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*DETAILED SYLLABUS*

*FOR*

*DISTANCE EDUCATION*

Under graduate degree Program

**B.SC. PCM**  
(PHYSICS, CHEMISTRY & MATHS)

**(B.SC.PCM)**

**(YEARLY SYSTEM)**

**COURSE TITLE : B.SC. PCM (PHYSICS, CHEMISTRY & MATHS)**  
**DURATION : THREE YEARS**  
**MODE : YEARLY**  
**MARKS :**

**FIRST YEAR**

COURSE TITLE	PAPER CODE	MARKS				TOTAL
		THEORY		PRACTICAL		
		INTR.	EXT.	INTR.	EXT.	
Classical Mechanics	PCM/Y/110	40	60	NA	NA	100
Electromagnetism	PCM/Y/120	40	60	NA	NA	100
Waves & oscillations, mathematical physics	PCM/Y/130	40	60	NA	NA	100
Fundamentals of Inorganic Chemistry – I	PCM/Y/140	40	60	NA	NA	100
Fundamentals of Organic Chemistry – I	PCM/Y/150	40	60	NA	NA	100
Fundamentals of Physical Chemistry – I	PCM/Y/160	40	60	NA	NA	100
Introduction to Trigonometry and Algebra	PCM/Y/170	40	60	NA	NA	100
Vectors algebra	PCM/Y/180	40	60	NA	NA	100
Applied Calculus	PCM/Y/190	40	60	NA	NA	100

**SECOND YEAR**

COURSE TITLE	PAPER CODE	MARKS				TOTAL
		THEORY		PRACTICAL		
		INTR.	EXT.	INTR.	EXT.	
Heat and Thermodynamics	PCM-Y/210	40	60	NA	NA	100
Applied Optics	PCM-Y/220	40	60	NA	NA	100
Electronic devices	PCM-Y/230	40	60	NA	NA	100
Fundamentals of Inorganic Chemistry – II	PCM-Y/240	40	60	NA	NA	100
Fundamentals of Organic Chemistry – II	PCM-Y/250	40	60	NA	NA	100
Fundamentals of Physical Chemistry – II	PCM-Y/260	40	60	NA	NA	100
Introduction to Differential Equations	PCM-Y/270	40	60	NA	NA	100
Concepts of Analysis – I	PCM-Y/280	40	60	NA	NA	100
Introduction to Numerical Analysis and Boolean Algebra	PCM-Y/290	40	60	NA	NA	100

**THIRD YEAR**

COURSE TITLE	PAPER CODE	MARKS				TOTAL
		THEORY		PRACTICAL		
		INTR.	EXT.	INTR.	EXT.	
Classical quantum and Statistical physics	PCM-Y/310	40	60	NA	NA	100
Nuclear Physics and laser	PCM-Y/320	40	60	NA	NA	100
Solid State Physics	PCM-Y/330	40	60	NA	NA	100
Fundamentals of Inorganic Chemistry – III	PCM-Y/340	40	60	NA	NA	100
Fundamentals of Organic Chemistry – III	PCM-Y/350	40	60	NA	NA	100
Fundamentals of Physical Chemistry - III	PCM-Y/360	40	60	NA	NA	100
Concepts of Analysis – II	PCM-Y/370	40	60	NA	NA	100
Introduction to Mechanics	PCM-Y/380	40	60	NA	NA	100
Basics of Linear Programming	PCM-Y/390	40	60	NA	NA	100

**FIRST YEAR****i) Classical Mechanics****Paper Code: PCM/Y-110****Conservation of Energy and Linear Momentum**

Mechanics of a particle work energy theorem. Conservative and non-conservative forces and their examples. Conservative forces as negative gradient of potential energy. Center of mass of a system of particles. Conservation of linear Momentum and energy. Systems of variable mass, single and multistage rockets. Elastic and inelastic collisions.

**Rotational Dynamics**

Rigid body motion, Rotational motion, torque and angular momentum, moment of inertia and its calculations for disc, cylinder, spherical shell and solid sphere. Body rolling down on an inclined plane, Fly wheel, Motion of top.

**Motion Under Central Forces**

Concept of central force, Kepler's laws of planetary motion, Gravitational Law, Gravitational potential and fields due to spherical shell and solid sphere, Gravitational potential energy and escape velocity. Two particle central force problem and reduced mass. Motion of planets and satellites.

**Properties of matter**

Elasticity, small deformations, Hooke's Law, elastic constants and relation among them. Beam supported at both the ends, cantilever, torsion of a cylinder, Maxwell's needle and Searl's method. Streamline and turbulent flow, equation of continuity, viscosity, Poiseuille's law, critical velocity, Renold's number, Stroke's law and terminal velocity. Surface tension and surface energy, molecular interpretation of surface tension, pressure on a curved liquid surface.

**Relativity**

Reference System, Inertial frames, Galilean invariance, Michelson-Morley's experiment, Einstein's postulates for the special theory of Relativity. Lorentz transformation equations, Length contraction and time dilation. Concept of simultaneity. Relativistic addition of velocities. Variation of mass with velocity. Mass energy equivalence. Momentum -energy relations.

**ii) Electromagnetism****Paper Code: PCM/Y-120**

### **Electrostatics**

Coulomb's law in vacuum expressed in vector form. Force between a point charge and a continuous charge distribution. Electric field in a material medium. Dielectric polarization and dielectric constant. Polarization vector  $P$  and Displacement vector  $D$ . Gauss Law in a dielectric medium. External field of a dielectric medium, Clausius-Mossotti equation and its molecular interpretation. Langevin-Debye equation. Boundary conditions satisfied by  $E$  and  $D$  at the Interface between two homogeneous dielectrics.

### **Varying and Alternating Currents**

Kirchoff's law & Analysis of multiloop circuits, Growth and Decay of Currents in LR circuits. Charging and Discharging of a capacitor through a resistance and through a LR circuit. Measurement of high resistance by leakage method. AC circuits containing  $R, L$  &  $C$ . Impedance and admittance, Phasor diagram for current and voltage in AC circuits, Analysis of AC using operator, Series and parallel resonant circuits,  $Q$ -factor, Power consumed by an AC circuit. Choke coil.

### **Magnetostatics and Magnetic Properties of matter**

Force on a moving charge. Lorentz force equation. Definition of magnetic induction  $B$ . Force on a straight conductor carrying current in a uniform magnetic field. Biot Savart law and its applications to a straight conductor, circular coil and solenoid. Ampere's law and its applications. Motion of a charge particle in magnetic field and cyclotron. Torque on a current loop in a magnetic field. Theory of Ballistic galvanometer, critical dampening, current and charge sensitivity. Magnetic permeability and susceptibility, Relation between them. Hysteresis. Theory of Para-, Di- and Ferro magnetism.

### **Electromagnetic Induction.**

Faraday's law, Lenz's law, Electromotive force, Energy stored in a magnetic field, Energy stored in an inductor conducting rod moving in a magnetic field. Mutual and self inductance, transformer, Maxwell's displacement current. Statement of Maxwell's equations and their significance.

### **Electromagnetic waves**

Wave equation satisfied by  $E$  and  $B$ . Plane electromagnetic waves in a vacuum. Poynting's vector, reflection at a plane boundary of dielectrics, polarization by reflection and total internal reflection

## **iii) Waves & Oscillations, mathematical physics**

**Paper Code: PCM/Y-130**

### **Vector Analysis**

Scalars and Vectors dot and cross product, Triple and Quadruple vector product of vector, scalars and Vector fields, Gradient of a scalar and Vector field, Gauss divergence theorem, Green's theorem and Stokes's theorem.

### **Matrices**

Definition of matrix, addition, Subtraction and multiplication of the matrices. Transpose of a matrix, symmetric and skew-symmetric matrix. Adjoint of a matrix. Hermitian matrices, Inverse of a matrix, Singular and non-singular matrices. Orthogonal matrices. Rank of a matrix.

### **Oscillations**

Potential well and periodic oscillations, case of harmonic oscillations, differential equation and solution of simple harmonic oscillations. kinetic and potential energy. Examples of simple harmonic oscillations. Spring and mass system. Simple and compound pendulum. Torsional pendulum. Helmholtz resonator, LC circuit, vibrations of magnet. Oscillations of two masses connected by a spring. Superposition of two simple harmonic motions of same frequency are same along the same line. Interference, Superposition of two mutually perpendicular simple harmonic vibrations of the same frequency. Lissajous figure, case of different frequencies. Free and forced oscillations. Effect of damping on resonance.

## Waves

Waves in media, speed of transverse waves on a uniform string, speed of longitudinal waves in a fluid, Energy density and energy transmission in waves over liquid surface, gravity waves and ripples. Group velocity and phase velocity and their measurements. Superposition of waves. Linear homogeneous equation and the superposition principle, nonlinear superposition and consequences. Standing waves as normal mode of bounded systems. Harmonics and the quality of sound, production and detection of ultrasonic and infrasonic waves and applications. Acoustics Noise and Music. The human ear and its responses, limits of human audibility, intensity and loudness, bel and decibel, musical scale, temperament and musical Instruments. Reflection, refraction and diffraction of sound, acoustic impedance of a medium, percentage reflection and refraction at a boundary, impedance matching for transducers, diffraction of sound, principle of a sonar system, sound ranging.

Applied acoustics: Transducers and their characteristics. Recording and reproduction of sounds, various system, Measurements of frequency, waveform, intensity and velocity. The acoustics of halls, reverberation period, Sabine's formula.

## iv) Fundamentals of Inorganic chemistry –I

Paper Code: PCM/Y-140

### Atomic Structure

Dual nature of matter and idea of de Broglie matter waves, de Broglie equation; Wave mechanical model, Heisenberg's uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of  $\Psi$  and  $\Psi^2$  quantum numbers, shapes of s, p, d orbitals. Aufbau and Pauli's exclusion principles, Hund's multiplicity rule. Electronic configuration of the elements.

### Periodic properties

Atomic and ionic radii, ionization energy, electron affinity and electro negativity –definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior.

### Chemical bonding

**Covalent Bond**-Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electrons pair repulsion (VSEPR) theory to  $\text{NH}_3$ ,  $\text{H}_3\text{O}^+$ ,  $\text{SF}_4$ ,  $\text{ClF}_3$ ,  $\text{ICl}_2$  and  $\text{H}_2\text{O}$  MO theory. homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

**Ionic Solids**-Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semi conductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability of ions. Fajan's rule. Inert pair effects in lead bond, odd electron bonds, hydrogen bond.

**Weak Interactions**-Hydrogen bonding VanderWaals forces

### s-block elements

Comparative study, diagonal relationship, characteristics including their positions in the periodic table, abnormal behaviour of Li and Be. Preparation, properties and uses of Lithium hydride, sodaamide and Basic beryllium acetate. Comparative study of groups 13-17 elements, characteristics including their positions in the periodic table, Abnormal behaviour of nitrogen, oxygen and fluorine compounds like hydrides, oxides, oxyacids and halides of group 13-16, hydrides of boron-di-borane and higher boranes, borax, carbides, peroxy acids of sulphur, sodium thiosulphate, interhalogens, freon Teflon.

### Chemistry of noble gases

Isolation of noble gases, chemistry of xenon, structure and bonding in xenon compounds.

**Structure and Bonding and Mechanism of Organic reactions**

Hybridization, bond lengths and bond angles, bond energy, van der Waals interactions, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding. Curved arrow notation, drawing electron movements with arrows half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents-electrophiles and nucleophiles. Types of organic reaction. Energy consideration. Reactive intermediates-carbocations, carbanions, free radicals, carbenes, arynes and nitrene (with examples). Assigning formal charges on intermediates and other ionic species.

**Stereochemistry of Organic Compounds**

Concept of isomerism. Types of isomerism.

Optical Isomerism-elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, meso compounds, resolution of enantiomers, racemization. Relative and absolute configuration, sequence rules, D&L and R&S systems of nomenclature. Geometric isomerism-determination of configuration of geometric isomer. E&Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism – conformational analysis of ethane and n-butane, confirmation of cyclohexane, axial and equatorial bonds, Newman projection.

**Alkanes and cycloalkanes**

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes; orientation, reactivity and selectivity. Cycloalkanes-nomenclature, methods of formation, chemical reactions, Bayer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings.

**Alkenes, Dienes And Alkynes**

Nomenclature of alkenes, method of formation, mechanisms of dehydration of alcohols and dehalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hoffmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes – mechanisms involved in hydrogenation, electrophilic and free radical additions, Markovnikov's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with  $\text{KMnO}_4$ . Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of Butadiene, methods of formation, polymerization. Chemical reactions-1,2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reaction, hydroboration-oxidation, metal ammonia reductions, oxidation and polymerization.

**Arenes and Aromaticity**

Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of Benzene; molecular formula and Kekule structure, stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity-the Huckle rule, aromatic ions. Aromatic electrophilic substitution-general pattern of the mechanism, role of  $\sigma$ - and  $\pi$ - complexes. Mechanism of nitration, halogenation. Sulphonation, mercuration and Friedel-Crafts reaction. Activating and deactivating substituents, orientation and ortho:para ratio. Side chain reactions of benzene derivatives.

Methods of formation and chemical reactions of alkyl benzene, alkylbenzene. Alkyl and aryl halides. Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides,  $\text{S}_{\text{N}}2$  and  $\text{S}_{\text{N}}1$  reactions. Methods of formation of Aryl halides, nuclear and side chain reactions. The addition-elimination and elimination addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.

**Mathematical concepts and Computers**

Logarithmic relations, curve sketching, linear graphs and calculations of slopes, differentiation of functions like  $k_x$ ,  $e^x$ ,  $x^n$ ,  $\sin x$ ,  $\log x$ ; Maxima and minima, partial differentiation and reciprocity relations. Integration of some useful/relevant functions; permutations and combinations. Factorials and Probability.

**Computers**

General introduction to computers, different component of a computer, hardware and software, input output devices ; binary numbers and arithmetic; introduction to computer languages. Programming, operating systems.

**Gaseous State**

Postulates of kinetic theory of gases, derivation from ideal behaviour, vander Waals equation of state. Critical phenomena: PV Isotherms of real gases, continuity of states, the isotherms of vander waals equation , relationship between critical constants and vander Waals constants., the law of corresponding states, reduced equation of state .Molecular velocities: Root mean square , average and most probable velocities . Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameters. Specific heats of gases. Liquification of gases (based on Joule-Thomson effect).

**Chemical equilibrium**

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action, reaction isotherm, reaction isochore, Clapeyron equation and Clausius- Clapeyron equation, application, Le Chatelier's principle. Statement and meaning of the terms-phase , component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water and S system.

**Phase Equilibrium**

Phase equilibria of two component system-solid –liquid equilibria, simple eutectic –Pb-Ag system and desilverisation of lead. Liquid-liquid mixture-ideal liquid mixtures, Raoult's and Henry's law. Non ideal system-azeotropes-HCl-H<sub>2</sub>O and ethanol-water systems. Partially miscible liquids –Phenol water, tri methylamine –water systems. Lower and upper consolute temperature Effect of impurity on consolute temperature. Nernst distribution Law , limitations thermodynamics derivation, distribution law in case of association and disassociation.

**Colloidal State**

Definition of collides, classification of colloids. Solids in Liquids (sols),: properties – kinetic , optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number, zeta potential. Liquids in Liquids (Emulsions): types of emulsion , preparation , Emulsifier. Liquids in solids (gels): classification and preparation and properties, inhibition, general application of collides. Elementary idea of sol-gel transformation and thixotropy.

**Chemical Kinetics and Catalysis**

Chemical kinetics and its scope, rate of reaction, factors influencing the rate of a reaction-concentration , temperature, pressure, solvent, light , catalyst. Concentration dependence rates, mathematical characteristics of a simple chemical reactions-half order, zero order, first order ,second order , third order, nth order, pseudo order, half life and mean life. Determination of the order of the reaction-differential method, method of integration, method of half life period and isolation method. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Simple collision theory of uni molecular reaction , transition state theory (mathematical treatments) Expression for the rate constant based on equilibrium constant and thermodynamic aspects. Catalysis, characteristics of catalyzed reaction , classification of catalysis, miscellaneous examples of catalysis, acid-base catalysis, enzyme catalysis including its kinetics.

Direct and inverse circular hyperbolic functions. Logarithm of complex quantity. Expansion of trigonometrical functions. Gregory's series. Summation of series. Relations between the roots and coefficient of general polynomial equation in one variable. Transformation of equations. Descartes rule of signs. Solution cubic equations (Cardano method), Biquadratic equations. Row, rank, column rank and rank of a matrix. Equivalence of column and row and Eigen values, eigenvectors and the characteristics equation of a matrix. Cayley Hamilton theorem and its use in finding inverse of a matrix. Applications of matrices to a system of linear (both homogeneous and non homogeneous) equation. Theorems on consistency of a system of linear equations. Definition of a group with examples and simple properties. Subgroups. Generation of groups. Cyclic group closure decomposition. Lagrange's theorem and its consequences. Homomorphism and Isomorphism. Permutation groups. Even and odd permutations. Normal subgroups. Quotient groups. The fundamental theorem of homomorphism. The alternating groups  $A_n$ . Cayley's theorem. Automorphism. groups. Conjugacy relation. Normaliser. The class equation of a finite group.

### **viii) Vectors algebra Paper Code: PCM/Y-180**

Vector Analysis Scalar and Vector product of three vectors. Product of four vectors. Reciprocal. Introduction to partial differentiation. Vector differentiation. Gradient, divergence and curl, Vector Integration, Theorems of Gauss, Green, Stokes and problems based on these. Geometry (2-dim) General equation of second degree. System of conics. Confocal conics. Polar equation of a conic. Geometry (3-dim) Plane, Straight line, Sphere, Cone, Cylinder. Central conicoids, Paraboloids, Plane Sections of conicoids. Reduction of second degree equation.

### **ix) Applied Calculus**

### **Paper Code: PCM/Y-190**

Differential calculus

$\epsilon$ - $\delta$  definition of the limit of a function. Basic properties of limits. Continuous functions and classification of discontinuities, Differentiability, Successive differentiation. Leibnitz theorem. Maclaurin and Taylor series expansion, Asymptotes, Curvature. Tests for concavity and convexity. Points of Inflexion. Multiple points. Tracing of curves in Cartesian and Polar coordinates. Integral Calculus Quadrature, Rectification. Volumes and surfaces of solid of revolution. Differential equation Linear equations and equations reducible to the linear form. Exact differential equations, First ordered higher degree equations solvable for  $x$ ,  $y$ ,  $p$ . Clairaut's forms and singular solutions. Geometrical meaning of a differential equation orthogonal trajectory. Linear differential equation with constant coefficients. Homogeneous linear ordinary differential equations. Linear differential equations of second order. Transformation of the equation by changing the dependent/independent variable Method of variation of parameters. Simultaneous differential equation.

## **SECOND YEAR**

### **i) Heat and thermodynamics**

**Paper Code: PCM/Y-210**

#### **Kinetic Theory of Matter(I)**

Ideal Gas: Kinetic Model, deduction of Boyle's law, interpretation of temperature, estimation of rms speeds of molecules. Brownian motion, estimate of the Avogadro's number. Equipartition of energy, specific heat of monoatomic gas, extension to di and tri atomic gases, Behavior at low temperatures. Adiabatic expansion of an Ideal gas, application to atmospheric physics. Real gas: Van Der Waal gas, equation of state nature of Van der Waal forces, comparison with experimental P-V curves. The critical constants, gas and vapor. Joule expansion of Ideal gas, and of a Van der waals gas, Joule coefficient, estimates of J-T cooling.

#### **Kinetic Theory of Matter(II)**

Liquification of gases: Boyle's temperature and Inversion temperature. Principle of regenerative cooling and of cascade cooling, liquification of hydrogen and helium. Refrigeration cycles, meaning of efficiency. Transport phenomena in gases: Molecular collision, mean free path and collision cross sections. Estimates of molecular diameter and mean free path. Transport of mass, momentum and energy and interrelationship, dependence on temperature and pressure.

#### **Thermodynamics(I)**

The laws of thermodynamics: The Zeroth law, various indicator diagrams, work done by and on the system, first law of thermodynamics, internal energy as a state function and other applications. Reversible and irreversible changes. Carnot cycle and its efficiency, Carnot theorem and the second law of thermodynamics. Different versions of the second law, practical cycles used in internal combustion engines. Entropy, principle of increase of entropy.

#### **Thermodynamics(II)**

Thermodynamic relationship: Thermodynamic variables: extensive and intensive, Maxwell's general relationships, application to Joule-Thomson cooling and adiabatic cooling in a general system, Van der Waal gas, Clausius-Clapeyron heat equation. temperature, its identity with the perfect gas scale. Impossibility of attaining the absolute zero; third law of thermodynamics. Thermodynamics potential and equilibrium of thermodynamical systems, relation with thermodynamical variables. Cooling due to adiabatic demagnetization

#### **Thermodynamics(III)**

Black body radiation: Pure temperature dependence, Stefan-Bolzman law, pressure of radiation. Special distribution of black body radiation. Wein displacement law. Rayleigh-Jean's law, the ultraviolet catastrophe, Planck's quantum postulates. Plank's Law, complete fit with experiment Interpretation of behavior of specific heats of gases at low temperature.

## ii) Applied Optics

Paper Code: PCM/Y-210

Geometrical Optics: Fermat's principle: Principal of extremum path and its simple applications reflection, refraction and straight line motion of light. General theory of image formation: Cardinal points of an optical system, general relationships, thick lens, combination of two thin lenses, Nodal slide and Newton's formula. Huygen's and Ramsden's eyepieces. Aberration in imager: Chromatic aberration, achromatic combination of lenses in contact & separated lenses. Monochromatic aberration and their reduction; crossed lens, aplanatic points, oil immersion objectives.

### Physical Optics(I)

#### Interference

Interference of light: The principle of superpositions, two slit interference, coherence requirement of the sources, optical path retardation, lateral shift of fringes, Rayleigh refractometer and other applications. Thin films, application for precision measurements for displacements. Interference in thin films, Newton's ring, its application in determination of wavelength, refractive index of liquid.

### Physical Optics(II)

#### Interference

Michelson interferometer, its application for precision determination of wavelength, wavelength difference, refractive index of thin transparent film and width of spectral lines, Intensity distribution in multiple beam interference. Fabry-perot interferometer & etalon.

#### Diffraction of light:

Fresnel diffraction, intensity due to cylindrical wave front by Fresnel half period zone method, zone plate. Diffraction at straight edge.

Fraunhofer diffraction: Diffraction at a slit & circular aperture. Diffraction at N-parallel slits, its intensity distribution, plane diffraction grating, concave grating and different mountings. Resolution of images; Rayleigh criterion, resolving power of grating, telescope and prism.

### Physical Optics(IV)

#### Polarization

Double refraction and optical rotation: refraction in uniaxial crystal, its electromagnetic theory, Phase retardation, quarter waveplate and half wave plate, double image prism, Rotation of plane polarization, Fresnel explanation of rotation.

## iii) Electronic devices

Paper Code: PCM/Y-230

### A.C. Network Analysis and A.C. bridges.

Kirchoff's Laws, statement and explanation of superposition theorem, Thevenin's theorem, Norton's theorem and Maximum power transmission theorem. A.C Bridge: General balance conditions, Maxwell's Inductance bridge, Anderson Bridge, Deasuty Bridge, Schering Bridge

### Semi conductor physics and devices

Intrinsic and extrinsic (p-type) semiconductors, p-n junction diode: working and V-I characteristics of under forward and reverse bias, breakdown mechanism, diode equation, switching action of diode, Zener diode and its V-I characteristics, Bipolar transistor: pnp and npn transistors and their working, Characteristic of transistor in common base and in common emitter configuration. Transistor parameters  $\alpha$  and  $\beta$ . D.C. Load line and switching action of transistor.

### Rectifiers and power supplies

Rectifiers: Working of half wave and full wave (center tap and bridge) rectifiers using p-n junction diode; calculation of ripple factor and efficiency of half wave and full wave rectifiers. Comparison of full wave center tap and bridge rectifiers. Filters: Shunt capacitor filter, series inductor filter, Choke input (L-section filter, capacitor input ( $\pi$ - section) filter. D.C power supplies using zener diode voltage regulator and transistor series voltage regulator.

### **Amplifiers**

Basic principle of amplification, Gain of Amplifier, transistor CE and CB amplifiers, expression for voltage gain, comparison of CE and CB amplifiers. Transistor biasing :fixed bias and voltage divider bias A practical single stage transistor amplifier with voltage divider bias and its working. Classifications of Amplifier :Class A, Class B, Class C amplifiers .Qualitative analysis of two stage dry-C coupled and transformer coupled amplifiers along with the discussion of their frequency response curves.

### **Oscillators**

Definition .Feedback in Amplifiers, Barkhausen criterion for oscillators.Comparison between amplifier and oscillator.Sinusoidal and non-sinusoidal oscillators. Qualitative analysis of tuned collector. Hartley oscillator

### **Digital Electronics**

Number Systems: Binary and decimal number systems, Conversion of binary to decimal and decimal to binary .Logic Gates: Positive and negative logic , Basic gates-OR gate, AND gate, NOT, NAND, NOR gates(their truth table , Boolean equation , Circuit diagram and operation), Exclusive OR gate, simple combination of basic gates.

## **iv) Fundamentals of Inorganic Chemistry –II**

**Paper Code: PCM/Y-240**

### **Radio activity**

Disintegration theory, Group displacement law, rate of disintegration. Half life period, Average life period, Disintegration series , Radioactive equilibrium, Artificial Radioactivity, types of Nuclear reactions, Nuclear fission and fusion, Applications of Radioactivity.

### **Chemistry of Elements of First transition Series**

Characteristic properties of d-block elements

Properties of the elements of the first transition series , their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.

### **Chemistry of Elements of Second and Third transition Series**

General characteristics, comparative treatment with their 3d –analogous in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.

### **Coordination compounds**

Werner's coordination theory and its experimental verification, effective atomic number concept chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes and its limitations.

### **Acids and Bases**

Arrhenius, Bronsted-Lowry, and Lewis and Usanovich concepts of acids and bases.

### **Chemistry of Lanthanides and Actinide Elements**

Electronic structure , oxidation states atomic and ionic radii, lanthanide contraction, complex formation, magnetic properties separation of Lanthanides.

### **Chemistry of Actinides**

General features and chemistry of extraction of uranium, similarities between the later actinides and the later lanthanides.

### **VIII. Quantitative Analysis**

Chemistry and principles involved in the volumetric analysis.Numerical problems based on the quantitative volumetric estimation-redox, iodometric and iodimetric titrations.Chemistry and principles involved in the reacti metric estimation of Ba,Cu and Ni.

## **v) Fundamentals of Organic Chemistry-II**

**Paper Code: PCM/Y-250**

### **Alcohols**

Classification and nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature, reactions of alcohols. Dithere alcohols- nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [ $\text{Pb}(\text{OAc})_4$  and  $\text{HIO}_4$ ] and pinacol-pinacolone rearrangement. Trihydric alcohols- nomenclature and methods and structure of formation, chemical reactions of glycerol.

### **Phenols**

Nomenclature Structure and bonding, preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols-electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction and Picric acid.

### **Ethers and Epoxides**

Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions-Cleavage and autoxidation, Ziesel's method.

Synthesis of epoxide. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagent with epoxides.

### **Aldehydes and ketones**

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particularly synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using using 1,3 - dithianes, synthesis of ketones from nitriles and from carboxylic acids, properties. Benzaldehyde, salicyl aldehyde and acetophenone. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction. Cannizzaro reaction. Clemmensen and Wolf-Kishner reduction. An introduction to  $\alpha, \beta$  unsaturated aldehydes and ketones.

### **Carboxylic Acids**

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation, reactions of carboxylic acids Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of formation and chemical reaction of Halo acids. Hydroxyl acids: malic, tartaric and citric acids. Benzoic acids, Salicylic acid, Anthranilic acid. Methods of formation of and chemical reactions of unsaturated monocarboxylic acids, Acrylic acid, Crotonic acid, cinnamic acid. Dicarboxylic Acid: succinic acid, malonic acid and phthalic acid.

### **Carboxylic Acid derivatives**

Structure and Nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives. Chemical reaction. Mechanisms of esterification and hydrolysis (acidic and basic).

### **Organic compounds of nitrogen**

Preparation of nitroarenes. Chemical reactions of nitro alkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reduction in acidic neutral and alkaline media. Halonitroarenes: reactivity. Structure and nomenclature of amines, physical properties. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Preparation of alkyl and aryl amines (reduction of nitro compounds nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamine reaction. Reaction of amine, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

### **Numerical problem**

Based on structure and reactivity of compounds.

**vi) Fundamentals of Physical Chemistry-II**

**Paper Code: PCM/Y-260**

**Thermodynamics –I**

Definition of thermodynamic terms: system, surroundings etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

First Law of thermodynamics: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law-Joule-Thomson coefficient and inversion temperature. Calculation of  $w$ ,  $q$ ,  $dU$  &  $dH$  for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Thermochemistry: standard state, standard enthalpy of formation-Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature, dependence of enthalpy. Kirchhoff's equation.

### **Thermodynamics-II**

Second Law of thermodynamics: need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot cycle and its efficiency, Carnot theorem. Thermodynamics scale of temperature. Concept of Entropy: entropy as a state function, entropy as a function of  $V$  &  $T$ , entropy as a function of  $P$  &  $T$ , entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in Ideal gases and mixing of gases. Third Law of thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions: Gibbs function ( $G$ ) and Helmholtz function ( $A$ ) as thermodynamic quantities,  $A$  &  $G$  as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of  $G$  and  $A$  with  $P$ ,  $V$  and  $T$ .

### **Liquid State**

Intermolecular forces, structure of liquids (a qualitative description) Structural differences between solids, liquids and gases. Liquid crystals: Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholesteric phases. Thermography and aeven sement cell.

### **Solid state**

Definition of lattice, unit cell. Laws of crystallography-(i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of  $\text{NaCl}$ ,  $\text{KCl}$  and  $\text{CaCl}_2$  (Laue's method and powder method).

### **Electrochemistry-I**

Electric transport-conduction in metals and in electrolyte solutions, specific conductance, equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitation, weak and strong electrolytes, Ostwald's dilution law and its uses and limitation. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number,  $m$  definition and determination by Hittorf method and moving boundary method. Applications of conductivity of measurements: determination of degree of dissociation, determination of  $K_a$  of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

### **Electrochemistry -II**

Types of reversible electrodes-gas-metal ion, metal-metal ion, metal insoluble salt-anion and redox electrodes. Electrode reaction, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference electrodes-standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurements. Computations of all EMF, Calculations of thermodynamic quantities of cell reactions ( $\Delta G$ ,  $\Delta H$  and  $K$ ), polarization, over potential and hydrogen over voltage. Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficients, potentiometric titrations. Definition of pH and  $pK_a$  determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods. Buffers-mechanism of buffer action, Henderson-Hasselbalch equation. Hydrolysis of salts. Corrosion-types, theories and method of prevention.

Differential Equation of first order, but not of first Degree. General and Singular solutions: Trajectories, Linear Differential equations with constant coefficients, Homogeneous differential equation. Wronskian, Linear differential equations of second order with variable coefficients including method of variation of parameters. Definition of partial differential equations; its order and degree. Classification of partial differential equation into linear, semi linear, quasi linear and non linear. Linear partial differential of first order. Solution of Standard forms. Compatible system of first order equation Lagrange's Monge's ( $Rr+Ss+Tt=V$ ) Charpit's method Series solution of second order differential equations. Lagrange's Bessel's function.

### viii) Concepts of Analysis –I

**Paper Code: PCM/Y-280**

Limit of a sequence, convergent and divergent sequence, Bounded sequences, Limit Superior and limit Inferior, Monotonic sequence, operation on Convergent sequence, Cauchy's sequence, Cauchy's theorem on limits and Cauchy principle on convergence of a real sequence.

**Convergence of infinite series of positive terms, Comparison tests, Root test, Ratio tests, Gauss test, Integral test, Notion of absolute convergence of infinite series, Leibnitz test, Conditional convergence.**

Differentiability, Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's theorem and series, Expansion of  $e^x$ ,  $\log(1+x)$ ,  $(1+x)^m$ ,  $\sin x$ ,  $\cos x$ , Lagrange's and Cauchy form of remainders.

Real valued functions of two variables, Continuity, Partial differentiation, Differentiability, Schwarz and Young's theorem, Implicit function theorem.

Maxima and Minima of functions of two and three variables, Lagrange's method of undetermined multipliers, Jacobians.

### ix) Introduction to Numerical Analysis & Boolean Algebra

**Paper Code: PCM/Y-290**

Solution of equations, Bisection secant, Regular form, Newton's method, Root of polynomials, Lagrange, Newton and Hermite Interpolation formulae using differences Numerical differentiation, Numerical Quadrature, Trapezoidal Rule, Simpson's 1/3, 3/8 Rule, Weddle's Rule, Newton –Cotes formulae, Gauss quadrature formulae, Clabyshev's formulae. Linear Equation : Direct method for solving system of linear equations, Gauss elimination, LU Decomposition, Jordan's Crout's method, Matrix Inversion: Gauss elimination, Triangularisation, Choleski's methods: Jacobi, Gauss seidel, Relaxation method. Statement, Connectives, Compound Statement, Truth values and Truth tables, Tautology, Duality, Algebra, Duality, Algebra of statements, Validity of Arguments. Definition of Boolean Algebra, Ideas of a Boolean algebra. Boolean junction, Disjunctive Normal form, Conjunctive Normal form, Representation of finite Boolean Algebra. Application of switching circuits.

## **THIRD SEMESTER**

### **i) Classical, quantum & Statistical physics**

**Paper Code: PCM/Y-310**

#### **Classical Mechanics(I)**

Constraints , degree of freedom, Generalized coordinates. Generalized notations of displacement , velocity, acceleration and force. Configuration space D' Lambert's principle, Deduction and Lagrange's equation of motion using D' Lambert's Principle. Applications of Lagrange's equation of motion to conservation theorem.

#### **Quantum Mechanics(II)**

Wave particle duality, de Broglie's hypothesis of matter waves , wave and group velocity,experimental demonstration of matter waves,quantization in hydrogen atom. Heisenberg's uncertainty relation for p &x and its extention to energy and time, diffraction at a slit,particle in a box, position of electron in Bohr orbit.

#### **Quantum Mechanics(III)**

Wave function ,position probability, Schroedinger's equation, postulatory basis of quantum mechanics:operators,expectation value, eigen value and eigen function.Solution of Schrodinger's equation for a particle in a rigid one- and three- dimensional boxes,linear harmonic oscillator,Transmission across a potential barrier

#### **Statistical Physics(I)**

Simple laws of permutations, Probability of any event & its few examples , Equilibrium states and its relation with probability ,principle of equal a priori probabilities.Macroscopic and microscopic systems, Thermodynamic properties for macroscopic system as Entropy ,Enthalpy,Helholtz free energy, Gibbs free energy.

Phase space , u-space and T-space;Example of phase space for one dimensional oscillator, Ensemble and ensemble density, Merits of ensemble averages over the time averages for any thermodynamical system. Difference between micro canonical, canonical and grand canonical ensembles.

#### **Statistical Physics(II)**

Basic difference between classical and Quantum mechanics,Phase value of a quantum cell for one dimensional phase space and then extention to n-dimensional phase space , the number of phase cell in a given energy range for three dimensional free particle.

Boltzmann canonical distribution function and its derivation with application in law of equipartion of energy.Maxwell's distribution law for velocities,value of RMS velocity,average speed and most probable velocity of gas molecules.

## ii) Nuclear Physics & lasers

Paper Code: PCM/Y-320

### Atomic spectra and structure

Rutherford  $\alpha$  particle scattering experiment, Rutherford scattering formula, Nuclear dimension, Failure of Rutherford atom model, Bohr model of hydrogen Atom Spectral series of Atomic hydrogen, Nuclear motion, Franck –Hertz experiment, Sommerfield's theory of elliptical orbits, Vector atom model, Stern Gerlach experiment, Concept of quantum numbers and Pauli's exclusion principle.

### Laser

Spontaneous and stimulated emissions, Temporal and special coherence and their relation, Principles of laser, Ruby Laser.

### Nuclear Disintegration

Natural and artificial radioactivity, radioactivity decay laws, successive disintegration. Radio active carbon dating, elementary idea of fundamental particles and cosmic rays.

### Nuclear structure, Nuclear Forces and Nuclear Reactions

The constituents of nucleus, Nuclear size and method of its determination, Nuclear mass, Binding energy, Semi empirical mass formula, Liquid drop model, Nuclear fission and fusion, Shell model, explanation of magic numbers(qualitative). Properties of ground state deuteron and its simple theory. Meson theory of nuclear force, Q-value of nuclear reaction, Different mechanics of particle induced nuclear reactions(discussions only).

## iii) Solid State Physics

Paper Code: PCM/Y-330

### Crystal Structure and its determination-

Lattice, Transitional vectors, basis, unit cell, classification into systems, different lattice of a cubic crystal, lattice planes of a crystal, Miller indices, Interplanar spacing, NaCl and hcp structures, X-ray diffraction, Bragg's law, Analysis of crystal structure, Laue method, Rotating crystal method, Powder crystal method, Reciprocal lattice and its properties.

### Crystal binding

Binding Energy, Various types of crystal binding, Inert gas, Ionic, covalent and metallic binding in crystals. Quantitative study of the binding of ionic crystals.

### Lattice Vibrations

Vibration of monatomic linear lattice, Vibrations of the diatomic linear lattice, Phonon, Phonon momentum, Einstein theory of specific heats.

### Electron gas in Metal and Fermi Energy

Maxwell Boltzmann, Bose Einstein and Fermi-Dirac distribution(Qualitative Study). Fermi-Dirac energy distribution among free electrons in metals, Fermi energy. Average free electron energy at absolute zero.

### Band Theory of Solids

Motion of electron in periodic lattice, Kronig-Penny model, Formation of energy bands, Classifications of solids on the basis of band structure, Effective mass of electron.

### Solid State Devices

Intrinsic and Extrinsic semiconductor (p-type and n-type), Methods of fabrications of p-n junction, Working and characteristics of p-n junction under forward and reverse on the basis of band theory, Tunnel diode, Zener diode, Photo diode, Light emitting diode(qualitative) and their characteristics. Bipolar transistor, its working and characteristics. Bipolar transistor, its working and characteristics on the basis of band theory.

#### iv) Fundamentals of Inorganic Chemistry-III

Paper Code: PCM/Y-340

##### Hard and Soft Acids and Bases(HSAB)

Classification of acids and bases as hard as hard and soft. Pearson's HASB concept, acid base strength and hardness and softness, symbiosis, theoretical basis of hardness and softness, electro negativity and hardness and softness.

##### Metal-ligand Bonding in Transition Metal Complexes

Crystal field theory , crystal field splitting in octahedral , tetrahedral and square planar complexes, factors affecting the crystal-field parameters.Spectrochemical series, John –Tellar effect in octahedral complexes.

##### Magnetic properties of Transition Metal Complexes

Types of magnetic behavior , methods of determining magnetic susceptibility, spin only formula .L-S coupling, correlation of  $\mu_s$  and  $\mu_{eff}$  values , orbital contribution to magnetic moments, application of magnetic moment data for  $3d^0$  metal complexes.

##### Organometallic Chemistry

Definition , nomenclature and classification of organometallic compounds. Preparation , properties, bonding and applications of alkyl and aryl of Li, Al, Hg, Sn and Pb, a brief account of metal ethylenic complexes and homogenous hydrogenation , mononuclear carbonyls and the nature of bonding in metal carbonyls.

##### Non-aqueous Solvents

Physical properties of a solvent , types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid  $NH_3$  and liquid  $SO_2$ .

##### Silicones and Phosphazenes

Silicones and Phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

##### General Methods of extraction and purifications of metals .Chemistry involved in the extraction of the following methods.

Titanium, vanadium, chromium, Nickel and Platinum

##### Preparations., properties and uses of the following compounds

Titanium dioxide, Titanium tetrachloride, chromyl chloride, potassium dichromate, potassium per manganate, Potassium ferro and ferri cyanides, chlorophatinic acid, Sodium cobaltinitrite, sodium nitro prusside.

#### v) Fundamentals of Organic Chemistry –III

Paper Code: PCM/Y-350

##### Organ metallic Compounds

Organ magnesium compounds: the Grignard reagents-formation , structure and chemical reactions  
Organizing compounds: formation and chemical reactions. Organ lithium compounds: formation and chemical reaction

##### Organosulphur compounds

Nomenclature, structural features, Methods of formation and chemical reactions with particular emphasis on the mechanism of electrophilic substitution . Mechanism of nucleophilic substitution reaction in pyridine derivatives.Comparison of basicity of pyridine, piperidine and pyrole.Introduction to condensed five and six numbered hetrocycles.Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fischer indole synthesis, Scrap synthesis.Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

### **Organic Synthesis via Enoltes**

Acidity of  $\alpha$ -hydrogen .Synthetic applications of diethyl acetoacetate.Synthesis of ethyl acetoacetate :the Claisen condensation.Keto-enol Tautomerism of ethyl acetoacetate.

### **Carbohydrates**

Classification and nomenclature .Monosaccharides, mechanism of osazone formation , interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses.Configuration of monosaccharides.Erythro and threodiastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters.Determination of ring size of monosaccharides.Cyclic structure of D(+)-glucose.Mechanism of mutarotation.An introduction to disaccharides(maltose, sucrose and lactose) and polysaccharides(starch and cellulose)without involving structure determination.

### **Amino acids,Peptides, Proteins and Nucleic Acids**

Classification , structure and stereochemistry of amino acids.Acid –base behavior, iso electric point and electrophoresis. Preparation and Reactions of  $\alpha$ -amino acids.Structure and nomenclature of peptides and proteins .Classification of proteins.Peptide structure determination , end group analysis, selective hydrolysis of peptides.Classical peptide synthesis, solid –phase peptide synthesis Structures of peptides and proteins. Levels of protein structure.Protein Denaturation/renaturation.Nucleic acids:introduction .Constituents of nucleic acids.Ribonucleosides and ribonucleotides.The double helical structure of DNA

### **Sulphadruugs**

Bisulphacetamide, Sulphaguinidine, Sulphapyridine, Sulphadizine, Sulphathiazoles and sulphamethazines, mechanism and action of sulpha drugsSynthetic PolymersAddition of chain growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization,Ziegler-Natta polymerization and vinyl polymers.CondensationOr step growth polymerization.Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins , epoxy resins and polyurethanes Natural and Synthetic rubbers

### **Synthetic Dyes**

Color and constitution (electronic concept).Classification of dyes, Chemistry and Synthesis of methyl orange, Congo red,Malachite green, Phenolphthalein, Fluoresce in , Alizarin and Indigo.

## **vi) Fundamentals of Physical Chemistry –III**

**Paper Code: PCM/Y-360**

### **Spectroscopy**

Introduction:electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppernheimer approximation, degrees of freedom.Rotational SpectrumDiatomic molecules.Energy levels rigid rotor(semi classical principles), selection rules spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution)determination of bond length, qualitative description of non-rigid rotor, isotope effect.

### **Vibrational Spectrum**

Infra red spectrum:Energy levels of simple harmonic oscillator , selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of an harmonic motion and isotope on the on the spectrum, idea of vibrational frequencies of different functional groups .Raman spectrum:concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

### **Electronic spectrum**

Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle.Qualitative description of  $\sigma$ , $\pi$ -and n M.O., their energy levels and the respective transitions.

### **Photochemistry**

Interaction of radiation with matter, difference between thermal and photochemical processes.Laws of photochemistry:Grothuss-Draper law, Stark-Einstein law, Jabolonski diagram depicting various processes occurring in the excited state, qualitative description of intersystem crossing, quantum yield, photosynthesized reactions energy transfer processes (simple examples).

### **Physical Properties and molecular structure**

Optical activity, polarization –(Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment , measurement of dipole moment –temperature method and refractivity

method, dipole moment and structure of molecules, magnetic properties-Para magnetism, diamagnetism and ferromagnetic

### **Solutions , Dilute Solutions and Colligative properties.**

Ideal and non-ideal solution, methods of expressing concentration of solutions, activity and activity coefficient.

Dilute solution, colligative properties, Raoult's law, relative lowering of vapor pressure, molecular determination. Osmosis , Law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties.

Abnormal molar mass, degree of disassociation and association of solutes.

### **vii) Concepts of Analysis-II**

**Paper Code: PCM/Y-370**

Real analysis Riemann integral .Integrability of continuous and monotonic functions.The fundamental theorem of integral calculus.Mean value theorems of Integral calculus.Improper integrals and their convergence,Comparison tests, Abel's and Dirichlet tests.Series of arbitrary terms.Convergence, divergence and oscillations.Abel's and Dirichlet's tests.Partial derivation and differentiability of real valued functions of two variables.Complex analysisComplex number as ordered pairs.Geometric representation of Complex numbers.Continuity and differentiability of complex functions.Analytic functions.Cauchy Riemann equations.Harmonic functions.Metric spacesDefinition and Examples of metric spaces.Neighborhoods. Limit points.Interior points .Open and closed sets.Closure and Interiors.Boundary points, sub space of a metric space Cauchy sequences.Completeness.Definition and concepts,Cantor's intersection theorem.

### **viii) Introduction to Mechanics**

**Paper Code: PCM/Y-380**

Kinematics in two dimension .Rectilinear motion with variable acceleration.Constrained motion (circular and cycloidal), Central orbits, Kepler's LawMoments and Products of Inertia, Momental ellipsoid, Principal axes, Principal planes.D'Alembert's Principle, Motion about a fixed axis, Simple equivalent pendulum, Reactions of the axis, Simple equivalent pendulum, Reactions of the axes of rotation, Center of percussionCenter of Gravity in two and three dimensions

### **ix) Basics of Linear Programming**

**Paper Code: PCM/Y-390**

Statement and formulation of a general Linear Programming Problem.Definition of Feasible, Basic Feasible and Optimal Solutions and their identification, Graphical , Convex sets and Analytical methods.

Theory of Simplex methods , Application of Simplex Methods in Numerical Problems, Two phase Method, Big M-Method, Problem of unrestricted variablesTransportation problem:Basic feasible Solutions , North-West Corner Rule, Vogel's Approximation Method, Method of Matrix Minima, Optimum Solution for T.P. Degeneracy in T.P.Assignment models: Mathematical Formulation, Hungarian Method for solving assignment problems. Traveling Salesman problem, Sensitivity Analysis.

