SYLLABUS

M.Sc. CHEMISTRY

SEMESTER – I to IV

(CBCS)

Department of Chemistry

Krantiguru Shyamji Krishna Verma

Kachchh University

Mundra Road, Bhuj-Kachchh

DEGREE OF MASTER OF SCIENCE

(CHEMISTRY)

DEPARTMENT OF CHEMISTRY

SKELETON OF NEW SYLLABUS OF M Sc CHEMISTRY, ACCORDING TO CHOICE BASED CREDIT SYSTEM (CBCS)

Semester 1:

Type of Course	Name of the course	Hours per week	credits
Core – 1(C101)	Inorganic Chemistry	04	04
Core – 2(C102)	Organic Chemistry	04	04
Core – 3(C103)	Physical Chemistry	04	04
Core – 4(C104)	Spectroscopy and Separation Techniques	04	04
Practical(Pra106)	Combined	12	06
Interdisciplinary (C105)	Environmental Science / Education	04	04
Foundation course/Self study		15	04
		Total	**30**

Semester 2:

Type of Course	Name of the course	Hours per week	credits
Core – 1(C201)	Inorganic Chemistry	04	04
Core – 2(C202)	Organic Chemistry	04	04
Core – 3(C203)	Physical Chemistry	04	04
Elective 1(C204)	Analytical Chemistry or Polymer Science	04	04
Practical(pra206)	Combined	12	06
Interdisciplinary (C205)	Research Methodology/ Education	04	04
Foundation course/Self study		15	04
		Total	**30**

Semester 3:

Type of Course	Name of the course	Hours per week	credits
Core – 1(C301)	Industrial Chemistry	04	04
Core – 2(C302)	Medicinal Chemistry	04	04
Elective 3*(C303A)	A Selective Approach in Organic Chemistry	04	04
Elective 4* (C303B)	Heterocyclic Chemistry	04	04
Elective 5*(C303C)	Bio Organic Chemistry	04	04
Practical (Pra304)	Combined	12	06
		Total	**26**

* ***Electives*** for Semester 3:

Advanced Organic Chemistry, Heterocyclic Chemistry, Bio Organic Chemistry, Selected Methods in Analytical Chemistry, Advanced Nanotechnology, Computational Chemistry, Instrumentation-A developing Approach in Analytical Chemistry, Synthetic Dye Chemistry,

Semester 4:

Type of Course	**Name of the course**	**Hours per week**	**credits**
Dissertation / Industrial training (C401)	Report	36	18
Seminar(C402)	Report	12	06
		Total	**24**

Total credits: 110

M Sc Semester – I
C-101: INORGANIC CHEMSITRY
EACH UNIT IS OF 14 MARKS

Unit – 1: Quantum Mechanics and its applications : 14 hours

Basic vector algebra, matrix, determinant, eigen value equations, quantum mechanical operators, orthogonal functions, Schmidt's orthogonalization technique. Planck's quantum theory, wave-particle duality, uncertainty principle, postulates of quantum mechanics, Schrodinger equation, free particle, particle in a box, degeneracy, harmonic oscillator, rigid rotator, the hydrogen atom, angular momentum, electron spin, spin-orbit coupling. Born-Oppenheimer approximation, Hartree-Fock method, Brillouin theorem, Koopman's theorem, Roothan's equations, models of chemical bonding-Molecular orbital (MO) and Valence bond (VB) theories, application to diatomic molecules such as, H_2, H_2^+ etc. Quantitative MO theory-Huckel -electron theory and its application to ethylene, butadiene and benzene, energy levels of di- and tri- atomic molecules. Walsh diagrams and molecular geometry.

Unit – 2: Inorganic Reaction Mechanisms 14 hours

Mechanisms of substitution reactions of tetrahedral, square planar, trigonal bipyramidal, square pyramidal and octahedral complexes. Potential energy diagrams, transition states and intermediates, isotope effects, Berry's pseudo rotation mechanism, factors affecting the reactivity of square planar complexes, Swain-Scott equation, Trans effect and its application to synthesis of complexes.

Unit – 3: Moss Bauer Spectroscopy: 08 hours

Introduction of Moss Bauer effect, Isomer shift, Magnetic hyperfine interactions, Applications of the technique to the studies of (i) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (ii) Sn^{+2} and Sn^{+4} compounds – nature of M-L bond, co-ordination number, structure and (iii) detection of oxidation state and inequivalent MB atoms.

Unit – 4: Electron Spin Resonance Spectroscopy: 12 hours

Introduction to ESR, technique of ESR, interaction between nuclear spin and electron spin : hyperfine splitting, calculation and energies of Zeeman levels, ESR spectrum when one electron is influenced by a single proton and one electron delocalized over two equivalent protons, difference between ESR and NMR, EPR spectroscopy- origin of g-shifts and hyperfine coupling, line shape.

Unit – 5: Chemical Bonding : 12 hours

LCAO-MO theory, Metallic bonding, band theory, hydrogen bonding, VSEPR model. Bonding in alloys, intermetallic compounds. Bonding in non-transition element compounds.

Rerference Books:

1. Cotton F A and Wilkinson G : Advanced inorganic chemistry, 5th Ed, J. Wiley & sons, New York (1988).
2. Concept and Models of Inorganic Chemistry, Bodie Douglas, Darl McDaniel, John Alexander
3. Chandra A K : Introductory Quantum Chemistry, 3rd Ed Tata Magrow Hill, New Delhi (1988).
4. Basolo F and Pearson R G : Mechanism of Inorganic Reactions, 2nd Ed, J. Wiley & Sons, New York (1988).
5. Chandra M : Atomic structure and Chemical Bonding (including molecular spectroscopy), 3rd Ed, Tata Magrow Hill, New Delhi (1991).
6. Chatwal & Anand : Quantum Mechanics, Himalaya Publishing House.Katakis, D. & Gordon, G. *Mechanism of Inorganic Reactions* John Wiley & Sons: N. Y (1987).
7. Tobe, M. in *Inorganic Reaction Mechanisms* F. C. Wadington, Ed., Thomas Nelson: London (1973).
8. Inorganic Chemistry, J.E. Huhey, Harpes & Row.

M.Sc. Semester – I
C-102: ORGANIC CHEMSITRY
EACH UNIT IS OF 14 MARKS

Unit – 1: Reactive Intermediates: 14 hours

Carbocations: Classical and non-classical, neighboring group participation, ion-pairs, molecular rearrangements in acyclic, monocyclic and bicyclic systems, stability and reactivity of bridge-head carbocations.

Carbanions: Generation, structure and stability, ambient ions and their general reactions; HSAB principle and its applications.

Radicals: Generation, structure, stability and reactions, cage effects; radical-cations & radical-anions.

Carbenes: Formation and structure, reactions involving carbenes and carbenoids.

Nitrenes: Generation, structure and reactions of nitrenes.

Unit – 2: Selected organic reactions and reagents: 10 hours

Favorski, Stork-enamine, Michael addition, Mannich, ene, Hofmann-Loffler-Freytag, Shapiro, Chichibabin and Wittig reaction, Robinson annulation, Gilman's reagent,
Lithium dimethyl cuprate, Dicyclohexyl carbodimide, Lithium diisopropylamine, 1,3–dithiane (reactivity umpolung), Trimethyl silyl iodide, Baker Yeast, Phase-transfer catalysts.

Unit – 3: Aromaticity: 12 hours

Concept of Aromaticity, non-aromaticity and antiaromaticity, NMR in aromatic character, Huckel's rule and its limitations, non-benzonoid compounds (aromaticity), annulenes, fulvenes, fulvalenes, azulenes.

Unit – 4: Free Radical Reactions 14 hours

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, reactivity in the attacking radicals, the effect of solvents on reactivity, allylic halogenations (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation.

Unit 5: Elimination Reactions: 10 hours

Mechanism and orientation, reactivity, mechanism and orientation in pyrolytic elimination, Reactions–dehydration of alcohols, Shapiro reaction, conversion of epoxide to olefines, dehalogenation of vicinal halide.

Reference Books:

1. Finar I L : Organic Chemistry, Vol 1 (The Fundamental Pinciples) 6th Ed Longman (1973).
2. Finar I L : Organic Chemistry, Vol 2 (Stereochemistry and chemistry of Natural Products) 6th Ed Longman (1973).
3. March Jerry : Advanced Organic Chemistry, 4th Ed, Wiley Eastern Ltd., New Delhi (1985).
4. V K Ahluwalia, R K Parasar : Organic Reaction Mechanism, 2nd Ed.
5. G R Chatwal : Reaction Mechanism and Reagents in Organic Chemistry.
6. Morrision R T and Boyd R N : Organic Chemistry, Prentice Hall of India Pvt Ltd., 6th Ed (2003).
7. J P Trivedi : Reaction Intermediates in Organic chemistry, University Granth Nirman Board, Ahmedabad.
8. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
9. Principles in Organic Synthesis, R.O.C. Norman and J.M. Coxon.

M.Sc. Semester – I
C-103: PHYSICAL CHEMSITRY
EACH UNIT IS OF 14 MARKS

Unit - 1: Thermodynamics **12 hours**
Brief review of laws of thermodynamic and thermodynamics functions, relation between Cp and Cv, enthalpies of physical and chemical changes, temperature dependence of enthalpies, entropy, Gibbs-Helmholtz equation and calculation of entropy.

Unit - 2: Chemical equilibrium: **14 hours**
Free energy and entropy of mixing, partial molar properties, chemical potential, Gibbs-Duhem equation, chemical equilibrium, temperature dependence of equilibrium constant, phase diagram of one and two component systems, phase rule, thermodynamic description of phase transitions, Clapeyron-Claussius equation.

Unit - 3: Ideal and non-ideal solutions: **12 hours**
Excess properties, activities, concepts of hydration number, activities in electrolytic solutions, mean ionic activity coefficient, Debye- Hückel treatment of dilute electrolyte solutions.

Unit - 4: Non-equilibrium thermodynamics: **08 hours**
Postulates and methodologies, linear laws, Gibb's equation, Onsager's theory.

Unit - 5: Statistical thermodynamics: **14 hours**
Thermodynamics probability and entropy, ensembles, distribution laws of MB,FD and BE, partition functions, rotational, translational, vibrational and electronic partition functions for diatomic molecules, calculation of thermodynamic functions and equilibrium constants, theories of specific heats of solids.

Reference Books:
1. Physical Chemistry, P.W. Atkins, ELBS.
2. Encyclopedia of Physical Chemistry, Vol I – IV, J.C. Moore.
3. Physical chemistry, I.N. Levine, McGraw Hill.
4. Physical chemistry, G.W. Castellan, Narosa.

M Sc Semester – I

C-104: SPECTROSCOPY AND SEPARATION TECHNIQUES

EACH UNIT IS OF 14 MARKS

Unit – 1: Carbon-13 NMR Spectroscopy: **12 hours**

General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbon), coupling constants. Two dimension NMR spectroscopy – COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques.

Unit - 2: Infra Red Spectroscopy : 10 hours

Introduction, basic theory, instrumentation, sample handling. 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, FT IR.

Unit - 3: Mass Spectrometry: 10 hours

Theory, instrumentation and modifications; Unit mass and molecular ions; Important terms- singly and doubly charged ions, metastable peak, base peak, isotropic mass peaks, relative intensity, FTMS, etc.; Recognition of M^+ ion peak; General fragmentation rules: Fragmentation of various classes of organic molecules, including compounds containing oxygen, sulphur, nitrogen and halogens; α-, β-, allylic and benzylic cleavage; McLafferty rearrangement.

Unit - 4: 14hours

(a) High Performance Liquid Chromatography

Instrumentation, Working and Applications

(b) Gas Liquid Chromatography

Principle, Instrumentation, Working, Stationary phases, Applications.

Unit – 5: 12 hours

(a) Hyphenated Techniques

GC-MS, HP-TLC, LC-MS etc., Principle and Applications.

(b) Ion Exchange and Affinity Chromatography

Principle and Applications.

Reference Books:

(1) Bartt L et al : Vogel's Textbook of Quantitative Inorganic Analysis, ELBS 6th Ed.
(2) Sharma B K : Instrumental methods of Chemical Analysis, Goel Publishing House.
(3) Silverstein R M, Bassler G C : Spectrometric Identification of Organic Compounds, John Wiley.
(4) Sharma Y R : Elementary Organic Spectroscopy, Jallandhar.
(5) Kalsi P S : Spectroscopy of Organic Compounds, New Age International Ltd.
(6) Sethi P D, High Performance Liquid Chromatography.
(7) Skoog D A., Loary J I and Saunder W B, Principles of Instrumental Analysis.
(8) Skoog D A, West D M, Holler F J and Saunder W B, Fundamentals of Analytical Chemistry.
(9) Sethi P D, HPTLC.

M Sc Semester – I
Interdisciplinary
C-105: Environmental Science / Education

Unit – I: Atmospheric Chemistry **20 hours**

Composition, structure and functions of atmosphere, atmospheric chemistry, classification of elements, earth's energy budget, reactions in the lower and upper atmosphere, radioactivity in the atmosphere, atmospheric stability, inversions and mixing heights, wind roses

Unit – II: Hydrosphere Chemistry **20 hours**

Hydrosphere: Structure and properties of water and their environmental significance, distribution of water in earth, fresh water and its chemistry, solubility of gases in water, role of water in environment

Marine chemistry: seawater properties and its constituents, nutrients and salts, Metallic and non-metallic mineral resources like manganese nodules etc.

Unit – III: Lithosphere and Analytical Tools **20 hours**

Lithosphere: Factors and processes of soil development, soil types and their formation, soil profiles, physical and chemical properties

Principles of analytical methods: Titrimetry, gravimetry, centrifugation, colourimetry, flame photometry, spectrophotometry, chromatography, electrophoresis, atomic absorption spectrometry

References:

1. K. S. Valdiya, Environmental Geology: Indian Context
2. Hanley, Nick, Jason F. Shrogen & Ben White: Environmental Economics in Theory and Practice,New Delhi: Macmillan – India, 1997
3. A Taxt book of environmental - C.S. Rao, wiley eastern limited, 1993 pollution and control
4. Environmental chemistry – by B.K.sharma S.H.kaur , goel publishing house meerut,1992
5. Environmental chemistry – moor, W.A. and moore E.A
6. Chemistry and the Environmental – Johnson , D.O.netterville, J.T. wood, J.C. and james, M., 1973 W.B. saunders company, Philadelphia.

M Sc Semester – I
PRA-106: Practical

Inorganic Chemistry: [40+40 marks]

1. Preparation of Metal Complexes.
2. Qualitative Analysis: Six radicals separation with one less common ion.

Physical Chemistry: (any two) 80 marks

1. Conductometry: Mono and biprotic acids, mixtures of acids against strong / weak bases, argentometric, complexometric, replacement titrations, verification of Onsagar's equation, dissociation of weak acids.
2. Ultrasonics: Acoustical parameters of liquids.
3. Refractometry: Binary mixtures and solids.
4. Polarimetry: Optically active compounds.
5. Partition coefficient: Dimerization of acids, $I\text{-}I_2$ system, $Cu_2\text{-}NH_3$ complexes.
6. Potentiometry: Acid-base, redox and argentometric titrations.
7. PHmetry: Acid-base titration, pKa of acids.
8. Spectrophotometry: Lambert-Beer's law, binary mixture, kinetics of iodination etc.
9. Chemical Kinetics: Energy coefficient of IInd order reactions.

Viva Voce Examination: 40 marks

EXAM PATTERN

Day 1: Inorganic Chemistry 80 marks
Day 2: Physical Chemistry and Viva 120 marks
Time: 7 hours on each day.

STYLE OF QUESTION PAPER

Q.1 TO Q.5
Each question from one unit of the syllabus. Each question carries **14 marks.** Sub question (a) answer any two out of 3 or 4, 5 marks each, 10 marks of sub question (a). sub question (b) 4 marks.
Hence Q.1 to Q.5 will be of 70 marks.

Total 70 marks + 30 marks internal.

FORMAT OF INTERNAL ASSESSMENT (TOTAL MARKS 30.)
Written test of 20 marks for each paper.
Attendance 05 marks.
Behavior 05 marks

M Sc Semester – II
C-201: INORGANIC CHEMSITRY
EACH UNIT IS OF 14 MARKS

Unit – 1 Magnetic Properties & Electronic Structure of Transition Metal Complexes
14 hours

Brief review of different types of magnetic behaviour, spin-orbit coupling, quenching of orbital angular momenta, temperature-independent paramagnetism, measurement of magnetic susceptibility using Gouy and Faraday methods, Term symbols for metal ions; Crystal field theory and its application to explain magnetic properties of coordination compounds, spin crossover; Structural effects: ionic radii and Jahn-Teller effect; octahedral vs. tetrahedral coordination, magnetic properties of Lanthanides and Actinides and splitting of f-orbitals in octahedral field.

Unit - 2: Organometallic Compounds. **10 hours**

Introduction and nature of bonding in organometallic compounds of transition metals; σ-bonded organo transition metal compounds, general characteristics, chemical reactions, bonding and structure; π-bonded organometallic compounds: (a) η^2-alkene complexes; preparative methods, physical and chemical properties, bonding and structure; (b) η^3-allyl (or enoyl) complexes preparation, physical and chemical properties.

Unit - 3: Bio Inorganic Chemistry **10 hours**

Introduction to Bio Inorganic chemistry, classification and role of metal ions according their action in biological system, essential trace elements and chemical toxicology, introduction of trace elements, the essential ultra trace metals and non metals, iodine and thyroid hormones, toxic elements, toxicity and deficiency, transport and storage of proteins, metalloporphyrins, oxygen carriers – hemoglobin and myoglobin, physiology of blood.

Unit - 4: Symmetry and Group Theory in Chemistry **14 hours**

Representation of groups – some properties of matrices and vectors, the great Orthogonality theory and its consequences, character tables, Wave functions as the basis for irreducible representations, direct product, identifying non-zero matrix elements, application of symmetry to molecular orbitals, hybrid orbitals, and molecular vibrations.

Unit – 5: Chemistry of d-and f-block elements: **12 hours**

Term-symbols, Russel-Saunders states, Crystal field theory and splitting in O*h*, T*d*, D*4h* and C*4v* systems, Orgel and Tanabe-Sugano diagrams, determination of *Dq* and Racah parameters, oxidation states and electronic absorption spectra of complex ions. Spectrochemical series and effects of covalency. nephelauxetic series, magnetic properties of transition metal complexes and lanthanides, metal-metal bonds, cluster compounds of *d*-block elements, poly-oxo metallates of Ru, Os, Mo. Structure and bonding in complexes containing π-acceptor ligands. Relativistic effects affecting the properties of heavier transition elements.

Reference Books:

1. Chandra A K : Introductory Quantum Chemistry, 3rd Ed Tata Magrow Hill, New Delhi (1988).
2. Mehrotra R C and Singh A : Organo Metallic Chemistry, Willey Eastern Pvt. Ltd, New Delhi (1991).
3. K. Hussain Reddy : Bioinorganic Chemistry, New Age International Publishers, New Delhi (2007).
4. Cotton F A : Chemical Applications of group theory, Wiley Estern Pvt. Ltd, New Delhi (1978).
5. Jaffe H H and Orchin M : Symmetry orbitals and spectra, Wiley Interscience (1971).
6. Jaffe H H and Orchin M : Symmetry in Chemistry, Willey Eastern Pvt. Ltd, New Delhi (1991).
7. Concept and Models of Inorganic Chemistry, Bodie Douglas, Darl McDaniel, John Alexander, J Wiley.
8. Dutta & Shyamal : S. Chand & Co.
9. P. Atkins, T. Overton, J. Rourke, M. Weller & F. Armstrong, *Shriver and Atkins Inorganic Chemistry*, Oxford University Press (2006).
10. Sutton, D. *Electronic Spectra of Transition Metal Complexes* McGraw-Hill: New York (1968).
11. Mabbs, F. E. & Machin, D. J. *Magnetism and Transition Metal Complexes* Chapman and Hall: U.K. (1973).

M.Sc. Semester – II
C-202: ORGANIC CHEMSITRY
EACH UNIT IS OF 14 MARKS

Unit – 1: Rearrangement Reactions: 14 hours

Formation and stability of carbonium ions, carbanion, carbenes, nitrenes, radicals and arynes. Rearrangement involving carbonation (Wagner-Meerwein, Pinacol-Pinacolone rearrangement), reaction involving acyl cation, PPA cyclization and Fries rearrangement, rearrangement of carbenes (Wolff & Arndst-Eistert synthesis), rearrangement of nitrenes (Hoffman, Curtius, Schmidt, Lossen, Beckman rearrangement).

Unit - 2: Methods in Organic Synthesis 12 hours

Organosilicon Compounds*:* Preparation and applications in organic synthesis; Applications of Pd(0) and Pd(II) complexes in organic synthesis- Stille, Suzuki and Sonogashira coupling, Heck reaction and Negishi Coupling,Preparation and applications of lithium organocuparates.

Unit – 3: Pericyclic Reactions: 14 hours

Main features of pericyclic reactions; Woodward-Hoffman rules, correlation diagram and FMO approaches; Electrocyclic reactions – conrotatory and disrotatory motions for *4n* and *4n+2* systems;. Cycloadditions – antarafacial and suprafacial additions, [2+2] and [4+2] reactions (*hv* and _), 1,3-dipolar cycloadditions and chelotropic reactions; Sigmatropic *[i,j]* shifts of C-H and C-C bonds; Sommelet-Hauser, Claisen, thio-Claisen, Cope and aza-Cope rearrangements.

Unit-4: Organic Photochemistry: 12 hours

Introduction to photochemical reactions, *cis-trans* isomerisation, Paterno-Buchi reaction, Norrish type I & II reaction, photoreduction of Ketones, dipimethane rearrangement, photochemistry of arenes, Barton reaction.

Unit -5: Principles of Green Chemistry and its applications: **08 hours**

Biotransformations: Classification of enzymes, advantages and disadvantages, applications in organic synthesis; Principles of ultrasound and microwave assisted organic synthesis, Reactions in ionic liquids.

Reference Books:

1. Finar I L : Organic Chemistry, Vol 1 (The Fundamental Pinciples) 6th Ed Longman (1973).
2. Finar I L : Organic Chemistry, Vol 2 (Stereochemistry and chemistry of Natural Products) 6th Ed Longman (1973).
3. March Jerry : Advanced Organic Chemistry, 4th Ed, Wiley Eastern Ltd., New Delhi (1985).
4. V K Ahluwalia, R K Parasar : Organic Reaction Mechanism, 2nd Ed.
5. P S Kalsi : Stereochemistry of Organic Compounds.
6. S M Mukherjee : Pericyclic Reactions.
7. J Coxon and B Halton : Introduction to Photochemistry.
8. Carey, F.A. & Sundberg, R. J. *Advanced Organic Chemistry*, Parts A & B, Plenum: U.S. (2004).
9. Carruthers, W. *Modern Methods of Organic Synthesis* Cambridge University Press (1971).

M.Sc. Semester – II

C-203: PHYSICAL CHEMSITRY

EACH UNIT IS OF 14 MARKS

Unit - 1: Reaction Kinetics: **10 hours**

Methods of determinations of reaction rates laws, mechanism of photochemical chain and oscillatory reactions, Collision theory of reaction rates, steric factor, treatment of unimolecular reactions, Activated complex theory, comparison of results with Eyring and Arrhenius equations.

Unit - 2: Ionic reactions: **14 hours**

Salt effect, Homogeneous catalysis and Michaelis- Menten kinetics, heterogeneous catalysis. Fast reactions: Luminescence and energy transfer process, study of fast reactions by stopped flow method, relaxation method, flash photolysis, T and P jump and nuclear magnetic resonance method.

Unit - 3: Electrochemistry: **12 hours**

Electrodes and electrochemical cell, Nernst equation, electrode kinetics, electrical double layer, electrode/electrolyte interface, batteries, primary and secondary fuel cells, corrosion and its prevention.

Unit - 4: Surface phenomena: **10 hours**

Surface tension, adsorption on solids, electrical phenomena at interfaces including electrokinetics, micelles, reverse micelles, solubilization. Application of photoelectron spectroscopy, ESCA and Auger spectroscopy to the study of surfaces.

Unit - 5: Solid State Chemistry **14 hours**

Solid State Reactions: Types; sintering; nucleation; Factors influencing the reactivity of solids; Precursors to solid state reactions; Tammann and Hedvall mechanism; Wagner's diffusion theory of reaction; Material transport in solid state reaction—counter diffusion, Kirkendall effect; Huttig's mechanism; Kinetic model: Reaction in powder compact, parabolic rate law, Jander's rate equation.

Reference Books:

1. Modern Electrochemistry, Vol. I & II, J.O.M. Bokris and A.K.N. Reddy, Plenum
2. Chemical Kinetics, K.J. Laidler, McGraw Hill.
3. Physical Chemistry, P.W. Atkins, ELBS.
4. Encyclopedia of Physical Chemistry, Vol I – IV, J.C. Moore.
5. Solid State Chemistry, D.K. Chakrabarty, New Age Publishers.
6. Physical Chemistry of Surfaces, Wiley, A.W. Adamson.
7. Textbook of Polymer Science, F.W. Billmeyer, Wiley.
8. A. R. West. *Solid State Chemistry and its Applications*, John Wiley (1998).
9. N. B. Hannay. *Solid State Chemistry*, Prentice-Hall (1979).
10. D. K. Chakraborty. *Solid State*, New Age International, New Deldi (1996).

M.Sc. Semester – II
C-204: ELECTIVE PAPER ANALYTICAL CHEMSITRY
EACH UNIT IS OF 14 MARKS

Unit – 1: Molecular Spectroscopy & Electronic Spectra: 14 hours

Pure rotational, vibrational and vibrational-rotational spectra of diatomic molecules. Pure vibrational spectra of polyatomic molecules: Normal coordinate analysis, symmetry of normal coordinates; group theoretical derivation of selection rules, Fermi resonance. Theory of Raman scattering, rotational, vibrational and vibrational-rotational Raman spectra of molecules.
Electronic spectra: Frank-Condon principle, electronic spectra of polyatomic molecules, electronic transitions, change of molecular shape on electronic excitation, selection rule, intensity and oscillator strengths.

Unit -2: 14 hours

(a) Food Analysis and Forensic Science:
Moisture, ash, important constituents, protein, fat, crude fiber, carbohydrate, Ca, K, Na and PO_4, Oil and fat analysis, food adulteration and contamination of food.General Introduction of Forensic Science, its applications in crime scene examination, explosion, fire and arson.

(b) Analysis of Body fluids:
Clinical Chemistry: Composition of blood-collection and preservation of samples. Clinical analysis. Serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulins, barbiturates, acid and alkaline phosphatases. Immunoassay: principles of radio immunoassay (RIA) and applications. The blood gas analysis-trace elements in the body.

Unit - 3: Fluorimetry and Phosphorimetry: 12 hours
Principle, origin of fluorescence and phosphorescence spectra, types of relaxation processes, variables affecting fluorescence and phosphorescence spectra, instrumentation and applications.

Unit – 4: Thermal Methods 08 hours
Principle, theory, instrumentation and applications of thermogravimetry (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC) and enthalpimetric methods.

Unit – 5: Basic theory, Instrumentation, laboratory technique and applications 12 hours

X-ray methods: X-ray diffraction, X-ray fluorescence, X-ray absorption and X-ray emission spectroscopy.

Reference Books:

(1) Skoog D A, West D M : Fundamentals of Analytical Chemistry, Thomson Asia Pvt Ltd. 8th Ed, (2004).
(2) Bartt L et al : Vogel's Textbook of Quantitative Inorganic Analysis, ELBS 6th Ed.
(3) Sharma B K : Instrumental methods of Chemical Analysis, Goel Publishing House.
(4) Mahindru S N : Food Analysis, Swan Publishing House, 23rd Ed.
(5) Khopkar S M: Basics concepts of Analytical Chemistry, Wiley Eastern
(6) Physical Methods in Chemistry, R.S. Drago, Saunders College.
(7) Modern Spectroscopy, J.M. Hollas, John Wiley.
(8) Instrumental Methods of Analysis, H.H. Willard, East West Press

M.Sc. Semester – II
C-204: ELECTIVE PAPER POLYMERS
EACH UNIT IS OF 14 MARKS

Unit - 1: Basics 08 hours

Importance of polymers, Basic Concepts: Monomers, repeat units, degree of polymerization, linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous systems.

Unit - 2: Polymer Characterization 14 hours

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. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers, chemical analysis of polymers, spectroscopic methods. X-ray diffraction study. microscopy. Thermal analysis and physical testing-tensile strength.

Unit - 3: Structure and Properties 14 hours

Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point Tm – melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, effects of molecular weight, chemical structure, branching and cross linking.

Unit - 4: Polymer processing 12hours

Plastics, elestomers and fibers. Compounding, processing techniques: Calendaring, die casting, rotational casting, film casting, injection molding, blow molding, extrusion molding, thermoforming, foaming, reinforcing and fiber spinning.

Unit – 5: Properties of Commercial Polymers 12 hours

Polyethylene, polyvinylchloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers – fire retarding polymers and electrically conducting polymers. Biomedical polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

Reference Books:

1. Textbook of Polymer Science, F. W. Billmeyer Jr, Wiley.
2. Polymer science, V. R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.
3. Functional Monomers and Polymers, K.Takemoto, Y. Inaki and RM Ottanbrite.
4. Contemporary Polymer Chemistry, H. R. Alcock and F. W. Lambe, Prentice Hall.
5. Physics and Chemistry of Polymers, J. M. G. Cowie, Blackie Academic and Professional.

M.Sc. Semester – II
Interdisciplinary
C-205: Research Methodology/ Education

Introduction: Objective of research, motivation in research, types of research, interdisciplinary research, scientific methods of research, criteria of good research, and characteristics of a good researcher.

Defining Research Problem: Art of literature review, user of ICT in effective literature review, formulation of problem, formulation of hypothesis, developing research plan, meaning of research design, types of research design, basic principles of experimental design, selection of relevant variables, validity of experiments.

Data Collection and Utilization: Types of data, methods & techniques of data collection, sampling, characteristic of a good sample design, methods used in sampling, sampling errors, tests of hypothesis.

Quantitative Methods: Data presentation, statistical analysis and interpretation of data, types of analysis, simple regression analysis, correlation, coefficient of determination (r2), z-test, t-test, ANOVA, Chi-square test, multi-variate analysis of data, multiple regression.

Computer Application: Role of computer in research, data organization, software selection and its applications, solving problems by using scientific software & tools, sample programmes for analysis of data.

Thesis Writing and Presentation: Significance of writing thesis, different types of research writing; conference paper, journal paper, patents, thesis etc., different steps in writing thesis, layout of thesis, guidelines for writing good thesis, precautions in writing thesis, presentations skills, defending the thesis.

Reference Books:

1. Research Methodology: Methods & Techniques by C R Kothari, 2e, Wishwa Publication, New Delhi
2. Research Methodology by D K Bhattacharyya, 1 e, Excel Books, New Delhi, 2003
3. How to Research by Loraine Blaxter, Christina Hughes and Molcolm Tight, Viva Books Pvt. Ltd., New Delhi
4. Writing Your Thesis by Paul Oliver, Vistaar Pulication, New Delhi, 2006
5. The Research Student's Guide to Success by Pat Cryer, Viva Books Pvt Ltd., New Delhi

M Sc Semester – II
PRA-206: Practical

Organic Chemistry: 40 + 40 marks

1. Preparation of organic compounds: 1 and 2 stage preparation
2. Organic spotting with spectral interpretation / 2 component mixture separation.

Analytical Chemistry: (ANY ONE IN EXAM) 40 marks

1. Practicals based on food analysis: Milk, honey, oil, tea-leaves, turmeric powder etc.
2. Drug Analysis: Aspirin, benzyl benzoate etc.
3. Volumetric and gravimetric analysis: Ester, peroxides, etc.

Chromatography (Inorganic) 40 marks
Viva Voce Examination: 40 marks

EXAM PATTERN
Day 1: Organic Chemistry 80 marks
Day 2: Analytical Chemistry, Chromatography and viva 120 marks

Time: 7 hours on each day.

STYLE OF QUESTION PAPER

Q.1 TO Q.5
Each question from one unit of the syllabus. Each question carries **14 marks.** Sub question (a) answer any two out of 3 or 4, 5 marks each, 10 marks of sub question (a). sub question (b) 4 marks.
Hence Q.1 to Q.5 will be of 70 marks.
Total 70 marks + 30 marks internal..

FORMAT OF INTERNAL ASSESSMENT (TOTAL MARKS 30.)
Written test of 20 marks for each paper.
Attendance 05 marks.
Behavior 05 marks

The M.Sc. Degree Program

The program of studies for the M.Sc. degree aims at equipping the students with adequate theoretical foundation for subsequent specialization in any area of pure & applied chemistry and giving them a fairly comprehensive practical training to make them self-reliant in their work. The principal motivation of the course is an understanding of the interactions of matter, based on knowledge of its ultimate structure, the principles of relationship behind chemical, biological & physical phenomenon. The course offer exclusive specialization in a particular branch of chemistry named "Organopharmaceutical Chemistry ". It offers, instead, a unified program of instruction in all the branches, designated as Theoretical, Physical, Inorganic, Analytical, Organic and Biochemistry. The first three Semesters are devoted to core; compulsory courses, elective courses while, the final semester is reserved for project/ dissertation work and presentation/viva voce.

Semester 3:

Type of Course	**Name of the course**	**Hours per week**	**credits**
Core – 1(C301)	Industrial Chemistry	04	04
Core – 2(C302)	Medicinal Chemistry	04	04
Elective 3*(C303A)	A Selective Approach in Organic Chemistry	04	04
Elective 4*(C303B)	Heterocyclic Chemistry	04	04
Elective 5*(C303C)	Bio Organic Chemistry	04	04
Elective 6*(C303D)	Selected Methods in Analytical Chemistry	04	04
Elective 7*(C303E)	Advanced Nanotechnology	04	04
Elective 8*(C303F)	Computational Chemistry	04	04
Elective 9*(C303G)	Instrumentation-A developing Approach in Analytical Chemistry	04	04
Elective 10*(C303H)	Synthetic Dye Chemistry	04	04
Practical (Pra304)	Combined	12	06
		Total	**26**

* Total Elective papers offered (03)

**Electives* for Semester-3:

Advanced Organic Chemistry, Heterocyclic Chemistry, Bio Organic Chemistry, Selected Methods in Analytical Chemistry, Advanced Nanotechnology, Computational Chemistry, Instrumentation-A developing Approach in Analytical Chemistry, Synthetic Dye Chemistry,

Semester 4:

Type of Course	**Name of the course**	**Hours per week**	**credits**
Dissertation / Industrial training (C401)	Report	36	18
seminar(C402)	Report	12	06
		Total	**24**

M.Sc. Semester – III
C-301: Industrial Chemistry
EACH UNIT IS OF 14 MARKS

Unit: 1 Chemical Engineering for Chemists **14 hours**

An introduction to chemical engineering principles, Mass Balance- Energy Balance- Fluid Flow- Heat Transfer, Mass Transfer- Process Control- Mixing, Concept of total quality management, requirements of GMP, GLP, Regulatory requirements of drugs and Pharmaceutical (USFD-NDA/ ANDA & ICH guide line)Standard operating procedures (SOP) and documentation

Unit: 2 Industrial Skills **12 hours**

Basic concept, factors affecting the plant location, Plant layout, main objects of scientific layout, factors affecting layout, Chemical economics, ethics, Management of Human Resources recruitment and selection, training and development, industrial safety,welfare of employees, Materials Management , Inventory Control and Introduction of patents.

Unit: 3 Industrial Preparations of Selected Organic Compounds: **12 hours**

Production of lsopropanol, Phenol- Formaldehyde Resin,5-NIPA, 5-CIPA, Penicillin, Preparation of, H-Acid, R–Acid, G-Acid,

Unit: 4 Chemical Industries based on Agrochemicals: **12 hours**

1. General introduction , structure and structure-activity relationship of:-

Pesticides: endosulphan, methyl parathione;

Fungicides: zerum, thirum, kasugancycin;

Herbicides: alachlor, suphonyl ureas,

2. Mullusides: metaldehydes and carbamater; Plant growth regulator: gibberelic and indol acetic acids, cytokinins.

3. Phosphorous containing pesticides

Unit: 5 Mineral based industries: **10 hours**

Ceramics: classification–Basic raw material- Application of colours to pottery porcelain and china ware- manufacture. Glass-raw materials, Manufacture of special glass-optical Borosilicate, flint and coloured glasses.

Industrial poisons:classification solid , liquid and gaseous poisons, their identification,physiological activity and control.

Solids: Pb, As, Hg, asbestos, textile fibers.

Liquids: organic solvents, gases oxides of S, N and H_2S, Cyanides, Aldehydes, Ketones and Hydrocarbons.

Explosives: classification, characteristics-special explosives-nitrocellulose- T.N.T, Picric acid, Dynamite-cordite and Gunpowder.

Reference books:

1. Chemical process industries by N.D. Shreve.
2. Applied chemistry for Engineer by Diamont.
3. Industrial poisons and solvents by Jacobs.
4. Chemistry of engineering materials by Jain & Jain.
5. Engineering chemistry by B.K. Sharma.
6. Environmental chemistry by B.K. Sharma.
7. Industrial Chemistry by BK Sharma, Goel Publishing house Meerut.
8. Corrosion, Volume-I, Metal Environment Reactions by L.L. Shreir, Newnes Butterworths, London.
9. Corrosion Engineering by Fontana and Greene, McGraw Hill Publication.
10. Dryden's outlines of Chemical Technology 2nd Edn., edited and revised by M. Gopala Rao, Marshel sitting – East West Press, 1973.
11. Willing, S.W., & Stoker, Good Manufacturing Practices for Pharmaceuticals, Marcel Dekker, New York.
12. Federal Food, Drug & Cosmetic Act.
13. Pisano-FDA Regulatory Affairs.
14. Indian, Pharmacopoeia, British Pharmacopoeia and U. S. Pharmacopoeia.
15. B.K. Sharma, Industrial Chemistry.
16. Guidelines on GMP/GLP by S. Lyer.

M.Sc. Semester – III
C-302: Advanced Medicinal Chemistry
EACH UNIT IS OF 14 MARK

Unit: 1 **12 hours**

Introduction to Medicinal Chemistry, History of Medicinal Chemistry, Classification of drugs, Important Terminology used in Medicinal Chemistry,

Pharmacokinetics: Introduction to drug absorption, disposition, drug metabolism, elimination , important pharmacokinetic parameters in defining drug disposition and in therapeutics, mention of uses of pharmacokinetics in drug development process, concept of pro drug and soft drug.

Pharmacodynamics: Introduction, principles of drug action,mechanisms of drug action, introduction to the concept of receptors and drug receptor interactions, Dose-response relationships, drug potency and efficacy, combined effect of drugs.

Unit: 2 **10 hours**

Drug Design & Development,History and development of SAR and QSAR, Physiochemical parameters,Lipophilicity, electronic parameters, steric parameters, Shelton and surface activity parameters and redox potentials, Free Wilson and Hansch analysis, other statistical methods.

Unit: 3 Introduction, classification, synthesis and SAR of old and new drugs: **15 hours**

1. **Antibiotics**: Introduction, classification.
a) β-lactam antibiotics: penicillin, Classification (early, resistant, broad spectrum, broad spectrum,adverse effects of penicillins.SAR of penicillin, Synthesis: ampicillin, pivampicillins,
b) cephalosporins: Classification and SAR Synthesis: cephalexin, 7- amino cephalosporonic acid,
c) tetracyclines: introduction and SAR, Synthesis: methacycline, doxycycline,
d) macrolides: introduction and SAR, Synthesis: azithromycin.
e) others: chloramphenicol.
f) sulphonamide: classification and SAR, Synthesis: general methods, sulphamethaxazole, sulphadiazine
g) sulphones: synthesis : dapsone.
h) DHFR inhibitors: synthesis: trimethoprim, pyrimethamine.
i) quinolones: introduction, classification, SAR, synthesis:fluoroquinolones, ofloxacin
2. **Anti TB Agents**: introduction, classification, **Synthesis**: isoniazid, ethambutal, PAS
3. **Antifungal**: introduction, classification **Synthesis**: ketoconazolem, 5- flucytosine
4.Anasthetics: General Anaesthetics: Enflurane, halothane, ketamine, thiopentone sodium, methohexetal sodium, medazolam. **Local Anaesthetics:** Cocaine, benzocaine, procaine hydrochloride, diperodone, lidocaine hydrocholoride, etidocaine hydrochloride.
5. **Antidipressants:** Isocarboxazide, dibenzazepines, doxepine,fluoxetine.
6. **Antianginal:** Isosorbiddinatrate,dipyridamol.
7. **Oral Hypoglycemic:** meglitinide, linogliride.
8. **Oral anticoagulants:** warfarine, dicomarol,

Unit: 4 Introduction, classification, synthesis and SAR of old and new drugs: **15 hours**

Antihistamines and anti ulcer drugs: Diphenhydramine, carbinoxamine, doxylamine, pheniramine, cyclizine, cetrizine, ranitidine, famotidine, roxatidine, omeprazole.
Diuretics: Acetazolamide, methazolamide, thiazide diuretics, zipamide.
Antihypertensive: Doxazosin, methyldopa, propanolol, atenolol, nifedipine.
Antihyperlipidemics: Fluvastatine, benzafibrate, fenofibrate.
Adrenergics: Adrenaline, salbutamol, ephedrine, xylometazoline.
Cholinergic drugs: Pilocarpine, isofluorophate, neostigmine, cyclopentolate.
Narcotic Analgesics: Levallorphan, mepiridine (pethidine), pentazocine.
Sedatives, Hypnotics and Anxiolytics: Phenobarbital, diazepam,bromazepam, meprobamate, zaleplan, buspirone.

Anticonvulsants: Hydantoins, vigabatrin, progabide, sodium valproate, denzimol, zonisamide.
Antipsychotic: thiothixene, haloperidol, pimozide, chlozapine, ziprasidone, seretindole.
Antipyretics and NSAIDS: Aspirin, salsalate, diflunisil, paracetamol, phenylbutazone, oxephenbutazone, flufenamic, indomethacin, sulindac, tolmetin, ibuprofen, diclofenac, naproxen, ketoprofen, tenoxicam, nambutone, nimesulide, anlagin, selecoxib, etodolac.
Miscellaneous CNS drugs: Levodopa, carbidopa, mefanicin,baclofen, milameline, besiperdine, phenserine, ecopizil.
Antiarrhythmic drugs: Procanamide, mexiletine, encainide, flecainide, amiodarone.

Unit: 5 Combinatorial Chemistry: 08 hours
Including automation, solid supported and solution phase of synthesis (**SPPS & SPOS** concept) and related other methodologies, preparation and study of targeted or focused libraries.

Reference books:

1. Medicinal Chemistry, A. Burger Vols. I to V Ed. M. E. Wolff, John Wiley(1994).
2. Goodman & Gilman. Pharmacological Basis of Therapeutics, McGraw-HilI (2005).
3. S. S. Pandeya & J. R. Dimmock.Introduction to Drug Design,New Age International. (2000).
4. D. Lednicer. Strategies for Organic Drug Synthesis and Design,John Wiley (1998).
5. Graham & Patrick. Introduction to Medicinal Chemistry (3rd edn.), OUP (2005).
6. Medicinal Chemistry — A molecular and Biochemical Approach,Thomas Nogrady and Donald F. Weaver
7. Principles of Medicinal Chemistry, W. O. Foye
8. Wilson and Gisvolds Text book of Medicinal Chemistry
9. The Organic Chemistry of the Drug Design and Drug Action,Richard B. SilvermanS
10. Analogue based Drug Discovery, János Fischer and C. Robin Ganellin
11. Goodman and Gilmans Text book of Pharmacology.
12. Chemoinformatics - Concepts, Methods, and Tools for Drug Discovery,Jürgen Bajorath
13. A Kar, Textbook of Medicinal Chemistry; Asian Age Publication.
14. Sriram D and Yogeshwari P, Medicinal Chemistry; Pearson Education.
15. Ahluwalia V K, Chopra Madhu, Medicinal Chemistry; Ane Books India.

M.Sc. Semester – III
ELECTIVE PAPER
C-303A: A selective Approach in Organic Chemistry
EACH UNIT IS OF 14 MARK

Unit 1: Stereo Chemistry **12 hours**

a. Geometrical isomerism
b. Stereochemistry of Allenes.
c. Optical rotation and Optical rotatory dispersion.
d. Uses of achiral and chiral heterogeneous and homogenous catalysts.
e. Stereochemistry of five & six member rings fused & bridged rings.
f. Stereo selective synthesis and stereo regulated polymerization.

Unit 2: Organic Synthesis – A disconnection approach **12hours**

Introduction to disconnection, concept of Synthon, Synthetic Equivalent, functional group inter conversion, concept and design of synthesis, criteria of good disconnection.

Protecting Groups:

Protection of organic functional groups, protecting reagents and removal of protecting groups.

One Group disconnection: Disconnection and synthesis of alcohols, olefins, simple ketones, acids and its derivatives.

Two Group Disconnection: Disconnection in 1, 3-dioxygenated skeletons, preparation of β-hydroxy carbonyl compounds, α, β-unsaturated carbonyl compounds, 1, 3-dicarbonyls, 1, 5-dicarbonyls and use of Mannich Reaction.

Illogical two group disconnections:

Disconnection and synthesis of 2-hydroxy carbonyl compounds, 1,2-diols, 1,4 and 1,6-dicarbonyl compounds.

Unit 3: **12hours**

(A) Unit Processes and Operations

Nitration, oxidation, sulphonation, reduction, halogenations, Filtration, extraction, crystallization, drying, distillation.

(B) Synthetic Perfumes

Definition, classification, synthesis and uses of : ester of cinnamic acid, linalool, phenyl ethyl alcohol, civetone, musk ambrette, alpha and β-ionones, alpha and β-irones.

Unit 4: Alkaloids and Vitamins **12hours**

General methods of isolation and structure determination of natural products.

Vitamins

Introduction and Chemistry of Vitamine A, E and K. Synthesis of
Riboflavin, Pyridoxine, vitamin C, Niacin, Pentothenic acid, Folic acid.

Alkaloids

Chemistry of cinchonine and atropine. Synthesis of morphine, nicotine, colchinine, strychnine.

Unit 5: Terpenoids and carotenoids **12hours**

Classification, nomenclature, general methods of structure determination, Chemistry and synthesis of abietic acid and gibberellic acid (gibberllin-A), farnesol,zingeberine and squalene, Biosynthetic studies on triterpenoidsand tetraterpenoides.

Reference Books:

1. Eliel, E.L., Stereochemistry of Carbon compounds MC. Graw Hill Book Company, Inc. New York
2. Stereochemistry by P. S. Kalsi (New Age International)
3. Warren S, Designing organic synthesis; Wiley.
4. Norman R and Coxon J M, Principles of Organic Synthesis.
5. Carey F A and Sundberg R J, Advanced Organic Chemistry, Part B.
6. Fuhrhop J, Organic synthesis – concept, methods and starting materials.Warren, Disconnection Approach.
7. Unit processes in organic synthesis by P.H.Groggins
8. Alta-Ur-Rehman and Chaudhary M I, New trends inNatural Product Chemistry.
9. Bhat Sujata, Chemistry of Natural Products;Springer-Narosa.
10. Singh Ayodhya, Chemistry of Natural Products Vol 1 and 2.

M.Sc. Semester – III
Elective Paper
C-303B: HETEROCYCLIC CHEMISTRY
EACH UNIT IS OF 14 MARKS

Unit 1: Introduction and Nomenclature of Heterocycles: 14hours

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

Aromatic Heterocycles

General Chemical Behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in 1H NMR-spectra.

Unit2: Chemistry of cyclopropane and cyclobutane hetero analogues: 12hours

Preparation and properties of azirine, oxirane, azitidine, oxetene, oxatane and thietane. Preparation of diazirine and oxaziridine.

Unit 3: Hetero analogues of five member ring system: 14hours

Preparation and properties of pyrrole, furan, thiophene, pyrazole and imidazole. Preparation of phosphole, benzaluminol, isoindole, indolizine, dibenzofuran, isobenzofurans, carbazole, isoxazole, oxazole, isothiazole and thiazole.

Unit 4: Heterocyclic analogues of higher ring systems: 14hours

Synthesis and reactions of pyridine, pyran, quinoline, isoquinoline, acridine and phenanthridine.

Synthesis of 2-pyrones, 4-pyrones, benzopyran, benzo-2-pyrones and benzo-4-pyrone, azepine, thiepine, diazepine.

Unit 5: Compounds with two or more than two hetero atoms 16hours

Preparation of pyridazine, pyrimidine, pyrazine, oxazine, thiazine, dioxane, quinazoline, quinaxaline, cinnoline, pteridine, triazenes.

Non Aromatic Heterocycles

Strain – bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of 6 membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction.

Reference Books:

1. Bansal R K, Heterocyclic Chemistry.
2. Acheson R H, An introduction to the chemistry of Heterocyclic compounds.
3. Trivedi J J, Chemistry of Heterocyclic Compounds.
4. Gupta R R, Kumar M amd Gupta V, Heterocyclic Chemistry, Springner.
5. Eicher T and Hauptmann S, The Chemistry of Heterocycles.
6. Joule J A, Mills K and Smith G F, Heterocyclic Chemistry.
7. Gilchrist T L, Heterocyclic Chemistry.

M.Sc. Semester – III
Elective Paper
C-303C: BIO ORGANIC CHEMISTRY
EACH UNIT IS OF 14 MARKS

Unit 1: Fundamentals of Biochemistry: 12hours
Introduction of Biochemistry, Amino acids: peptides, primary, secondary, tertiary, and quaternary structure of proteins. Nucleic acids: Base pairing, double helices, DNA replication, transcription and translation, Enzymatic hydrolysis of proteins to peptides; Amino acid sequencing; amino acid metabolism (biosynthesis and degradation).

Unit 2: Metabolism and Metabolic Reactions: 14hours
Overview and important relationships between-glycolysis, Bioenergetics And bioenergetic principles, oxidative phosphorylation process, ATP synthetase, photophosphorylation.

Fatty acid metabolism: Biological importance of fatty acids and lipids, even chain and odd chain fatty acids, saturated and unsaturated fats, ketone bodies, fatty acid metabolism, calorific value of foods, bological membranes, properties and function of lipid bilayers and liposomes.
Protein-related transformations: urea cycle, uric acid and ammonia formation;

Unit 3: Nucleic Acids: 12hours
Chemical and enzymatic hydrolysis of nucleic acids; Structure and function of mRNA, tRNA, rRNA; Polymorphic nature of DNA, B- and Z-DNA, multi- stranded DNA; DNA sequence determination by chemical and enzymatic methods, Genetic code – origin, salient features, Gene expression transcription and translation; Gene mutation and carcinogenesis

Unit 4: Biochemistry of naturally occurring Macro molecules: 12hours
Classification: classification based on chemical structure, physiological activity, taxonomy and biogenesis.
Monoterpines and sesquiterpenes: bisabolene, juvabione, transchrysanthamic acid, logifolene, taxines, caryophyilene.
Steroids: Synthesis and functions of cholesterol, ergo sterol, progesterone, testosterone, cortisone.
Alkaloids, quinine, morphine, tylophorine and reserpine.
Anthocyanins, **flavones and isoflavones**, examples in each family.
Plant Hormones, gibberllins, gibberellic acid.
Peptides, bradykinin, oxytocin, vasopressins, gramicidins.
Juvenile hormone cecropia, Insect pheramons, sweet potato pest and cotton seed pest.

Unit 5: Concepts in biotechnology: **10hours**
bioprocesses technology, microbial growth dynamics, bioreactor concepts, immobilisation of cells, concepts in agricultural, and other industrial biotechnology.

Reference Books:

1. Albert L. Lehninger, David L. Nelson, Michael M. Cox., Principles of Biochemistry, CBS Publishersand Distributors, 1993.
2. Lubert Stryer, Biochemistry, W. H. Freeman and Company, 4th edition, 1995.
3. Christopher K. Mathews and K. E. Von Holder, Biochemistry, Benjamin/Cummings, 1990.
4. Eric E. Conn, Paul K. Stumpf, George Breening and Roy H. Doi, Outlines of Biochemistry, 5th edition,John Wiley and Sons,1987.
5. F. A. Carey and R. J. Sundberg, (Eds) 3rd Edition, Part B. Plenum/Rosetta,1990.
6. I.Fleming, Selected Organic Synthesis, John Wiley and sons, 1982.
7. Atta-ur-Rehman, Studies in Natural Products Chemistry, Vol.1 and 2, Elsevier, 1988.
8. T.Lindberg, Strategies and Tactics in Organic Synthesis, Academic Press, 1984.
9. E. J. Corey and X-M. Cheng, Logic of Chemical Synthesis, John Wiley, 1989.
10. H. Pape and J. H. Rehm, (eds): Biotechnology, A Comprehensive Treatise,Vol. 1-8, VCH, 198

M.Sc. Semester – III
Elective Paper
C-303D: SELECTED METHODS IN ANALYTICAL CHEMISTRY
EACH UNIT IS OF 14 MARKS

Unit 1: Electro analytical Techniques **12hours**

(a) Polarography

Theory, apparatus: derivative polarography, modified polarographic techniques,AC polaography, pulse polarography, chronopotentometry and their application in qualitative and quantitative analysis,

b) Voltammetry

Basic principles, Instrumentation, Cyclic voltammetry- Principle and applications, Voltammograms, Stripping voltammetry, Instrumentation

Unit-2: Turbidimetery and Nephelometery **10hours**

Principle, theory, instrumentation, sample handling and applications

Unit –3: **14hours**

a)Atomic absorption spectroscopy
Instrumentation, Working and Applications
b)Atomic emission spectroscopy
Instrumentation, Working and Applications

Unit-4. Hyphenated Techniques **12hours**

TGA-IR : principles, Instrumentation, Interfaces and Applications

GC-FT-IR: Principles Instrumentation, and Applications

ICP-MS: Instrumentation, principles, applications

Unit-5: Solvent extraction method in analysis **12hours**
Principle, classification, theory, instrumentation and applications

REFERENCE BOOKS:

1. Fundamentals of analytical chemistry. D. A. Skoog, D. M. West, F. J. Holler and Crouch.
2. Analytical Chemistry.- G. D. Christian.
3. Analytical Chemistry. Principles – J. K. Kennedy and W. B. Saunders.
4. Instrumental Methods of Chemical Analysis.B. K. Sharma.
5. Vogel's Textbook of quantitative Inorganic Analysis – L. Barrt et. al. ELBS.
6. Skoog D A., Loary J I and Saunder W B, Principles of Instrumental Analysis.
7. Silverstein : Spectroscopic Identification of organic compounds (John Wiley)
8. Basic Concepts of Analytical chemistry by S.M. Khopkar-New Age International Publishers
9. F. J. Welcher: Standard methods of Chemical analysis, 6th Ed. Vol. I and II

M.Sc. Semester – III
Elective Paper
C-303E: Advanced Nano-Technology
EACH UNIT IS OF 14 MARKS

Unit: 1 INTRODUCTION 08hours

Nano technology-Introduction, Definition, Role of Bottom-up and Top-Down approaches in Nano technology, Challenges in Nano technology

Unit: 2 NANO MATERIALS 12hours

History of Nanomaterials, Causes of interest in nanomaterials,Fundamental issues in nanomaterials, Basic concepts of Nano science and technology, Quantum wire, Quantum well, Quantum dot, Properties and technological advantages of Nano materials, Material processing by Sol,Gel method, Chemical Vapour deposition and Physical Vapour deposition, Microwave Synthesis of materials, Principles of SEM, TEM and AFM .

Unit: 3 SYNTHESES OF NANOMATERIALS 14hours

Top-down (Nanolithography, CVD), Bottom-up (Sol-get processing, chemical synthesis). Wet Deposition techniques, Self-assembly (Supramolecular approach), Characterization TEM, SEM and SPM technique, Fluorescence Microscopy and Imaging.

BIOLOGICAL METHODS OF SYNTHESIS:
Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Magnetotactic bacteria for natural synthesis of magnetic nanoparticles; Viruses as components for the formation of nanostructured materials; Synthesis process and application, Role of plants in nanoparticle synthesis.

Unit: 4 APPLICATIONS OF NANOMATERIALS 12hours

APPLICATIONS Solar energy conversion and catalysis, Polymers with a special architecture, Liquid crystalline systems, Applications in displays and other devices, Advanced organic materials for data storage, Photonics, Plasmonics, Chemical and biosensors, Nanomedicine and Nanobiotechnology.

Unit: 5 THE GEOMETRY OF NANOSCALE CARBON 14hours

Introduction –Carbon molecules-nature of the carbon bond-new carbon structures-discovery of C60-structure of C60 and its crystal- From a Graphene Sheet to a Nanotube , Single wall and Multi walled Nanotubes, Zigzag and Armchair Nanotubes , Euler's Theorem in Cylindrical and Defective Nanotubes.

CARBON NANOTUBES
History Molecular and Super molecular Structure-Intrinsic propertries of individual carbon nano tubes-Synthesis -Arcing in the present and absent of catalys-laser method-Chemical Vapour Deposition -ball milling.

SOCIETIAL IMPLICATIONS OF NANOTECHNOLOGY:

Navigating Nanotechnology through Society, Nanotechnology, Surveillance, and Society, Innovations for Social Research and Social Trends "Integration/Penetration Model" - Social Impacts of Nanobiotechnology Issues

Reference notes:

1. Nano materials by J. Dutta & H. Hofman.
2. Mick Wilson, Kamali Kannagara et.al., "NANOTECHLOGY-basic science and emerging technologies, University of new south wales press ltd,2008.
3. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002
4. A. Nabok, "Organic and Inorganic Nanostructures", Artech House, 2005
5. C. Dupas, P.Houdy, M.Lahmani, Nanoscience: "Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007
6. Nanomedicine, Vol. IIA: Biocompatibility by Robert A. Freitas
7. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
8. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers
9. Massimiliano di Ventra.et.al. Introduction to NANOSCALE SCIENCE AND TECHNOLOGY", springer 2009
10. Charles P.Poole Jr et.al.,"INTRODUCTION TONANOTECHNOLGY",Wiley Student Edition,2008
11. Mihail C. Roco and William Sims Bainbridge, "Nanotechnology: Societal Implications II – Individual Perspectives", Springer Publishers, Sponsored by National Science Foundation, ISBN-10 1-4020-4658-8.

M.Sc. Semester – III
Elective Paper
C-303F: Computational Chemistry
EACH UNIT IS OF 14 MARKS

Unit 1: Fundamentals of Computational chemistry: 12hours
Component of computer system, computer language, PC, an introduction to Disk Operation System (DOS) and Windows, WINDOWS and file editing, MATLAB language,

Unit 2: Computer Applications: 12hours
Application package for report generation and presentation, MS-office- introduction to MS-word, document and manipulations, saving and printing, incorporation of graphs, tables, pictures and chemical structures into the document. Excel: spreadsheets, report generation, data base management, and graphical representation of tabulated data. Power Point: application of power point for representation reports.

Unit 3: Elements of computer architecture: 14hours
Evaluation of analytical wave functions and graphing, 3D and contour plots, Regression analysis of experimental data, linear and non-linear deconvolution techniques, Solution of simultaneous equations by matrix methods. Eigen values and eigen vectors of matrices, Huckel theory and applications. Systems of linear and non-linear differential equations, numerical integration methods, stability analysis of solutions. Signal analyses by Fourier transform.

Unit 4: Computer programming: 14hours
Computer programming in FORTRAN, Use of computer programmes: Execution of linear regression, X-Y plot, numerical integration and differentiation as well as differential equation solution programmes, Monte Carlo and Molecular dynamics. Programmes with data preferably from physical chemistry laboratory.

Unit 5: Computer Applications in Chemistry: 10hours
Development of small computer codes involving simple formulae in chemistry, such as van der Waals equation, pH titration, kinetics, radioactive decay, Evaluation of lattice energy and ionic radii from experimental data, Applications of **MOLPAC** and other chemistry packages, Use of internet in chemical research.

References:

1. P. C. Jurs, Computer software applications in chemistry, Wiley Interscience, 1986.
2. K. J. Johnson, Numerical Methods in Chemistry, Marcel Dekker, 1980.
3. A. F. Carley and P. H. Morgan, Computational Methods in the Chemical Science, Eillis Horwood Ltd, 1989.
4. Computer Manuals: PC-MATLAB, the Mathworks, Inc., 1989.
5. Computational Chemistry by A. C. Norris, John Wiley
6. Numerical Recipes in FORTRAN/C by W. H. Press, S. A. Teukolsky, W.T. Vetterling and B. P. Flannery, Cambridge University Press, 2nd Ed. 1996.
7. Fortran 77 and Numerical Methods by C. Xavier, New Age International, 2002
8. Inside the IBM PC by Peter Norto

M.Sc. Semester – III
PRA-304: Practical

Multistep synthesis of organic compound using TLC	**40 Marks**
Drug Estimation	**40 Marks**
Organic Mixture Separation.	**40 Marks**
Spectral Analysis	**40 Marks**
Viva Voce	**40 Marks**

Exam Pattern:
Day 1. Synthesis and Drug Estimation

Day 2. Organic Mixture seperatrion, Spectral analysis and Viva.

Time: 7 hours daily.

STYLE OF QUESTION PAPER

Q.1 TO Q.5

Each question from one unit of the syllabus. Each question carries **14 marks.** Sub question (a) answer any two out of 3 or 4, 5 marks each, 10 marks of sub question (a). Sub question (b) 4 marks.

Hence Q.1 to Q.5 will be of 70 marks.

Total 70 marks + 30 marks internal.

FORMAT OF INTERNAL ASSESSMENT(TOTAL MARKS 30.)

Written test of 20 marks for each paper.

Attendance 05 marks.

Behavior 05 marks

M.Sc. Semester – IV
ORGANOPHARMACEUTICAL CHEMISTRY

C-401 Industrial training/Desertation	**500 Marks**
C-402 Project work & Seminar	**200 marks**