Third Year Fifth Semester

Paper 502101 **Physical Chemistry 3 Credits, 75 Marks (45 hrs.)**
3 Hrs./ Week

Elementary quantum mechanics **12 Hrs.**

Black Body Radiations, Plank's radiation law, Photoelectric effect, Bohr's models of hydrogen atom (no derivation) and its defects. De-Broglie hypothesis, the Heisenberg's uncertainty principle, Hamiltonians operator, Schrodinger wave equation and its importance, Physical interpretation of the wave function, Postulates of quantum mechanics. Schrodinger wave equation for H- atom, separation into three equations (without derivation), quantum numbers and their importance.

Spectroscopy **15 Hrs.**

Introduction-Electromaganetic radiation, Regions of spectrum, basic feature of different spectrometer, statement of the born- Opperheimer, Approximations. Vibrational spectrum, rotational spectrum-Diatomic molecules, energy levels of rigid rotor, (Semi-classical principles), selection rule, rotational spectra of rigid diatomic molecule, determination of bond length, numerical problems.

08 Hrs.

Photochemistry

Introduction of radiation with matter, difference between thermal and photochemical process. Law of photochemistry, Grothus-Drapper law, Stark-Einstin Law, Joblonsiki diagram. qualitative description of fluroscence, phosphorescence, non- radioactive process, (Internal Conversion , Intersystem Crossing) ,quantum yield, photosynthesized reaction.

Physical properties and molecular structure **10 Hrs.**

Optical activity and its measurements, dipole movement and its measurements by temperature change method, magnetic property and its measurements Guoy balance method. applications of optical activity, dipole movement and magnetic property for determination of structure of molecule.

A Third Year Fifth Semester

Paper -502102 Organic Chemistry 3 Credits, 75 Marks (45 hrs.)
3 Hrs./ Week

Synthetic dyes and drugs 16 Hrs.

Definition, color and constitution (Electronic concept) of dye, classification based on chemical constitution, synthesis of methyl orange, Congo red, malachite green, Crystal violet, Alizarin and indigo dye. Synthetic drugs, definition, Introduction, Classification of drugs. Properties of ideal drugs. Synthesis of Chloromycetin, Paracetamol, Sulphaguainiidine, Phenacetien.

Oraganometalic Compounds 08 Hrs.

Organomaganesium compound: The Grignard reagent formation, Structure and chemical reaction. Oraganozinc compound, Formation and chemical reactions, Organolithium Compound, Formation and chemical reaction.

Oraganic synthesis via enolates 13 Hrs.

Defianation, Active Methylene compounds, Preparation of acetoacetic ester (Claisen Condensation with mechanism), Acidity of Alpha Hydrogen, Properties and reactions,Involving formation of mono,Di and unsaturated carboxylic acids, synthesis of ketone, Diketone, 4 Methyluracil from acetoacetic ester, Keto-enol tautomerism. Preparations of diethyl malonate, properties and reactions involve in alkylation, formation of mono, Di, and unsaturated carboxylic acids, synthesis of glycine and Barbituric acid from diethyl malaonate.

Fats, Oils and Detergents 08 Hrs.

Natural fats, Edible and industrial oils of vegetables origin, manufacture of Soyabean oil by solvent extraction method and isolation and uses of essential oils. Types of animal fats and oils, and definition of saponification value, iodine value and Acid value. Detergent: Defination, Introduction and preparations of sodium alkyl sulphonate, alkyl benzene sulphonate and amide sulphonate (one example each), Cleansing action of detergent.

Third Year Fifth Semester

Paper 502103 Inorganic Chemistry 3 Credits, 75 Marks (45 hrs.)
3 Hrs./ Week

Solid state chemistry **10 Hrs**.

Classification of solids on the basis of bonding.

Explanation of terms: Crystal lattices, lattice points, unit cell, lattice constant, closest packing of rigid spheres (hcp , ccp) Packing density in simple cubic, bcc, fcc & hcp lattice (Numerical problems expected) Tetrahedral & Octahedral voids , radius ratio , limiting radius ratio & their significance. Calculations of Limiting Radius Ratio for Coordination Number 3 and 4. Structure of NaCl, CsCl, $ZnSo_{4,.}$

Superconductivity **05 Hrs.**

Introduction, Critical Temperature, Meissner effect, Different type of superconducting materials : conventional , Organic , alkali metal , Fullerides & High temperature superconductors, applications.

Chemistry of Lanthanides **10 Hrs.**

Chemistry of lanthanides with reference to (I) Oxidation state (II) Magnetic properties (III)color and absorption spectra, (IV) complex formation (V) lanthanide contraction Occurrence, extraction & separation of Lanthanides by (I) Ion exchange (II) solvent extraction method . Applications of lanthanides.

Chemistry of Actinides **05 Hrs.**

Chemistry of Uranium and Plutonium, with reference to occurrence, extraction (solvent extraction method) properties and application. Comparative chemistry of Lanthanide and Actinides.

Organometallic Chemistry **10 Hrs.**

Introduction ,definition, classification on the basis of Hapticity and nature of metal carbon bond. Preparation, properties and applications of alkyl and aryls of Li, Al, Hg, Sn. Classification, preparation, properties and bonding in Metal carbonyls. Eighteen electron rule application and exceptions.

Chemistry of Non aqueous Solvent **05 Hrs.**

Classification of solvents and importance of Non aqueous solvents. Reaction in Non-aqueous solvents with reference to liquid ammonia and liquid SO_2 as solvents.

Third Year Fifth Semester

Paper 502104 Analytical Chemistry 3 Credits, 75 Marks (45 hrs.)
3 Hrs./ Week

Introduction to Analytical Chemistry: 07 Hrs.

Analytical chemistry qualitative and quantitative analysis, classification of analytical methods, emphasis on detection limits and sensitivity.

Steps involved in chemical analysis: Sampling, obtaining a sample, processing the sample, detection of a method of analysis, calibration and actual analysis, data collection, data processing, presentation of result and interpretation.

Performance characteristics of an analytical method: accuracy, precision, detection limit, dynamic range, sensitivity, selectivity.

Quantitative analysis with calibration curve and standard addition method.

Applications of analytical methods in various fields such as organic, pharmaceuticals, electronic and environmental analysis.

UV -visible Spectroscopy: 08 Hrs.

UV -visible Spectroscopy, Absorption spectroscopy, terms involved: radiant power absorption, transmittance, percentage transmittance, wavelength of maximum absorption. Statement of the Beer's law and Lambert's law (Derivation expected) combined expression/ molar extinction coefficient, deviation from beer-Lambert's law, limitations.

Components of an optical instrument, photometers and spectrophotometer and construction of a single beam photometer.

Titrimetric method: 15 Hrs.

Introduction to titrimetric methods of analysis

Terms: Titration, titrand, titrant, titre value, indicator, endpoint, equivalence point,

Classification of titrimetric analysis.

Acid base titration:

Construction of titration curves and choice of indicators in the titration of [1] Strong acid &strong base,[2] Strong acid and weak base,[3] weak acid and strong base,[4]weak acid and weak base.

Precipitation titration: Argentimetric titration, construction of titration curve, Volhard's method. Mohr's method, Adsorption indicator.

Complexmetric titration; General introduction, EDTA Titration, Advantages and limitations of EDTA as a titrant, Complexes metallochromic indicators.

Redox titration: General introduction, theory of redox indicators, criterion for choosing an indicator for redox titration, construction of the titration curves in the case of (1) Fe (II) Vs Ce (IV), (2) Fe (II) Vs dichromate, use of diphenyl amine and ferroin as redox indiactors.

Non-aqueous titrations: need for non- aqueous titrations, types of solvents, solvents used

Use of instrumental methods in titrimetric analysis:

Conductometric titrations: basic principles, Experimental setup, Titration curves, in the titration [1] strong acid Vs strong base, [2] weak acid Vs strong base, [3] weak acid vs weak base,[4] Mixture of strong and weak acid/ strong and weak base Vs strong base/ weak base or Strong acid/weak acid. [5] Sodium chloride Vs silver nitrate [6] Barium hydroxide Vs Magnesium sulphate. Advantages and limitations.

Potentiometric Titrations: Basic principles, concept of indicator electrode. Indicator electrodes for different types of titrations. determination of end point from the graphs of E Vs V. $\Delta E/\Delta V$ Vs mean volume, $\Delta^2 E/,\Delta^2 V$ Vs mean volume, advantages and limitations.

Methods of Separation **15 Hrs.**

Solvent Extraction: partition coefficient and distribution ratio, extraction efficiency, separation factor, role of complexing agents in solvent extraction, chelation, Ion –pair formation, salvation, types of solvent extraction: Batch, continuous

Chromatography: Introduction to Chromatographic techniques, Classifications of Chromatographic techniques,

Planar chromatography: Principle, techniques and applications of [1] Paper chromatography [2] Thin layer chromatography and

Electro chromatography: Electrophoresis, Slab Electrophoresis

Size Exclusion chromatography: principle and applications

Third Year Six Semester

Paper 602101 Physical Chemistry 3 Credits, 75 Marks (45 hrs.)
3 Hrs/ Week

Colligative Properties of Dilute Solutions 13 Hrs.

Dilute solutions, Colligative properties, Raoult's law, Relative lowering of vapour pressure. Elevation in Boiling point of a solution, Thermodynamic derivations relating elevation in the Boiling point of solutions and the molar mass of a non volatile solute. Depression in freezing point of solution and the molar mass of a non-volatile solute. Osmotic pressure, Van't Hoff's equation for osmotic pressure (derivation is expected) And determination of molar mass of the solute abnormal molar masses of solute and Van't Hoff factor (calculation of degree of association and degree of dissociation)

Nuclear Chemistry 10 Hrs.

Type of nuclear radiation and their characteristics, Behavior of ion-pairs electric field, Detection and measurement of nuclear radiation using G. M. counter and scintillation counter. Kinetics of radioactive decay, Units of radioactivity (Curie, Becquree, Rutherford). Radioactive equilibrium (Secular & Transient) Determination of radioactive consent for radio-elements having 1) Moderate half life, 2) Long life, 3) Extremely long or short half life. Use of radioisotopes as tracers in, 1) Chemical investigation reaction mechanism, 2) Age determination dating by tritium content and by carbon-14

Nuclear reaction- Nuclear transmutation, Artificial radioactivity (Suitable example using different projectile are expected) Q-value of nuclear reactions, Threshold energy. Fissile and Fertile material, Nuclear fission, Chain, Reactions, Factor controlling fission process (Multiplication factor and critical size or mass fissionable material) Nuclear reactor Breeder reactor. Nuclear fusion, characteristics of nuclear fusion, Thermonuclear occurring in stellar bodies.

Renewable Energy Sources 07 Hrs.

Batteries- Secondary cells lithium ion cell.

Fuel cell- Choice of fuel and oxidant, Thermodynamic and Kinetic aspects of electrochemical energy transformation, Efficiency of fuel, Cells Bacon H_2 and O_2 fuel cell.

Solar cells, Solar energy, Photovoltaic effect, Semiconductor, As solar energy converter, Silicon solar cell.

Biomass energy: Biomass and its sources, Conversion on biomass into energy by alcohol fermentation and anaerobic digestion method.

Hydrogen: Fuel of the future, Production of hydrogen by direct electrolysis of water and biomass gasification, Advantage of hydrogen medium.

Surface Chemistry 15 Hrs.

Adsorption, Physical and Chemical adsorption, Types of adsorption isotherms, Langumir's adsorption isotherm, (Postulates & derivation expected) B.E.T equation for multilayer (Adsorption equation expected) Determination surface area and adsorbent using B.E.T equation.

Third Year Six Semester

Paper 602102 Organic Chemistry 3 Credits, 75 Marks (45 hrs.)
3 Hrs. / Week

Heterocyclic compound: 13 Hrs.

Introduction: Molecular orbital picture and aromatic characteristic of pyrole, furan, thiophene and pyridine , Methods of synthesis and chemical reaction with particular emphasis on the mechanism of electrophilic substation. Mechanism of nucleophilic substation reaction in pyridine. Comparison of basicity of pyridine, piperidine and pyrrole. Condensed Heterocycles: Introduction preparation of Quinoline (Skraups synthesis), Isoquiniline (Bischler – napirlaski) and indole (Fischer indole Synthesis).

Carbohydrates: 10 Hrs.

Definition, Introduction and Classification of monosaccharide's, Inter Conversion of glucose to Fructose, chain lengthening, chain shortening of aldoses. Conversion of Glucose into mannose. Determination of ring size of monosaccharides, Mechanism of mutarotaion and introduction of Saccharides (Maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without giving determination.

Synthetic polymer: 07 Hrs.

Introduction Classification based on nature of synthesis (Without Mechanism) with example (addition and condensation polymers), properties, uses and synthesis Polyvinyl chloride, polyvinyl acetate, polystyrene, polycrylonitrile, nylon 6, Nylon 66. Introduction to synthetic Natural rubber, properties uses and synthesis of Buna N. Nioprene and silicon rubber.

Spectroscopy: 15 Hrs.

UV Visible Spectroscopy. Introduction, electronic transition and designation of UV absorption bands, general application of UV spectroscopy. Definition of chromophores, Auxochrome, Red and Blue shift. Identification of isolated double bond, conjugated dienes, polymers. Woodward fisher rule for dienes an trienes, Fiesher – Kuhn rules for polyenes. Woodward rule for Alpha, Beta unsaturated aldehyde and ketones.

Infrared Spectroscopy :

Introduction, Absorption in the IR region, presentation of IR spectra , Molecular Vibration, Calculation of vibrational Frequencies (Hook's Law). Application of IR spectroscopy, Interpretation of IR spectra, Characterizations of Functional Groups.

Third Year Six Semester

Paper 602103 Inorganic Chemistry 3 Credits, 75 Marks (45 hrs.)
3 Hrs./ Week

Metal ligand bonding in TM complexes 13 Hrs.

Crystal Field Theory (CFT) applied to coordination compound .Assumptions of CFT, splitting of d orbitals in octahedral, tetrahedral and square planar complexes Factors affecting the magnitude of 10Dq/ high and low spin complexes Crystal Field Stabilization Energy (CFSE), calculation of CFSE for octahedral and tetrahedral complexes, Effect of crystal field splitting on ionic radii and lattice energy. Theoretical failure of CFT.

Electronic Spectra of TM Complexes 07 Hrs.

Types of electronic transitions like d-d charge transfer, intra ligand Rules for electronic transitions Laporte and Spin selection rule Orgel diagram for d^1,d^4,d^6,d^9 metal ion Electronic spectra of $[Ti(H_2O)_6]^{+3}$ complex ion. Application of electronic spectra.

Stability of Complexes 05. Hrs.

Thermodynamic and Kinetic stability of complexes. Stepwise and overall stability constants and their inter-relationship. Factors affecting thermodynamic stability, Chelate effect

Substitution reactions of Octahedral Complexes 05. Hrs.

Introduction, types of reaction in complexes Ligand substitution reaction: Basic Mechanisms Labile and inert complexes, Electronic configuration and lability of complex Mechanism for acid and base hydrolysis of cobalt ammine complexes.

Bioinorganic Chemistry 10. Hrs.

Introduction, essential and nonessential elements, Biological role of Alkali metals (Na, K) and Alkaline earth Metalloporphyrins with special reference to Hemoglobin, Myoglobin, Chlorophyll.

Catalysis by Transition Metal Complexes 05. Hrs.

Introduction, Catalysis with reference to (I) Hydrogenation of alkenes (Wilkinson Catalyst),(II) Hydroformylation reaction (Roolen Catalyst) (III) Polymerization of alkenes (Ziegler-Natta Catalyst).

Third Year Six Semester

Paper 602104 **Analytical Chemistry 3 Credits, 75 Marks (45 hrs.)**
3 Hrs./ Week

Optical Methods **15 Hrs.**

Atomic spectroscopy: Absorption and emission spectra, energy level diagrams, processes involved in atomization, flame photometry, flame atomizer, types of burners, Monochromators and detectors, Atomic absorption spectroscopy: flame and electrothermal atomizer, Sources, instrumentation, Quantitative applications of atomic absorption & flame photometry, Calibration curve method, Standard addition method and internal standard method. Molecular fluorescence and phosphorescence spectroscopy: theory, instrumentation and applications.
Infrared spectroscopy**:** Sources, sample handling, detectors.

Methods of Separation. **15 Hrs.**
Gas chromatography: Gas liquid chromatography**,** Basic principles, retention time, retention volume, resolution, peak width, theoretical plates, HEPT, instrumentation, Columns, detectors, applications.
High performance liquid chromatography: Instrumentation, Types of Elution, UV & RI detector & applications.
Ion exchange chromatography: Types of ion exchanger, mechanism of ion exchange, selectivity coefficients & separation factors, capacity and its determination, factors affecting the separation of ions, applications.

Miscellaneous Methods **15 Hrs.**
Quality: Concept of Quality, Quality control, Quality assurance, Total Quality Management, ISO series, Good laboratory practices.
Turbidimetry and Nephelometry: Scattering of light, effect of concentration, Particle size and wavelength on light scattering, instrumentation and applications.
Mass spectrometry: Basic Principles, introduction of components only.
Introduction of radio analytical techniques: classification of the techniques, Introduction of Neutron activation analysis and its application.
Thermal Methods: Classification of Thermal Methods, Thermo gravimetric analysis: Basic principles, Instrumentation. Factors affecting the TG curve, Applications.