DEPARTMENT OF PHYSICAL SCIENCES

M. Sc. (Chemistry)

Course Details

SEMESTER – I

SN	Paper code	Name of Paper	MM	Credits
1	SMC- 501	Instrumental Methods of Analysis	100	03
2	SMC -502	Quantitative Analysis and Separation Techniques	100	03
3	SMC -503	Electro Analytical and Diffraction Methods	100	03
4	SMC -504	Spectroscopy and their Applications	100	03
5	SMC -505	Computer Application for Chemist	100+100	01+01
6	SMC -506	Practical - I	100	03
7	SMC-507	Internship/Apprenticeship	100	03
		Total	**800**	**20**

SEMESTER –II

SN	Paper code	Name of Paper	MM	Credits
1	SMC -508	Group Theory, Mathematics for Chemists & Biology for Chemists	100	03
2	SMC -509	Physical Chemistry-I	100	03
3	SMC -510	Inorganic Chemistry-I	100	03
4	SMC -511	Organic Chemistry-I	100	03
5	SMC -512	Solid State Chemistry	100	02
6	SMC -513	Practical - II	100	03
7	SMC -514	Industrial Training / Field Work & Seminar	100+100	02 + 01
		Total	**800**	**20**

Semester - III

SN	Paper code	Name of Paper	MM	Credits
1	SMC -601	Physical Chemistry-II	100	03
2	SMC -602	Inorganic Chemistry-II	100	03
3	SMC -603	Organic Chemistry-II	100	03
4	SMC -604	Photochemistry	100	03
5	SMC -605	Polymer Chemistry	100	02
6	SMC -606	Practical - III	100	03
7	SMC -607	Internship/Apprenticeship & Seminar	100+100	02 + 01
		Total	~~700~~ 800	**20**

Semester - IV

SN	Paper code	Name of Paper	MM	Credits
1	SMC -608	Natural Products / organic Synthesis / Analytical Chemistry	100	03
2	SMC -609	Heterocyclic Chemistry / Medicinal Chemistry / organometallic Chemistry	100	03
3	SMC -610	Project Work/Dissertation & Viva-voice / Electrochemistry	100	14
		Total	**300**	**20**
		Grand Total	~~2500~~ 2700	**80**

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M.Sc. (Chemistry)
Semester - I
SMC-501: Paper –I- Instrumental Methods of Analysis
External Marks - 80, Internal Assessment- 20
Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit- 1: Statistical Treatment of Data Types of errors, accuracy and precision, normal distribution of errors, statistical treatment of finite samples (mean median, range and average diviation), t-test, confidence interval of the mean, standard error of a mean lest of significance, comparison of two means, F-test, Chi-square test and distribution normality test, rejection of data, Q-test, Bivarate data, correlation and regression.
Unit -2: Spectroscopy- Concepts of spectroscopy, Instrumentation, Types of molecular specta, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetric.
Unit -3: UV - Visible Spectroscopy Introduction, principles, description of related instruments like colorimeter spectrophotometer, principles of UV-visible spectroscopy, nature of electronic transition, Chromospheres and auxochrome.
Unit- 4: Infrared Spectroscopy Introduction, Molecular transitions (Rotational and vibrational) and their types, vibrational frequencies, factors influencing vibrational frequencies, FTIR, Hormonic oscillator, hot band.
Unit -5: Atomic Absorption Spectroscopy General principles, instrumental set up and analytical procedures of absorption spectroscopy, precision and accuracy of AAS, relation between atomic absorption and flame emission spectroscopy, applications.

M.Sc. (Chemistry)
Semester - I
SMC-502: Paper- II- Quantitative Analysis and Separation Techniques
External Marks - 80, Internal Assessment - 20
Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit I: Concepts involved in Analysis Role of analytical chemistry, classification of analytical methods-classical and instrumental, types of instrumental analysis, selecting analysis method, neatness and cleanliness, laboratory operations and practices, good laboratory practices, techniques of weighing, errors, volumetric glassware-cleaning and calibration of glassware, sample preparation– dissolution and decompositions, selecting and handling reagents, laboratory notebooks, safety in the analytical laboratory, calibration and detection limits, proficiency testing.
Unit II : Separation Techniques-I (A) Solvent Extraction: Fundamental treatment, theoretical principle, classification, and factors favouring extraction, extraction equilibria, applications. (B) Solid phase extraction and solid phase micro extraction, applications. (C) Ion- Exchange: Theories, use of synthetic ion exchange in separation, chelating ion exchange resins, liquid ion exchangers, experimental technique.
Unit III : Separation Techniques-II An introduction to chromatographic methods, paper, thin layer and column chromatography, theory of chromatography, classification of chromatographic techniques, retention time, relationship between retention time and partition coefficient, the rate of solute migration, differential migration rates, band broadening & column efficiency, kinetic variables affecting band broadening, Electrophoresis and capillary electrophoresis.
Unit IV: Separation Techniques-III A. GC, Principle of GC, plate theory for GC, instrumentation for GC, working of GC, Detectors used, applications. B. HPLC, Principle of HPLC, Components of HPLC, detectors used, instrumentation, applications in qualitative and quantitative analysis.

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Size exclusion chromatography, super critical fluid chromatography, affinity chromatography, TLC, Ion chromatography, pyrolytic gas chromatography.

it V: Separation Techniques -IV

A. Titrimetric analysis, Theoretical considerations, classification of reaction in titrimetric analysis, standard solution, preparation of standard solution, primary and secondary standard, neutralization, complexation, oxidation and reduction, titration application.

B. Gravimetric analysis, Introduction, precipitation, colloidal state, saturation and precipitation formation co-precipitation, conduction for precipitation washing ignition in precipitate.

M.Sc. (Chemistry)

Semester - I

SMC-503: Paper- III- Electro Analytical and Diffraction Methods

External Marks - 80, Internal Assessment - 20

Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- A. Electro Gravimetric analysis-

Theory, some terms used in electro gravimetric analysis complete decomposition electrolytic separation of metals, characters of deposit electrolytic separation with controlled cathode potential. Apparatus, determination of copper and other examples.

B. pH metry & Conductimetry- Introduction, measurement, bases of conductimetry, titration, apparatus, application of conductimetry titration, high frequency titration. pH meteric titraions.

Unit II- A. Coulometry- General introduction, Coulometry at controlled potential, apparatus and generator techniques separation of nickel and Cobalt by Coulometric analysis at control potential flowing stream Coulometry, Coulometry titration, instrumentation, limitation, external generation of titration and some example on Coulometric titration, titration of acid and base, determination of antimony, chlorine, bromine, iodine.

B. Potentiometry- Introduction, reference and indicators electrodes, selective electrodes and other solid membrane electrodes, instrumentation and measurement of cell EMF direct potentiometry, potentiometric titration with one example each, potentiometric titration in non aqueous solvent.

Unit-III- A. Voltametry- General introduction, principles of polarography direct current polarography, evolution of quantitative result equipment for polarography, modified voltametric procedure, applications.

B. Amperometry- introduction, techniques with dropping electrode rotatory platinum electrode and biamperometric titration with example.

Unit-IV- X-ray Diffraction

Bragg condition, Miller indices, Laue Method, Bragg method, Debye Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern, Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules.

Unit-V- A. Electron Diffraction

Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces.

B. Neutron Diffraction-

Scattering of neutrons by solids measurement techniques, Elucidation of structure of magnetically ordered unit cells.

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M.Sc. (Chemistry)
Semester - I
SMC-504: Paper- IV- Spectroscopy and their Applications
External Marks - 80, Internal Assessment - 20
Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit - I- Electronic Spectroscopy:
Various electronic transitions (185-800 nm), effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fieser Woodward rules for conjugated dienes and carbonyl compounds. Electronic Spectral Studies for d^1- d^9 systems in octahedral, tetrahedral and square planar complexes.

Unit - II- Vibrational Spectroscopy
Symmetry and shapes of AB_2, AB_3, AB_4, AB_5 and AB_6, mode of bonding of ambidentate ligands, nitrosyl, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy and its applications. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, Detailed study of vibrational frequencies of carbonyl compounds (ketone's, aldehyde's, esters, amides, acids, anhydride's, lactones, lactams and conjugated carbonyl compounds).

Unit -III- Nuclear Magnetic Resonance Spectroscopy
A. General introduction and definition, Chemical shift, spin–spin interaction, shielding and deshilding mechanism, mechanism of measurement of chemical shift values and correlation for protons bonded to carbon and other nuclei. Spin decoupling, spin tickling, INDOR and diffrence couplng.
B. Chemical exchange, effect of deuteration, Stereochemistry, hindered rotation, NMR shift reagents, solvent effects. Two dimension NMR spectroscopy-COSY, NOESY and DEPT techniques, MRI.

Unit-IV- Electron Spin Resonance Spectroscopy
A. Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and Mc-Connell relationship, measurement techniques, applications.
B. ENDOR and ELDOR, spectra of DPPH radical, Intensity of ESR lines, Hyperfine interaction, fermi interaction, spin labelling, ESR spectroscopy, EPR spectra of transition metal complexes.

Unit-V-A. Mossbauer Spectroscopy
Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin.
B. Mass Spectroscopy
Introduction ion production E_1, C_1 FD, ESI and FAB, factors affecting fragmentation, ion analysis, ion abundance Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak. Me Lafferty rearrangement.

M.Sc. (Chemistry)
Semester - I
SMC-505: Paper- V- Computer Application for Chemist
External Marks - 80, Internal Assessment - 20
Total Marks - 100 or Total Credits- 01+01, Time -3 hrs.

Unit – 1: General
Introduction, fundamentals, Introduction to various types of input and output devices of a computer, computer memory, introduction to RAM, ROM, PROM, EPROM, magnetic hard disk, floppy disk drive and magnetic tape drive. Data representation - BINARY, OCTAL and HEXADECIMAL, conversion of decimal to binary, octal and hexadecimal and vice-versa, binary addition and subtraction by complementary method.

Unit -2: Disk Operating System and Windows - 98
Introduction to Disk Operating System (DOS) its internal and external commands. Introduction to Windows- 98 and its various utilities, comparison between Windows - 98 and Windows-3.11.

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-3: MS-Word & Tables in MS-Word
duction to MS-Word, navigating in MS-Word, editing and formatting in MS-Word. Working with table printing options; mail merge and graphics.
nit – 4: MS-Excel, Data and Charts
tarted with MS-Excel, formulae and functions, formatting and printing a workbook. Sharing, managing, analyzing ,organizing and charting of data.
Unit - 5: Internet
Introduction and concepts of internet, types of connection, trajectory, protocols, applications.

M.Sc. (Chemistry)
Semester - I
SMC-506: Paper - VI
Practical - I
M.M.- 100 or Total Credits - 3, Time - 5 hrs.

	1 - pH metric titration experiments
	2- Conductometric Titrations.
	3- Colorimetric experiments
	4- Paper and thin layer chromatographic experiments
	5- Spectrophotometric (UV and visible range) experiments

M.Sc. (Chemistry)
Semester - I
SMC-507: Paper – VII
Internship/ Apprenticeship
Total Marks-100 or Total Credits- 03

3-4 Weeks Internship/ Apprenticeship in some Industry/ research institute/ Pollution Control Board/ research and consulting organizations should he made compulsory. Each student should be required to submit report of his Training to the Course-Incharge.

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M.Sc. (Chemistry)
SEMESTER –II
SMC-508: Group Theory, Mathematics for Chemists and Biology for Chemists
External Marks - 80, Internal Assessment - 20
Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Symmetry and Group theory in Chemistry
Symmetry elements and symmetry operation, definition of group, subgroup. Conjugacy relation and classes. Point symmetry group. Schonfilies symbols, representations of groups by matrices (representation for the Cn, Cnv, Cnh, Dnh group to be worked out explicity). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use; spectroscopy. Derivation of character table for C_2v and C_3v point group Symmetry aspects of molecular vibrations of H_2O molecule.

Unit-II- Vectors
Vectors, dot, cross and triple products etc. gradient, divergence and curl, Vector Calculus.
Matrix Algebra
Addition and multiplication; inverse, adjoint and transpose of matrices.

Or

Carbohydrates
Conformation of monosaccharides, structure and functions of important derivatives of mono-saccharides like glycosides, deoxy sugars, myoinositol, amino sugars. Nacetylmuramic acid, sialic acid disaccharides and polysaccharides. Structural polysaccharides cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological function of glucosaminoglycans of mucopolysaccharides. Carbohydrates of glycoporteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid.

Unit-III- Differential Calculus
Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.).

Or

Amino-acids, Peptides and Proteins
Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins. force responsible for holding of secondary structures. a- helix, -b-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domina structure. Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequence determination: chemical/enzymatic/mass spectral, racemization/detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH).

Unit-IV- Integral calculus
Basic rules for integration, integration by parts, partial fractions and substitution. Reduction formulae, applications of integral calculus. Functions of several variables, partial differentiation, co-ordinate transformations (e.g. Cartesian to spherical polar). First-order and first degree differential equations, Applications to chemical kinetics,

Or

Lipid
Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Liproproteins-compositiion and function, role in atherosclerosis. Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolismboxidation of fatty acids.

Unit –V- Permutation and Probability
Permutations and combinations, probability and probability theorems average, variance root means square deviation examples from the kinetic theory of gases etc., fitting (including least squares fit etc with a general polynomial fit.

Or

Nucleic Acids
Purine and pyrimidine bases of nucleic acids, base pairing via Hbounding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.

M.Sc. (Chemistry)
SEMESTER –II
SMC-509: PHYSICAL CHEMISTRY- I
External Marks - 80, Internal Assessment - 20
Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Introduction to Exact Quantum Mechanical Results
Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom and helium atom.

Unit-II- Approximate Methods
The variation theorem, linear variation principle. Perturbation theory (First order and nondegenerate). Applications of variation

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d and perturbation theory to the Helium atom.

cular Orbital Theory

kel theory of conjugated systems bond and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl ical cyclobutadiene etc. Introduction to extended Huckel theory.

it-III- Angular Momentum

rdinary angular momentum, generalized angular momentum, eigenfucntions for angular momentum, eigenvalues of angular nomentum operator using ladder operators addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

Unit-IV- Classical Thermodynamics

Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar free energy, partial molar volume and partial molar heat content and their significance. Determinations of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems: Excess function s for non-ideal solutions. Activity, activity coefficient, Debye Huckel theory for activity coefficient for electrolytic solutions; determination of activity and activity coefficients; ionic strength. Application of phase rule to three component systems; second order phase transitions.

Unit-V- Statistical Thermodynamics

Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and micro-canonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-translation, rotational, vibrational and electronic partition functions, Calculation of thermodynamic properties in terms of partition. Application of partition functions. Fermi-Dirac Statistics, distribution law and applications to metal. Bose-Einstein statistics distribution Law and application to helium.

M.Sc. (Chemistry)
SEMESTER –II
SMC-510: INORGANIC CHEMISTRY- I

External Marks - 80, Internal Assessment - 20
Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Stereochemistry and Bonding in Main Group Compounds :

VSEPR, Walsh diagram (triatomic and penta-atomic molecules), dπ-pπ bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

Unit-II- Metal-Ligand Equilibrium in Solution

Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by potentiometry and spectrophotometry.

Unit-III- Reaction Mechanism of Transition Metal Complexes

Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anion reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

Unit-IV- Metal-Ligand bonding

Limitation of crystal field theory, molecular orbital theory for bonding in octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory.

Unit-V- HSAB Theory

Classification of acids and bases as hard and soft; HSAB principle, theoretical basis of hardness and softness; Lewis-acid base reactivity approximation; donor and acceptor numbers, E and C equation; applications of HSAB concept.

M.Sc. (Chemistry)
SEMESTER –II
SMC-511: ORGANIC CHEMISTRY- I

External Marks - 80, Internal Assessment - 20
Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Nature of Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, resonance hyperconjugation, bonding in fullerences, tautomerism. Aromaticity in benzenoid and non-benzoid compounds, alternate and non-alternate hydrocarbons. Huckel's rule, energy. Level of π-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent-addition compounds, crown ether complexs and cryptands, inclusion compounds, catenanes and rotaxanes.

Unit-II- Stereochemistry

Strain due to unavoidable crowding Elements of symmetry, chirality, molecules with more than one chiral center, threo and ertythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and

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e chirallity due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.
III- Conformational analysis and linear free energy relationship formational analysis of cycloalkanes, decalines, effect of conformation on reactivity, conformation of sugars. eration, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. The Hammett uation and linear free energy relationship, substituents and reaction constants, Taft equation.
nit-IV- Reaction Mechanism : Structure and Reactivity Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtir-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotopes effects.
Unit-V- Aliphatic Nucleophilic Substitution The SN^2, SN^1 mixed SN^1 and SN^2 and SET mechanism. The neighboring group mechanism, neighboring group participation by p and s bonds, anchimeric assistance. Classical and nonclassical carbocations, phenomium ions, norborynl systems, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations. The SN^1 mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

M.Sc. (Chemistry)
SEMESTER –II
SMC-606: SOLID STATE CHEMISTRY

External Marks - 80, Internal Assessment - 20, Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Solid State Reactions General principles, experimental procedure, co-precipitation as a precursor to solid state reactions, kinetics of solid state reactions.
Unit-II- Crystal Defects and Non-Stoichiometry Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schottky detects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centres, non-stoichiometry defects.
Unit-III- Electronic Properties and Band Theory Metals insulators and semiconductors, electronic structure of solid band theory band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Optical properties-Application of optical and electron microscopy. Magnetic Properties- Classification of materials : Effect of temperature calculation of magnetic moment, mechanism of ferro and anti ferromagnetic ordering super exchange.
Unit-IV- Organic Solids Electrically conducting solids. organic charge transfer complex, organic metals, new superconductors.
Unit-V- Liquid Crystals: Types of liquid crystals: Nematic, Smectic, Ferroelectric, Antiferroelectric, Various theories of LC, Liquid crystal display, New materials.

M.Sc. (Chemistry)
SEMESTER –II
SMC-513: PRACTICAL-II
(Duration: 6-8 hrs in each branch)
Practical examination shall be conducted separately for each branch

1. Inorganic Chemistry **1. Separation and estimation of two metal ions:** (i) Estimation of copper and nickel both by gravimetric method. (ii) Estimation of barium gravetrically and copper volumetrically methods. **2. Preparation and synthesis of metal complexes** (i) $VO(acac)_2$ (iii) $K_3[Fe(C_2O_4)_3]$ (ii) $Ni(acac)_2$ (iv) Prussian Blue, Turnbull's Blue **3. Paper chromatography:** Separation of cations by Paper Chromatography of following cations: (i) Ag(I), Pb(II) and Hg_2(II) (ii) Hg(II), Cu(II) and Pb(II)
2. Physical Chemistry **1. Chemical Kinetics** (i) Determination of velocity constant of the hydrolysis of methyl acetate catalysed by an acid (say HCl, H_2SO_4, etc.). (ii) Determination of velocity constant of saponification of ethyl acetate with sodium hydroxide. **2. Determination of composition of a mixture of weak and strong acids by conductor metric titration of following acids:** (i) HCl and CH_3COOH (ii) HNO_3 and CH_3COOH

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termination of composition of a mixture of weak and strong acids by pH metric titration of followings acids: Cl and CH_3COOH (ii) HNO_3 and CH_3COOH
3. Organic Chemistry **Qualitative Analysis** eparation, purification and identification of compounds of ternary mixture (one liquid and one solid) using TLC and columns chromatography, chemical tests. **2. Organic Synthesis** Acetylation : Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography. Oxidation : Adipic acid by chromic acid oxidation of cyclothexaneol. **3. Quantitative Analysis** Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method. Estimation of amines/phenols using bromate bromide solution/or acetylation method. Determination of iodine and Saponification values of an oil sample.

M.Sc. (Chemistry)
SEMESTER –II
SMC-514:

Industrial Training/Field Work & Seminar

Total Marks-100 or Total Credits- 03+02, Time 3-4 Days

3-4 Weeks Industrial Training/Field Work in some Industry/ research institute/ Pollution Control Board/ research and consulting organizations is compulsory. Each student is required to submit his/her Internship/ Apprenticeship report to the Course-Incharge.

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M. Sc. (Chemistry)
SEMESTER –III
SMC-601: PHYSICAL CHEMISTRY- II

External Marks - 80, Internal Assessment - 20
Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Chemical Dynamics
Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dyamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogenbromine and hydrogen-chlorine reactions) and homogenous catalysis, kinetics of enzyme reactions, general features fo fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis ad the nuclear magnetic resonance method, dynamics of unimolecular reactiosn (Lindemann Hinshelwood and Rice- Ramsperger-Kassel- Marcus (RRKM) theories for unimolecular reactions).

Unit-II- Surface Chemistry
Adsorption- Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), Surface films on liquids (Electro-kinetic phenomenon).
Micelles- Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solublization, micro emulsion, reverse micelles.

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

Unit-IV- Non Equilibrium Theromodynamics
Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations, electrokinetic phenomena, diffusion, electric conduction.

Unit-V- Electrochemistry
Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Overpotentials, exchange current density, derivation of Butler Volmer equation, Tafel plot. Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface. Polarography theory, Ilkovic equation; half wave potential and its significance.

M. Sc. (Chemistry)
SEMESTER –III
SMC-602: INORGANIC CHEMISTRY- II

External Marks - 80, Internal Assessment - 20
Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Electronic Spectral Studies of Transition Metal Complexes :
Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), Selection rule for electronic spectroscopy. Intensity of various type electronic transitions, Calculations of 10Dq, B and β parameters, charge transfer spectra.

Unit-II- Magnetic Properties of Transition Metal Complexes
Anomalous magnetic moments, Quenching of Orbital contribution. Orbital contribution to magnetic moment, magnetic exchange coupling and spin crossover.

Unit-III- Metal π-Complexes
Metal carbonyl, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reaction of transition metal nitrosyl, dinitrogen and dioxgen complexes; tertiary phosphine as ligand.

Unit-IV- Metal Clusters

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r boranes, carboranes, metalloboranes and metallo-carboranes compounds with metal metal multiple bonds.

V- Optical Rotatory Dispersion and Circular Dichroism

arly and circularly polarized lights; optical rotatory power and circular birefringence, elipticity and circular dichroism; D and Cotton effect, Faraday and Kerr effects; Assignment of electronic transitions; applications of ORD and CD for the termination of (i) absolute configuration of complexes and (ii) isomerism due to nonplanarity of chelate rings.

M. Sc. (Chemistry)

SEMESTER –III

SMC-603: ORGANIC CHEMISTRY- II

External Marks - 80, Internal Assessment - 20

Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reactiion, Gatterman-Koch reaction

Aromatic Nucleophilci Substitution

The SNAr SN1, benzyne and SN1 mechanism, Reactivity effect of substrate structure, leaving group and attacking nucleophile. The Von Richte. Sommelet-Hauser, and Smiles rearrangements.

Unit-II- Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboyxlic acids, autooxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

Unit III- Addition Reactions

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bounds, hydrogenation of aromatic rings. Hydroboration, Michael reaction, sharpless asymmetric epoxidation.

Unit-IV- Addition to Carbon-Hetero Multiple bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Witting reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

Elimination Reactions

The E^2, E^1 and E^1 cB mechanisms and their spectrum. Orientation of the double bond. Reactivity-effects of substrate structures, attacking base, the leavign group and the medium. Mechanism and orientation in pyrolytic elimination

Unit-V- Pericyelic Reactions

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

Ene reaction.

M. Sc. (Chemistry)

SEMESTER –III

SMC-604: PHOTOCHEMISTRY

External Marks - 80, Internal Assessment - 20

Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Photochemical Reactions

Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

Unit -II- Determination of Reaction Mechanism

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

Unit -III- Photochemistry of Alkene

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

Photochemistry of Aromatic Compounds

Isomerisations, additions and substitutions.

Unit -IV- Photochemistry of Carbonyl Compounds

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molecular reactions of carbonyl compounds-saturated, cyclic and acyclic, α, β, γ unsaturated and α, β, unsaturated compounds, cyclohexadienones, Intermolecular cyloaddition reactions-dimerisations and oxetane formation.

Unit-V- Miscellaneous Photochemical Reactions.

Photo-Fries reactions of annelids, Photo-Fries rearrangement, Barton reaction, Singlet molecular oxygen and its reactions, Photochemical formation of smog, Photodegration of polymers, Photochemistry of vision.

M. Sc. (Chemistry)
SEMESTER –III
SMC-605: Polymer Chemistry

External Marks - 80, Internal Assessment - 20
Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Basics

Importance of polymers. Basic concepts : Monomers, repeat units, degree ofpolymerization Linear, branched and network polymers. Classification of polymers.Polymerization: condensation, addition/radical chain-ionic and co-ordination andcopolymerization. Polymerization conditions and polymer reactions. Polymerization inhomogeneous and heterogeneous systems.

Unit-II- Polymer Characterization

Polydispersion-average molecular weight concept. Number, weight and viscosityaverage 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.

Unit-III- Analysis and testing of polymers

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

Unit-IV- Inorganic Polymers

A general survey and scope of Inorganic Polymers special characteristics, classification,homo and hetero atomic polymers. Structure, Properties and Applications of a. Polymers based on boron-borazines, boranes and carboranes. b. Polymers based on Silicon, silicone's polymetalloxanes and polymetallosiloxanes, silazanes.

Unit V- Structure, Properties and Application of

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

M. Sc. (Chemistry)
SEMESTER –III
SMC-606: PRACTICAL-III

(Duration: 6-8 hrs in each branch)

Practical examination shall be conducted separately for each branch

1. Inorganic Chemistry

1. Separation and estimation of two metal ions:
(i) Estimation of copper and zinc in a mixed solution of both by gravimetric methods.
(ii) Estimation of nickel and zinc in a mixed solution of both by gravimetric methods.

2. Preparation and synthesis of metal complexes
(i) $Hg[Co(SCN)_4]$ (iii) $[Ni(NH_3)_6]Cl_2$
(ii) $[Cu(NH_3)_4]SO_4H_2O$ (iv) $Ni(dmg)_2$

3. Paper chromatography: Separation of cations by Paper Chromatography of following cations
(i) Ni(II), Co(II) and Zn(II)
(ii) Ni(II), Co(II) and Cu(II)

2. Physical Chemistry

1. Chemical Kinetics
Determination of velocity of the reaction between potassium persulphate and potassium iodide.

2. Determination of composition of a mixture of weak and strong acids by conductor metric titration of following acids:
H_2SO_4 and CH_3COOH

3. Determination of composition of a mixture of weak and strong acids by pH metric titration of followings acids:
H_2SO_4 and CH_3COOH

3. Organic Chemistry

1. Qualitative Analysis
Separation, purification and identification of compounds of ternary mixture (one liquid and one solid) using TLC and columns chromatography, chemical tests.

2. Organic Synthesis

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ard reaction : Synthesis of triphenylmethanol from benzoic acid Aromatic electrophilic sustitutions : Synthesis of p-aniline and pbromoaniline. Aldol condensation Dibenzal acetone from benzaldehyde. Synthesis of different Schiff bases g salicylaldehyde and amines, Synthessis of different dithiocarbamates. The Products may be characterized by Spectral chniques

Quantitative Analysis

Determination of DO, COD and BOD of water sample

M. Sc. (Chemistry)
SEMESTER –III
SMC-607:

M. Sc. (Chemistry)
SEMESTER –IV
SMC-608: Chemistry of Natural Products

External Marks - 80, Internal Assessment - 20, Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Terpenoids and Carotenoids

Calcifications, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol α-Terpeneol, Menthol, Farnesol, Zingiberence, Santonin, Phytol, Abietic acid and β-Carotene.

Unit-II- Alkaloids

Definition, nomenclature and physiological action, occurrence, isolation, generalmethods of structure elucidation, degradation, classification based on nitrogenheterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+)- Coniine, Nicotine, Atropine, Quinine and Morphine.

Unit-III- Steroids

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereo chemistry, Isolation, Structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone, Biosynthesis of Steroids.

Unit-IV- Plant Pigments

Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin Quercetin, Myrcetin, Quercetin 3-glucoside, Vitexin, Diadzein, Aureusin, Cyanidin-7arabinoside, Cyanidin, Hirsutidin, Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

Prophyrins

Structure and synthesis of Haemoglobin and Chlorophyll.

Unit V- Prostaglandis

Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF_2a.

Pyrethroids and Rotenones

Synthesis and reactions of Pyrethroids and Rotenones. (For structure elucidation, emphasis is to be placed on the use of spectral parameters wherever possible).

M. Sc. (Chemistry)
SEMESTER –IV
SMC-609: Heterocyclic Chemistry

External Marks - 80, Internal Assessment - 20

Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Unit-I- Nomenclature of Heterocycles

Replacement and systematic nomenclature (HantzsMCH-Widman system) formonocyclic 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. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

Unit-II- Non-aromatic Heterocycles

Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformatino of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversino and 1,3-diaxial interaction. Stereo-electronic effects anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic lectrophilic interactions. Heterocyclic Synthesis Princples of heterocyclic synthesis involing cyclization reactions and cycloaddition reactions.

Unit-III- Small Ring Heterocycles

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

Benzo-Fused Five-Membered Heterocycles.

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sis and reactions including medicinal applications of benzopyrroles, bezofurans and benzothiophenes.

V- Meso-ionic Heterocycles

ral classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications.

Membered Heterocycles with one Heteroatom

thesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and ridones. Synthesis and reactions of quionlizinium and benzopyrylium salts, coumarins and chromones.

Unit-V

Six Membered Heterocycles with Two or More Heteroatoms Synthesis and reactions of diazones, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines.

Heterocyclic Systems Containing P, As, Sb and B

Heterocyclic rings containing phosphorus : Introduction, nomenclature, synthesis and characteristics of 5- and 6-membered ring systemsphosphorinaes, phosphorines, phospholanes and phospholes. Heterocyclic rings containing As and Sb: Introduction, synthesis and characteristics of 5- and 6-membered ring system. Heterocyclic rings containing B : Introduction, synthesis reactivity and spectral characteristics of 3- 5- and 6- membered ring system.

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SMC-605: PRACTICAL

(Duration: 6-8 hrs in each branch)

Practical examination shall be conducted separately for each branch

1. Inorganic Chemistry

1. Quantitative determinations of a three component mixture :

One Volumetrically and two gravimetrically

(i) Cu^{2+}, Ni^{2+}, Zn^{2+}

(ii) Cu^{2+}, Ni^{2+}, Ag^{2+}

(iii) Cu^{2+}, Ni^{2+}, Ba^{2+}

2. Synthesis and characterization of following metal complexes:

(i) Sodium tetrathionate $Na_2S_4O_6$.

(ii) Metal complex of dimethyl sulfoxide : $CuCl_2.2DMSO$

(iii) Synthesis of metal acethylacetonate

(iv) Synthesis of copper and nickel Schiff base complexes.

(v) Synthesis of copper and nickel dithiocarbamates

3. Chromatographic Separations

(i) Cadmium and zinc

(ii) Zinc and magnesium.

(iii) Thin-layer / Paper chromatography-separation of nickel, manganese, cobalt and zinc. Determination of Rf values.

2. Physical Chemistry

1. Chemical Kinetics (determination of strength of two acids)

(i) Determination of relative strengths of HCl and H_2SO_4 (k_1 / k_2) for the hydrolysis of methyl acetate.

(ii) Determination of relative strengths of HNO_3 and H_2SO_4 (k_1 / k_2) for the hydrolysis of methyl acetate.

2. Spectroscopy

(i) Determination of pKa of an indicator (e.g. methyl red) in (a) aqueous and (b) micellar media.

(ii) Determination of stoichiometry and stability constant of Ferric isothicoyanate ion complex ion in solution.

3. Adsorption

To study the adsorption of oxalic acid on activated charcoal and test the validity of Freundilich's adsorption isotherm.

3. Organic Chemistry

1. Multi-step Synthesis of Organic Compounds

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

(i)Prepreparation in steps: Benzophenone→ BenzpinacolB→enzpinacolone

(ii)Beckmann rearrangement : Benzanilide from benzene, Benzene B→enzophenone →Benzphenone oxime→ Benzanilide,

(iii)Benzilic acid rearrangement : Benzilic acid from benzoin, Benzoin→Benzil→Benzilic acid (iv)Synthesis of heterocyclic compounds Skraup synthesis : Preparation of quinoline from aniline.

2. Isolation

1. Isolation of caffeine from tea leaves.
2. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins).
3. Isolation of lactose from milk (purity of sugar should be checked by LC and PC and Rf values reported).
4. Isolation of piperine from black pepper.
5. Isolation of lycopene from tomatoes.
6. Isolation of b-carotene from carrots.
7. Isolation of eugenol from clove.

3. Paper Chromatography

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

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M. Sc. (Chemistry)

SEMESTER –IV

SMC-608- (OPTIONAL PAPER)

External Marks - 80, Internal Assessment - 20, Total Marks - 100 or Total Credits- 3, Time -3 hrs.

Optional Paper–1

SMC-608: Organic Synthesis

Unit-I- Disconnection Approach
An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemo selectivity, reversal of polarity, cyclisation reaction, amine synthesis, Protection of groups, chemo region and stereo selectivity.

Unit-II- One Group C-C Disconnections
Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic Nitro compounds in organic synthesis.
Two Group C-C Disconnections
Diels-Alder Reaction, 1,3-difunctionalised compounds, a-b- unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation.

Unit-III- Oxidation
Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated) Alcohols, diols, aldehyde's, ketones,ketals and carboxylic acids, amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium. (III) Nitrate.
Reduction
Introduction,Different reductive processes. Alkanes, alkenes, alkynes, and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides. Nitro, nitroso, azo and oxime groups. Expoxide, Nitro, Nitroso, azo and oxime groups. Hydrogenolysis.

Unit IV- Organometallic Reagents
Principle, preparations, properties and applications of the following in organic synthesis with mechanistic details. Group I and II metal organic compounds Li, Mg, Hg, Cd, Zn and Ce Compounds.

Unit V- Synthesis of some complex molecules:
Application of the above in the synthesis of following compounds: Canphor, longifoline, cartisone, reserpine, vitamin D, juvabion, aphidicolin and fredericamycin.

Optional Paper–2

SMC-608: Organotransition Metal Chemistry

Unit -I- Alkyls and Aryls of Transition Metals
Types, routes of synthesis, stability and decomposition pathways organocopper in organic synthesis.
Compounds of Transition Metal-Carbon Multiple Bonds
Alkylidenes, alkylidynes, low valent carbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis.

Unit -II- Transition Metal π-Complexes
Transition metal π-Complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparation, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.

Unit -III- Transition organometalic compounds:
Transition metal compounds with bonds to hydrogen, boron, silicon.

Unit -IV- Homogeneous Catalysis
Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such ashydrocarbonylation of olefins (oxoreaction), explanation reactions, activation of C-H bond.

Unit -V- Fluxional Organometallic Compounds
Flexionality and dynamic equilibrium in compounds such as $\eta 2$ olefine, $\eta 3$-allyl and dienyl complexes.

Optional Paper–3

SMC-608: Analytical Chemistry

Unit-I- Introduction
Role of analytical chemistry Classification of analytical methods classical and instrumental. Types of instrumental analysis. Selecting an analytical method. Neatness and cleanliness. laboratory operations and practices. Analytical balance. Techniques of weighing, errors. Volumetric glassware cleaning and calibration of glassware. Sample Volumetric glassware cleaning and Calibration of glassware. Sample preparationdissolution and decompositions. Gravimetric techniques. Selecting and handling

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...s. Laboratory notebooks. Safety in the analytical laboratory.

...and Evaluation

...ion of terms in mean and median. Precision-standard deviation, relative standard deviation. Accuracy-absolute error, ...e error. Types of error in experimental data determinate (systematic), indeterminate (or random) and gross. Sources of ... and the effects upon the analytical results. Methods for reporting analytical data. Statistical evaluation of data-...determinate errors. The uses of statistics.

...nit-II- Food analysis

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

Unit-III- Analysis of Water Pollution

Origin of Waste water, types, water pollutants and their effects. Sources of water pollution-domestic, industrial, agricultural soil and radioactive wastes as sources of pollution. Objectives of analysis-parameter for analysis-colour, turbidity, total solids, conductivity, acidity, alakalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different forms of nitrogen, Heavy metal pollution-public health significance of cadmium, chromium, copper, lead, zinc, managanese, mercurry and arsenic. General survey of instrumental technique for the analysis of heavy metals in aqueous systems. Measurements of DO, BOD, and COD. Pesticides as water pollutants and analysis. Water pollution laws and standards.

Unit-IV- Analysis of soil, Fuel, Body Fluids and Drugs

(a) Analysis of Soil, moisture pH total nitrogen, phosphorus, silica, lime, magnesia, manganese, sulphur and alkali salts.

(b) Fuel analysis : liquid and gas. Ultimate and proximate analysis-heating values grading of coal. Liquid fuels-flash point, aniline point, octane number and carbon residue. Gaseous fuels-produced gas and water gas-calorific value.

Unit-V- (a) **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 phosphates.Immunoassay: principles of radio immunoassay (RIA) and applications. The blood gas analysis trace elements n the body.

(b) **Drug analysis**: Narcotics and dangerous drug. Classification of drugs. Screening by gas and thin-layer chromatography and spectrophotometeric measurements.

Optional Paper–4

SMC-608: Electrochemistry

Unit-I Conversion and Storage of Electrochemical Energy Present status of energy Consumption: Pollution problem. History of fuel cells, Direct energy conversion by electrochemical means. Maximum intrinsic efficiency of an electrochemical converter. Physical interpretation of the Carnot efficiency factor in electrochemical energy converters. Power outputs.

Electrochemical Generators (Fuel Cells): Hydrogen oxygen cells, Hydrogen Air cell, Hydrocarbon air cell, Alkane fuel cell, Phosphoric and fuel cell, direct NaOH fuel cells, applications of fuel cells.

Electrochemical Energy Storage:

Properties of Electrochemical energy storage : Measure of battery performance, Charging and discharging of a battery, Storage Density, Energy Density. Classical Batteries: (i) Lead Acid (ii)Nickel-Cadmium, (iii) Zinc manganese dioxide. Modern Batteries: (i) Zinc-Air (ii) Nickel-Metal Hydride, (iii) Lithium Battery, Future Electricity storers: Storage in (i) Hydrogen, (ii) Alkali Metals, (iii) Non aqueous solutions.

Unit-II- Corrosion and Stability of Metals:

Civilization and Surface mechanism of the corrosion of the metals; Thermodynamics and the stability of metals, Potential -pH (or Pourbaix) Diaphragmsl; uses and abuses, Corrosion current and corrosion potential -Evans diagrams. Measurement of corrosion rate: (i) Weight Loss method, (ii) Electrochemical Method.

Inhibiting Corrosion :

Cathodic and Anodic Protection. (i) Inhibition by addition of substrates to the electrolyte environment, (ii) by charging the corroding method from external source, anodic Protection, Organic inhibitors, The fuller Story Green inhibitors.

Passivation : Structure of Passivation films, Mechanism of Passivation, Spontaneous Passivation Nature's method for stabilizing surfaces.

Unit-III- Bioelectrochemistry:

bioelectrodics, Membrane Potentials, Simplistic theory, Modern theory, Electrical conductance in biological organism: Electronic, Protonic electrochemical mechanism of nervous systems, enzymes as electrodes.

Kinetic of Electrode Process :

Essentials of Electrode reaction. Current Density, Overpotential, Tafel Equation, Butler Volmer equation. Standard rate constant (K) and Transfer coefficient (a), Exchange Current.

Irreversible Electrode processes: Criteria of irreversibility, informatino from irreversible wave.

Unit-IV- Methods of determining kinetic parameters for quasi-rversible and irreversible waves: Koutecky's methods, Meits Israel Method, Gellings method.

Electrocatalysis: Chemical catalysts and Electrochemical catalysts with special reference to purostates,porphyrin oxides of rare earths. Electrocatalysis in simple redox reactions, in reaction involving adsorbed species. Influence of various parameters.

Unit-V- Potential Sweep Method:

Linear sweep Voltammetry, Cyclic Voltammetry, theory and applications. Diagnostic criteria of cycli voltammetry. Controlled current microelectrode techniques : comparison with controlled potentials methods, chronopotentiometry, theory ad

cations.

k Electrolysis Methods:

atrolled potential coulometry, Controlled Coulometry, Electroorganic synthesis and its important applications. Stripping alysis : anodic and Cathodic modes, Pre electrolysis and Stripping steps, applications of Stripping Analysis.

Optional Paper–5

SMC-608: Medicinal Chemistry

Unit-I- Structure and activity:
Relationship between chemical structure and biological activity (SAR). Receptor Site Theory. Approaches to drug design. Introduction to combinatorial synthesis in drug discovery. Factors affecting bioactivity. QSAR-Free-Wilson analysis, Hansch analysis, relationship between Free-Wilson analysis and Hansch analysis.

Unit-II- Pharmacodynamics:
Introduction, elementary treatment of enzymes stimulation, enzyme inhibition, sulfonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry.

Unit-III- Antibiotics and antibacterials:
Introduction, Antibiotic β-Lactam type - Penicillins, Cephalosporins, Antitubercular. Streptomycin, Broad spectrum antibiotics, Tetracyclines, Anticancer – Dactinomycin (Actinomycin D).

Unit-IV- Antifungal: Polyenes, Antibacterial - Ciprofloxacin, Norfloxacin, Antiviral . Acyclovir
Antimalarials: Chemotherapy of malaria. SAR. Chloroquine, Chloroguanide and Mefloquine.

Unit-V- Non-steroidal Anti-inflammatory Drugs: Diclofenac Sodium, Ibuprofen and Netopam
Antihistaminic and antiasthmatic agents: Terfenadine, Cinnarizine, Salbutamol and Beclomethasone dipropionate.

SMC-609: Paper - IV - Project Work & Viva-voice

M.M. - 100 or Total Credits - 14

Students can carry out their Project Work in Departmental laboratory/ Industry/ Research Institute/ Pollution Control Board/ Research and Consulting Organizations and each student should be required to submit a report of his/her Project Work to the Course-Incharge.

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