbonyl and halide clusters:**
Polyhedral model of metal clusters, effect of electronic configuration and coordination number. Structures of metal carbonyl clusters of three atoms $M_3(CO)_4$ ($M = Fe, Ru \& Os$), Four metal atoms (tetrahedra) $[M_4(CO)_6]$ ($M = Co, Rh \& Ir$) and octahedron of type $M_6(CO)_8$ ($M = Co \& Rh$), and halide derivatives of Rhenium (III) triangles, metal carbonyls involving bridged-terminal exchange and scrambling of CO group.
Metal Carbonyls and Nitrosyl: Classification, bonding, factors affecting the magnitude of stretching frequency, Synthesis of metal carbonyls, Fluxionality, properties and reactions.
Fluxional Organometallic Compounds: Fluxionality and dynamic equilibrium in compounds such as η^2 olefine, η^3 -allyl and dienyl complexes.
- V. Transition Metal-Carbon multiple bonded compounds:**
Metal carbenes and carbynes (preparation, reactions, structure and bonding considerations). Biological applications and environmental aspects of organometallic compounds, Organometallic compounds in medicine, agriculture and industry.

M.Sc. Chemistry (Practical)-Semester-III

Paper Name: Chemistry Laboratory -VI

Paper CODE: B020904P

Marks: 100 (ETE 75 & CIE 25)

1. Separation & identification of organic compounds using chemical methods from organic mixtures containing upto three components.
2. Verification of Lambert-Beer's law and to determine concentration of unknown sample.
3. Flame emission photometric determination of ions e.g. sodium potassium etc.
4. Polarimetric determination of rate constant for hydrolysis/inversion of sugar.
5. Polarimetric study of Enzyme kinetics-inversion of sucrose.

M.Sc. Chemistry-Semester-III

Paper Name: Inorganic Spectroscopy

Paper CODE: B020905T

Marks: 100 (ETE 75 & CIE 25)

- I. Electronic Spectroscopy:**
Electronic spectral studies for d^1 - d^9 systems in octahedral, tetrahedral and square planer complexes,
- II. Vibrational Spectroscopy**
Symmetry and shapes of AB_2 , AB_3 , AB_4 , AB_5 and AB_6 . Mode of bonding of ambidentate ligands, nitrosyl, ethylenediamine and diketonato complexes. Application of resonance. Raman spectroscopy and its applications.
- III. Electron Spin Resonance Spectroscopy:**
Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors. Application to transition metal complexes (having one unpaired electron) including biological systems and to inorganic free radicals such as PH_2 , F_2 and $[BH_3]$.
- IV. Nuclear Magnetic Resonance Spectroscopy-I (Paramagnetic Substances in Solution):**
The contact and pseudo contact shift, factors affecting nuclear relaxation, some applications including biochemical systems, an overview of NMR of metal nucleides with emphasis on ^{195}Pt and ^{119}Sn NMR.
- V. Nuclear Magnetic Resonance Spectroscopy - II**
Chemical exchange, effect of deuteration, complex spin - spin interaction between two, three, four and five nuclei (I^{st} order spectra), stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with disordered angle, NMR shift reagents, solvent effects, Nuclear Overhauser effect (NOE).
- VI. Mossbauer Spectroscopy**
Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (2) Sn^{+2} and Sn^{+4} compounds: nature of M-L bond, coordination number, structure and (3) detection of oxidation state and in equivalent MB atoms.

M.Sc. Chemistry-Semester-III

Paper Name: Nano Materials & Solid State Chemistry

Paper CODE: B020906T

Marks: 100 (ETE 75 & CIE 25)

1. **Nano-materials:** Introduction and classification, Preparation and characterization of different types of nano structures-nanoparticles, nano clusters, nanowires, nanorods, nanofilms, nanotubes.
2. **Nano-catalysts:** Mode of action of catalysts, classification and comparison of nano-catalysis with homogeneous and heterogeneous catalysts. Specificity, shapes, surface area of nano-catalysts. Role of size, shape and surface area of nanoparticles in catalysts. Langmuir Hinshelwood mechanism on nano-catalysts.
3. **Liquid crystals:** Types of liquid crystals, Nematic, Smectic, ferroelectric and antiferro electric liquid crystals. Theories of LCs, liquid crystal display. New materials as liquid crystals.
4. **Solid State Reactions:** General principle, experimental procedure. Co-precipitation as a precursor to solid state reactions. Kinetics of solid state reactions.
5. **Organic Solids:** Electrically conducting solids, organic charge transfer complexes, organic metals, new superconductors.
6. **Crystal Defects and Non-Stoichiometry :** Perfect and imperfect crystals, intrinsic & extrinsic defects - point defects, line and plane defects, vacancies - Schottky defects & Frenkel defects.

M.Sc. Chemistry-Semester-III

Paper Name: Photochemistry

Paper CODE: B020907T

Marks: 100 (ETE 75 & CIE 25)

1. Introduction and Basic Principles of

Energy of a Molecule, Photochemical Energy, Photochemical Excitation of the Molecule, Electronic Transitions, Types of Electronic Excitation and Molecular Orbital View of Excitation, Spin Multiplicity, Nomenclature of Excited States, The Fate of the Excited Molecule—Physical Processes: Jablonski Diagram, Photolytic Cleavage, Laws of Photochemistry, Grotthurs-Draper Law, Einstein's Law of Photochemical Equivalence, Quantum Yield or Quantum Efficiency, The Reasons for High Quantum Yield

2. Photochemistry of Carbonyl Compounds

α -Cleavage or Norrish Type I Process, Norrish Type I Process given by Acyclic Saturated Ketones Norrish Type I Reaction of Saturated Cyclic Ketones, Norrish Type I Process given by Cyclopentanones, α -Cleavage given by Cyclobutanones, β -Cleavage Reaction, Intramolecular Hydrogen Abstraction (γ -Hydrogen Abstraction), Hydrogen Abstraction from Other Sites, β -Hydrogen Abstraction, δ - and ϵ -Hydrogen Abstraction, Hydrogen Abstraction from Distant Sites, Formation of Photoenols or Photoenolisation, Intermolecular Hydrogen Transfer: Intermolecular Photo Reduction, Photocycloaddition Reaction (Paterno-Büchi Reaction), Addition to Electron-Rich Alkenes, Addition to Electron Deficient Alkenes, Oxirane Formation with Dienes and Alkynes, Intramolecular Paterno-Büchi Reaction, $[2 + 2]$ Cycloaddition Reaction of Enones with Alkenes.

3. Photo Rearrangements

Photo Rearrangement of Cyclopentenone, Cyclohexanone Rearrangements, Lumiketone Rearrangement, Di- π -Methane Type Rearrangement, Rearrangement of Dienones, Photo Rearrangements of β , γ -Unsaturated Ketones, Mechanism of 1, 2-Acyl Shift, Mechanism of 1, 3-Acyl Shift, Aza-Di- π -Methane Rearrangement, Di- π -Methane (DPM) Rearrangement, Rearrangements in Aromatic Compounds

4. Photo Reduction and Photo Oxidation

Photo Reduction of Carbonyl Compounds, Photo Reduction of Aromatic Hydrocarbons, Photochemical Oxidations, Photo Oxidation of Alkenes and Polyenes

5. Photochemistry of Alkenes, Dienes and Aromatic Compounds

Photochemistry of Alkenes, *Cis-Trans* Isomerisation of Alkenes, *Cis-Trans* Isomerisation of Alkenes by Direct Irradiation, Sensitised *Cis-Trans* Isomerisation, Dimerisation of Alkenes, Intramolecular Dimerisation, Photochemistry of Conjugated Dienes, Photochemistry of Conjugated Dienes in Solution, Photoisomerisation of Benzene and Substituted Benzene, 1, 2-Alkyl Shift, Mechanism of 1, 3-Alkyl Group Shift.

6. Photo Substitution Reactions at sp^3 Hybrid Carbon Having At least One Hydrogen

Introduction, Barton Reaction, The Hoffmann-Loeffler-Freytag Reaction, Photolysis of Hypohalites.

M.Sc. Chemistry-Semester-III

Paper Name: Quantum Chemistry

Paper CODE: B020908T

Marks: 100 (ETE 75 & CIE 25)

- I. Time - independent perturbation theory for non - degenerate states (first order correction to energy and wave function), and its application to particle in a one - dimensional box, ground state helium atom (without spin consideration) and perturbed harmonic – oscillator. Vibrational method: theory and application to ground state hydrogen and helium atoms and one - dimensional oscillator.
- II. **Theory of time - dependent quantum approximation technique.** Fermi Golden Rule. Radiation - Matter interaction (induced emission and absorption of radiation). Einstein's transition probabilities. Determination of selection rules in respect of rigid rotation and harmonic - oscillator approximation.
- III. **Quantum - mechanics of multielectron atoms:** Hartree self - Consistent method. Hartree - Fock self - Consistent (HFSCF) method. Rootham's method. Correlation energy (CE) and configuration interaction (CI), Koopmann's theorem. Basic idea of Density Functional Theory (DFT): Kohn - Sham equation.
- II. **Quantum - mechanical treatment of diatomic molecules:** The Born Oppenheimer approximation and its formulation. The valence - bond treatment of hydrogen molecule. Heitler - London treatment and ionic contribution. Molecular Orbital Theory (MOT) of H_2^+ . MOT with configuration interaction (CI). Hybridization (sp , sp^2 & sp^3) from a quantum - mechanical view - point.
- V. **Quantum - mechanical treatment of π - electron systems.** The π - electron approximation . Free electron molecular orbital (FEMO) method and its application to polyenes. The Huckel - Molecular Orbital Theory (HMOT) for conjugated hydrocarbons and cyclic conjugated systems. Huckel calculations for ethylene, allyl systems, cyclobutadiene and benzene. Calculation of electron density, charge distribution and bond orders.

M.Sc. Chemistry-Semester-III

Paper Name: Name reactions & Rearrangements in Organic Synthesis

Paper CODE: B020909T

Marks: 100 (ETE 75 & CIE 25)

1. Some Specific Name Reactions:

Discuss following reactions in detail with appropriate stereochemistry (if possible).

Bamford–Stevens Reaction, Shapiro reaction, Chichibabin reaction, Dakin reaction, Stetter reaction, Favorskii reaction, Alkene Metathesis, Baylis–Hillman Reaction, Benzoin Condensation, Birch Reduction, Haloform Reaction, Knoevenagel Reaction, Mannich Reaction, McMurry coupling, Meerwein–Ponndorf–Verley Reduction, Michael Addition, Robinson Annulation, Mitsunobu Reaction, Nef Reaction, Perkin Reaction, Peterson Olefination, Stork Enamine Reaction, Wittig Reaction, Corey–Fuchs reaction, Eschenmoser–Tanabe fragmentation, Ramberg–Bäcklund reaction, Tebbe olefination.

2. Molecular Rearrangements

Introduction, heterolytic rearrangements homolytic rearrangements, migrating aptitude migratory effect.

A. Rearrangement to electron-deficient carbon atom:

Pinacol- Pinacolone rearrangement, Wagner- Meerwein rearrangement, Wolff rearrangement, Dienone-Phenol rearrangement.

B. Rearrangement to electron-deficient Nitrogen atom: Beckmann rearrangement, Hofmann rearrangement, Curtius rearrangement, Lossen rearrangement, Schmidt rearrangement.

C. Rearrangement to electron-deficient Oxygen atom: Baeyer-Villiger rearrangement, Benzil acid rearrangement, Favorskii rearrangement, Hydroperoxide rearrangement.

D. Aromatic rearrangements: Fries rearrangement, Claisen rearrangement, Benzidine rearrangement.

E. Electrophilic rearrangements: Stevens rearrangements, Wittig rearrangement, Sommelet- Hauser rearrangement, Smiles rearrangement.

M.Sc. Chemistry-Semester-III

Paper Name: Molecular Spectroscopy

Paper CODE: B020910T

Marks: 100 (ETE 75 & CIE 25)

1. Radiation and matter

Introduction, The basic spectroscopic experiment, Electromagnetic radiation, The interaction between radiation and matter, Relative energy units in spectroscopy.

2. Quantization and molecular energy levels

Introduction, The Schrodinger equation, Molecular wavefunctions: Born-Oppenheimer

Separation, Pauli exclusion principle: nuclear statistical weights

3. Transition probabilities and selection rules

Spectroscopic transitions, Radiative relaxation; Einstein A and B coefficients, Absorption coefficients, Spectroscopic selection rules and intensities.

4. Rotational spectroscopy

Introduction, The rotational Hamiltonian: eigenvalues and Eigenvectors, Rotational wavefunctions, form and symmetry, Selection rules and the rotational spectrum, Centrifugal distortion, determination of bond lengths; vibrational averaging, The Stark effect: molecules in electric fields.

5. Vibrational spectroscopy

Introduction, The simple harmonic oscillator: reduction to one-body form, Eigenvalues and eigenfunctions of the simple harmonic oscillator, The quantum harmonic oscillator: non-classical behaviour, Vibrational selection rules and spectrum of the simple harmonic oscillator, The anharmonic oscillator, Energy levels of the vibrating rotator, The vibration-rotation spectrum

6. Raman spectroscopy

Introduction, The nature of the interaction in Raman scattering: selection rules, Rotational Raman spectroscopy, Vibrational Raman spectrum.

7. Electronic spectroscopy

Introduction, Description of electronic states, The vibrational and rotational structure of electronic states, Transitions in electronic spectroscopy: selection rules, The vibrational (band) structure of, an electronic spectrum, Dissociation and predissociation

8. Photoelectron spectroscopy

Introduction, Principles of photoelectron spectroscopy, Examples of a photoelectron spectrum: molecular nitrogen, Autoionization, Zero kinetic energy (ZEKE) spectroscopy