# 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), dπ-pπ 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, $\pi$-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 pf bonding in organic molecules:**

Delocalised chemical bonding-conjugation, crossonjugation, resonance, hyper-conjugation, 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 cycloakanes-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 stereoslective 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 $S_N1$,$S_N2$,mixed $S_N1'$, $S_N2'$,$S_Ni$ 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 $S_N1$ and $S_N2$ 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 $ArSN^1$, $ArSN^2$& $ArSN^i$ 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, Chemsketch, 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 treatmentof 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 methyldopa and diazoxide propanol.

IV. **Local Anti-infective Drugs**

Anti-tubercular drugs and Anti-malerial drugs: Introduction and general mode of action. Synthesis of sulphonamides, norfloxacin, dapsone, 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 ß 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 Mareus-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. Earnshow, Pergamon.

4. Inorganic Electonic Spectroscopy, A.B.P. Lever, Elsevier.

5. Megnetochemistry, R.L. Carlin, Springer Verlag.

6. Comprehensive Coordination Chemistry edt., G. Wilkinson, R.D. Gillars and J.A. Mc Cleverty. 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 Rf 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 Witting reaction, Aldol condensation, Perkin reaction, Mannich reaction, Benzoin condensation, Robinson Annelation reaction and Stobbe condensation. Reaction mechanism of Hydrolysis of esters.

**III. Elimination Reactions:**

The E1, E2 and ElcB 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 Rf 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 Wooline 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 Interscinece.
10. Findlay's Practical Physical Chemistry, revised B.P. Lew Longman.
11. Experiments in Physical Chemistry, J.C. Ghose, Bharat Bhavan.
12. Vogel's Taxtbook of Quantitative Analysis. Revised, J.Bas set R.C. Denney. G.H. Jeffery and J. Mendham, ELBS.
13. Synthesis and Charaterisation of inorganic compunds-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. Vogels Texbook 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 Caroteroids:**.

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Stereochemistry and synthesis of the following representative molecules: a-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 signjficance 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 PGF2a.

**V. Anthocyanins:**

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

**BOOKS SUGGESTED -( Paper CODE: B020805T)**


1. Natural Products: Chemistry and Biological Significatnce, J.Mannm 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 of Flavonoids, B.A. Bohm, Harwood Academic Publishers.
7. New Trends in Natural Product Chemistry, Atta-ur-Rahaman and M.I. Choudhary, Harwood Academic Publichers.
8. Insectcides 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 condutrometry, conductometic 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 Ultrviolet 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 difunetionalised 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. Sundherg. 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 (Hantzs 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 ineluding 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. Hauptamann, Thieme.

3. Heterocyclic Chemistry, J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.

4. Heterocyclic Chemistry, T.L. Gilchrist, Longmane Schientific Technical.

5. Contermporary Heterocyclic Chemistry. G.R. Newkome and W.W. Paudler, Wiley-Inter Science.

6. An Introduction to teh 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. Organomettalic 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. thexylborane, 9-BBN, and isopinocampherylborane.

**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,Newyork.

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, Oxfrod.

4. Modern Synrhetic 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 WD 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., Carnell 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. Gravimetrie 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 foop 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, silican, 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 Eastem.

10. Handbook of Instrumental Techniques for Analytical Chemistry. F.Settle. Prentice Hall.