

**B.Sc (PCM) (w.e.f June 2010-11)**

First Year			Instructional System							Credits	Marks	
Course Code	SLM Code	Name of the subject	PC P	A W	VG D	PD P	PE C	P P W	I I L			
B.Sc(PCM)- 1	SC-101	Mathematics-I (Algebra, Trigonometry & Vectors)	√	√							5	100
B.Sc(PCM)-2	SC-102	Mathematics-II Geometry & Calculus	√	√							5	100
B.Sc(PCM)-3	SC-103	Physics-I (Mechanics)	√	√			√				5	100
B.Sc(PCM)-4	SC-104	Physics-II (Electricity & Magnetism)	√	√			√				5	100
B.Sc(PCM)-5	SC-105	Inorganic Chemistry	√	√			√				5	100
B.Sc(PCM)-6	SC-106	Organic Chemistry	√	√			√				5	100
B.Sc(PCM)-7	SC-107	Chemistry Practical					√				2	100
B.Sc(PCM)-8	SC-113	Physics Practical					√				2	100
<b>TOTAL</b>											<b>34</b>	<b>800</b>

Second Year			Instructional System							Credits	Marks	
Course Code	SLM Code	Name of the subject	PC P	A W	VG D	PD P	PE C	P P W	I I L			
B.Sc(PCM)-9	SC-114	Mathematics-III (Analysis)	√	√							5	100
B.Sc(PCM)-10	SC-115	Mathematics-IV (Special function & Mechanics)	√	√							5	100
B.Sc(PCM)-11	SC-116	Physics-III (Heat and Thermodynamics)	√	√			√				5	100
B.Sc(PCM)-12	SC-117	Physics-IV (Optics)	√	√			√				5	100
B.Sc(PCM)-13	SC-118	Physical Chemistry	√	√			√				5	100
B.Sc(PCM)-14	SC-119	Organic Chemistry-II	√	√			√				5	100
B.Sc(PCM)-15	SC-120	Chemistry Practical					√				2	100
B.Sc(PCM)-16	SC-121	Physics Practical					√				2	100
<b>TOTAL</b>											<b>34</b>	<b>800</b>

Third Year			Instructional System							Credits	Marks
Course Code	SLM Code	Name of the subject	PC P	A W	VG D	PD P	PE C	P P W	I I L		
B.Sc(PCM)-17	SC-127	Mathematics-V	√	√						5	100
B.Sc(PCM)-18	SC-128	Mathematics-VI	√	√						5	100
B.Sc(PCM)-19	SC-129	Physics-V (Atomic and Nuclear Physics)	√	√			√			5	100
B.Sc(PCM)-20	SC-130	Physics-VI (Electronics)	√	√			√			5	100
B.Sc(PCM)-21	SC-131	Environmental Studies	√	√			√			5	100
B.Sc(PCM)-22	SC-132	Industrial Chemistry	√	√			√			5	100
B.Sc(PCM)-23	SC-133	Chemistry Practical					√			2	100
B.Sc(PCM)-24	SC-134	Physics Practical					√			2	100
<b>TOTAL</b>									<b>34</b>	<b>800</b>	

**I YEAR**

**MATHEMATICS-I**  
**Algebra Trigonometry & Vectors (SC-101)**

**CHAPTER I**

Relation between the roots and coefficients of general polynomial equation in one variable. Transformation of equations. Descarte's Rule of signs. Solution of cubic equation (Cardon Method), Biquadratic equations. Circular function, hyperbolic function, Logarithm of a complex number, Gregory's series, Summation of series.

**CHAPTER II**

Review of Matrices, rank of a matrix. Inverse of a matrix, Application of matrices to a system of linear equations. Consistency of a system of linear equations. Eigenvalues, eigenvectors and characteristic equation of a matrix. Cayley Hamilton theorem and using it to find inverse of a matrix.

**CHAPTER III**

Definition of a group with examples, subgroup, cyclic group, Lagrange's theorem, Homomorphism and Isomorphism, Permutation groups. Even and odd permutations. The fundamental theorem of homorphism. Cayley's theorem.

**CHAPTER IV**

Scalar and vector product of three vectors. Product of four vectors. Reciprocal vectors Introduction to partial differentiation, Vector differentiation, Vector integration, Gradient, divergence and curl, Gauss's and Stoke's theorems.

**MATHEMATICS–II**  
**Geometry & Calculus (SC-102)**

**CHAPTER I**

Successive differentiation, Leibnitz theorem, Maclaurin and Taylor series expansions. Indeterminate form, Tangent and Normal (Cartesian curve), curvatures, Asymptotes singular points and curve tracing (only cartesian curve).

**CHAPTER II**

Length of curves, Area of Cartesian curves, Volumes of revolution and surfaces of revolution.

**CHAPTER III**

Definition of differential equation, Order and degree of differential equation. Differential equation to first order and first degree. Exact differential equations, First order higher degree differential equations, Clairaut's form and singular solution. Linear differential equation with constant coefficient. Homogeneous linear ordinary differential equations. Linear differential equation of second order Wronskian.

**CHAPTER IV**

**Geometry (2-dim) :** Coordinate system, General equation of second degree, System of conics, Confocal conics.

**Geometry (3-dim) :** Coordinate system, Direction cosines and ratios, The plane, The straight line, Sphere, Cone Cylinder.

**Physics-I**  
**MECHANICS (SC-103)**

**CHAPTER-1 : VECTOR ANALYSIS**

Scalars and vectors, dot and cross products, Triple and Quadruple product of vectors, Scalar and Vector fields, Gradient of a scalar field and its geometrical interpretation, Divergence and Curl of a vector field.

**CHAPTER-2 : 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.

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

**CHAPTER-3 : PROPERTIES OF MATTER**

Elasticity, Hook'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, Reynold's number, Stoke's law and terminal velocity. Surface tension and surface energy, molecular interpretation of surface tension, pressure on a curved liquid surface.

**UNIT-4 : RELATIVITY**

Reference system, Inertial frames, Gallilean 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.

**CHAPTER-5 : OSCILLATIONS**

Potential well and periodic oscillations, case of harmonic oscillation. 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.

Superposition of two simple harmonic motion of same frequency along the same line Interference, Superposition of two mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures, case of different frequencies.

## **ELECTRICITY AND MAGNETISM (SC-104)**

### **CHAPTER-1 : ELECTROSTATICS**

Coulomb's law in vacuum expressed in vector form. Force between a point charge and continuous charge distribution. Electric field and Potential for a continuous charge distribution. Electric field in a material medium. Dielectric polarization and dielectric constant. Polarisation 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.

### **CHAPTER-2 : VARYING AND ALTERNATING CURRENTS**

Kirchoff's law & analysis of multiloop circuit, Growth of current in LR circuit Charging and discharging of a capacitor through a resistance and through a LR circuit. Measurement of high resistance by leakage method.

A.C. circuit containing R, L & C. Impedance and admittance, Phasor diagram for current and voltage in AC circuits, Analysis of AC circuits using operator, Series and parallel resonant circuits, Q-factor, Power consumed by an A.C. circuit. Choke coil.

### **CHAPTER-3 : 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 application to a long straight conductor, circular coil and solenoid. Ampere's law and its applications.

Motion of a charged particle in a magnetic field and cyclotron. Torque on a current carrying loop in a magnetic field. Theory of Ballistic galvanometer. Critical damping. Current and charge sensitivity.

Magnetic permeability and susceptibility, Relation between them. Hysteresis. Theory of Para, Dia- and Ferro magnetism.

### **CHAPTER-4 : 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.

### **CHAPTER-5 : ELECTROMAGNETIC WAVES**

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



**Inorganic Chemistry**  
**SC-105**

**UNIT-I: ATOMIC STRUCTURE AND PERIODIC PROPERTIES**

Dual nature of matter and idea of de Broglie matter waves, de Broglie equation; Wave mechanical model, Heisenberg uncertainty principle, Schrodinger wave equation (Derivation not required), Quantum numbers, Aufbau and Pauli exclusion principles. Hund's multiplicity rule.

Definitions and applications of atomic and ionic radii, ionization energy, electron affinity and electronegativity.

**UNIT-II: CHEMICAL BONDING**

Valence bond theory and its limitations, various types of hybridization and shapes of simple inorganic molecules and ions. Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, Fajan's rule, inert pair effect, singlet bond, odd electron bonds and hydrogen bond.

**UNIT-III : s-BLOCK AND p-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 aluminium hydride, Comparative study of groups 13-17 elements, characteristics including their positions in the periodic table, Preparation and properties of diborane, borax, sodium thiosulphate, interhalogens, freon and teflon.

**UNIT-IV : CHEMISTRY OF NOBLE GASES**

History and isolation of noble gases, Position of noble gases in periodic table, compounds of noble gases.

**UNIT-V: RADIOACTIVITY**

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.

**UNIT-VI : CHEMISTRY OF ELEMENTS OF FIRST SECOND AND THIRD 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.

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

### **UNIT-VII : COORDINATION COMPOUNDS**

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of co-ordination compounds, isomerism in coordination compounds, valency bond theory, inner and outer orbital complexes

### **UNIT-VIII : LANTHANIDES AND ACTINIDES**

**Chemistry of lanthanides :** Occurrences, electronic structure, oxidation states, oxidation potential colour, solubility, colour, ionization potential, reactivity, melting and boiling points atomic and ionic radii, lanthanide contraction, complex formation, magnetic properties, separation of lanthanides.

**Chemistry of actinides :** General characteristics and chemistry of actinides, actinide contraction, Similarities between lanthanides and actinides, Chemistry of extraction of uranium,.

### **UNIT-IX : GENERAL METHODS OF EXTRACTION, PURIFICATION OF METALS, AND METALLURGY**

General methods of extraction and purification of metals, chemistry involved in the extraction of metals, *e.g.*, titanium, vanadium ,chromium, nickel and platinum.

### **UNIT X: STUDY OF COMPUNDS:**

Preparation, properties and uses of the following compounds :Titanium dioxide, titanium tetrachloride Chromyl chloride, potassium dichromate, potassium permanganate, potassium ferricyanide, chlorophatnic acid, sodium cobaltinitrite, sodium nitro prusside.

## **Organic Chemistry (SC-106)**

### **UNIT-I : STRUCTURE AND BONDING AND MECHANISM OF ORGANIC REACTIONS**

Hybridization, bond lengths and bond angles, bond energy, vander Waals interactions, resonance, inductive and electrometric effects, hydrogen bonding, homolytic and heterolytic bond breaking. Types of reagents-electrophiles and nucleophiles.

### **UNIT-II : STEREOCHEMISTRY OF ORGANIC COMPOUNDS**

Concept of isomerism. Types of isomerism.

Optical isomerism – elements of symmetry, molecular chirality, enantiomers, optical activity, diastereomers, meso compounds, racemization.

Relative and absolute configurations, D & L and R & S systems of nomenclature.

Geometrical isomerism – determination of configuration of geometrical isomers. E & Z system of nomenclature.

### **UNIT-III : ALKANES AND CYCLOALKANES**

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes, method of formation (with special reference to Wurtz reaction. Kolbe reaction, decarboxylation of carboxylic acids). Physical properties and chemical reactions of alkanes.

Cycloalkanes – Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations.

### **UNIT-IV : ALKENES AND ALKYNES**

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, ozonolysis, hydration, hydroxylation and oxidation with  $\text{KMnO}_4$ , Polymerization of alkenes.

Nomenclature, structure and bonding in alkynes, methods of formation and chemical reactions of alkynes. Acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions.

## **UNIT-V: 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 : Huckel rule, aromatic ions.

Aromatic electrophilic substitution – general pattern of the mechanism, role of  $\pi$ - and  $\pi$ -complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction in arenes (taking benzene as example).

## **UNIT-VI : ARYL HALIDES**

Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions.

Synthesis and uses of DDT and BHC.

## **UNIT-VII : ARYL ALDEHYDES AND KETONES**

Nomenclature and structure of the carbonyl group. Synthesis of aryl aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aryl aldehydes and ketones using 1, 3-dithianes, synthesis of aryl ketones from nitriles and carboxylic acids, properties of aryl aldehydes and ketones.

Preparation, properties and uses of benzaldehyde, salicylaldehyde and acetophenone.

### **SC-107 Chemistry Practical**

- Important Facts in Experimental Chemistry
- Chemical Analysis
- Identification of Acid Radicals
- Tests for Special Combinations of Acidic Radicals
- Interfering Acidic Radicals and Their Removal
- Tests for Basic Radicals
- Quick Approach to the Mixture Analysis
- Organic Analysis
- Chemical Kinetics
- Distribution Law
- Viscosity
- Surface Tension
- Appendix

**SC-113**  
**Physics Practical**

- To determine the moment of inertia of an irregular body, about an axis passing through its centre of gravity and perpendicular to its plane by dynamical method (Inertia Table).
- To determine the moment of inertia of a flywheel about its own axis of rotation.
- To study the variation of moment of inertia of a system with the variation in the distribution of mass and hence to verify the theorem of parallel axes.
- To estimate the time period of a simple pendulum using the theory of errors, graph-Gaussian distribution.
- To study simple harmonic underdamped oscillations and to calculate (i) time period  $T$  of oscillation, (ii) angular frequency, (iii) relaxation time and (iv) the quality factor  $Q$  of the oscillations.
- To determine Young's modulus, modulus of rigidity and Poisson's ratio of a given wire by Searle's dynamical method.
- To study the oscillations of a rubber band and a spring.
- To determine the coefficient of viscosity of water by Poiseuille's method.
- To determine terminal velocity of a body in a viscous medium (e.g. glycerine) by Stoke's Law.
- To draw velocity and momentum vectors in case of two dimensional collision.
- To convert a Weston galvanometer into an ammeter of a given range.
- To convert Weston galvanometer into a voltmeter of the given range.
- To determine the galvanometer resistance.
- To plot graph showing the variation of magnetic field with distance along the axis of a circular coil carrying current and to estimate from it the radius of the coil.
- To determine the self inductance of given coil by Rayleigh's method.
- To determine the self inductance of a coil by Anderson's method.
- To determine the self inductance by Maxwell's L/C bridge.
- To determine the self inductance of a given coil by Maxwell's induction bridge.
- Comparison of capacities by the method of mixtures.
- To determine the impedance (resistance and reactance) and power factor of an A.C. circuit.
- To find the resonant frequency of series LCR circuit using a variable frequency source (A.F. oscillator).
- To study the resonance in series LCR circuit with a source of given frequency (A.C. mains).
- To study a transformer to determine its (i) transformation ratio, (ii) percentage efficiency and (iii) copper losses.
- To obtain hysteresis curve (B.H. Curve) for a given ferromagnetic material (thin rod or thin wire) on a C.R.O. using a solenoid and then to determine the related magnetic constant from it.
- To determine hysteresis loss by C.R.O.

- To determine the magnetic moment  $M$  of a magnet and horizontal component of earth's magnetic field  $H$  at a place using deflection magnetometer and a vibration magnetometer.

## **Analysis SC-114**

### **CHAPTER I**

$\epsilon$ - $\delta$  definition of limit of a function, Continuity and differentiability, property of continuous function and types of discontinuities, Uniform continuity. Mean value theorems and their geometrical interpretations. Intermediate value theorem for derivatives.

### **CHAPTER II**

Limits and continuity of functions of two variables. Partial differentiation, Euler's theorem on homogeneous function, Jacobian.

### **CHAPTER III**

Envelopes, Evolutes, Maxima and Minima of functions of two variables. Lagrange's multiplier method.

### **CHAPTER IV**

Beta and Gamma function, Double and Triple integral, Change of order of integration, Dirichlet's integrals.

**SC-115**  
**Special function & Mechanics**

**CHAPTER I**

Power series solution of differential equation, Bessel's and Legendre equation with their properties, Orthogonality of Bessel functions and Legendre polynomials.

**CHAPTER II**

Partial differential equations of first order. Lagrange's solution. Some special types of equation which can be solved easily by methods other than the general method. Charpit's method.

**CHAPTER III**

Laplace transformation Linearity, Existence theorem, Laplace transforms of derivative and integral, Shifting theorem, Differential and integration of transform. Convolution theorem, Inverse of Laplace transforms, Solution of system of differential equations using the Laplace transformation.

**CHAPTER IV**

Forces in three dimensions, Poinsot's central axis, Stable and unstable equilibrium. Radial velocity and acceleration, transverse velocity and acceleration. Tangential velocities and acceleration, Normal velocity and acceleration, Rectilinear Motion, S.H.M., Moment of Inertia, D'Alembert Principle.

## HEAT AND THERMODYNAMICS

### CHAPTER-1 : KINETIC THEORY OF MATTER

Ideal Gas : Kinetic model, deduction of Boyle's law, interpretation of temperature, estimation of rms speeds of molecules, Brownian motion, estimate of the Avagadro number. Equipartition of energy, specific heat of monatomic gas, extension to di- and triatomic gases. Behaviour at low temperatures. Adiabatic expansion of an ideal gas.

Real Gas : Vander Waal gas, equation of state, nature of Vander Waals forces, comparison with experimental  $P$ - $V$  curves. Joule expansion of ideal gas, and of a Vander Waals gas, Joule coefficient, estimates of  $J$ - $T$  cooling.

### CHAPTER-2 : LIQUEFICATION OF GASES

Liquefication of gases : Boyle temperature and inversion temperature, Principle of regenerative cooling and of cascade cooling, liquefaction of hydrogen and helium.

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.

### CHAPTER-3 : THERMODYNAMICS

The laws of thermodynamics. The Zeroth law, first law of thermodynamics, internal and 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 Entropy, principles of increase of entropy. The thermodynamic scale of temperature;

### CHAPTER-4 : MAXWELL'S RELATIONS

Thermodynamic relationship : Thermodynamic variables; extensive and intensive Maxwell's general relationships, application to Joule-Thomson cooling and adiabatic cooling in a general system, Vander Waal gas, Clausius-Clapeyron heat equation Thermodynamic potentials and equilibrium of thermodynamical systems, relation with thermodynamical variables. Cooling due to adiabatic demagnetization.

### CHAPTER-5 : RADIATION

Black Body radiation : Pure temperature dependence, Stefan-Boltzman law, pressure of radiation. Spectral distribution of Black body radiation, Wein displacement law, Rayleigh-Jean's law. Planck's quantum postulates, Planck's law.

## **SC -117**

### **OPTICS**

#### **CHAPTER-1 : GEOMETRICAL OPTICS**

Fermat's principle : Principle of extremum path and its simple applications as reflection refraction and straight line motion of light.

General theory of image formation : Cardinal points of an optical system, general relationship thick lens, combination of two thin lenses, Nodal slide and Newton's formula, Huygen's and Ramsden's eyepieces. Aberration in images : Chromatic aberration, achromatic combination of lenses in contact and separated lenses, Monochromatic aberration and their reduction, crossed lens.

#### **CHAPTER-2 : INTERFERENCE**

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

#### **CHAPTER-3 : INTERFEROMETERS**

Michelson interferometer, its application 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 and etalon.

#### **CHAPTER-4 : DIFFRACTION**

Diffraction of Light : Fresnel diffraction, intensity due to cylindrical wavefront by Fresnel half period zone method, zone plate, Diffraction at straight edge.

Fraunhofer diffraction : Diffraction at a slit and 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.

#### **CHAPTER-5 : POLARIZATION**



Double refraction and Optical Rotation : Refraction in uniaxial crystal , its electromagnetic theory, quarter waveplate and half waveplate, double image prism, Rotation of plane of polarisation, Fresnel explanation of rotation.

## SC-118

### Physical Chemistry

#### UNIT-I : GASEOUS STATE

Postulates of kinetic theory of gases, derivation of kinetic equation, deviation 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.

Elementary idea of root mean square, average and most probable velocities, qualitative discussion of Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter.

#### UNIT-II : CHEMICAL KINETICS

**Chemical Kinetics** : Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half life. Determination of the order of reaction by 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 unimolecular reactions, transition state theory (mathematical treatment).

#### UNIT-III : CATALYSIS

Catalysis, characteristics of catalysed reactions, classification of catalysis, enzyme catalysis including its kinetics, industrial applications of catalysis.

#### UNIT-IV : COLLOIDAL STATE

Definition of colloids, classification of colloids.

Solids in liquids (sols) : Properties – kinetic, optical and electrical.

Stability of colloids, protective action, Hardy-Schulze law, gold number.

Elementary idea of liquids in liquids (emulsions), types of emulsions, preparation, Emulsifiers.

General applications of colloids.

### **UNIT-V : LIQUID STATE**

Elementary idea of intermolecular forces, structural differences between solids, liquids and gases, liquid crystals, classification and structure, differences between liquid crystal, solid and liquid.

### **UNIT-VI : SOLID STATE**

Crystalline and amorphous solids – main differences,

Laws of crystallography, space lattice, unit cell, Miller indices, Bragg's equation (only derivation).

### **UNIT-VII : THERMODYNAMICS-I**

Definition of thermodynamic terms : system, surroundings etc., types of systems, intensive and extensive properties. state and path functions, thermodynamic process.

Concept of heat and work.

*First law of thermodynamics* : Statement and mathematical formulation, definition of internal energy and enthalpy. Elementary idea of heat capacity, Joule-Thomson coefficient and inversion temperature.

(a) *Second law of thermodynamics* : Need for the second law, Different statements of the law, Carnot cycle and its efficiency.

(b) *Entropy* : Concept, entropy as a state function, entropy as a function of V and T, entropy as a function of P and T, entropy as a criteria of spontaneity and equilibrium.

(c) Concept of free energy and work function. Derivation of Gibbs-Helmholtz equation and Clausius-Clapeyron equation and applications.

(d) *Third law of thermodynamics* : Statements of third law of thermodynamics and Nernst heat theorem.

### **UNIT-VIII : THERMOCHEMISTRY**

Enthalpy of reaction and formation, Hess' law of heat summation and its applications, Enthalpy of reaction at constant pressure and constant volume. Enthalpy of neutralization. Temperature dependence of enthalpy, Kirchoff's equation.

### **UNIT-IX : PHASE EQUILIBRIUM**

Statement and meaning of the terms used in phase rule, application of phase rule to water system and lead-silver systems. Henry's law, Nernst distribution law, derivation of law distribution in case of association, application of distribution law to solvent extraction.

### **UNIT-X : ELECTROCHEMISTRY-I**

Specific conductance and equivalent conductance, Measurement of equivalent conductance, Variation of equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch's law, important applications of the law. Transport number, its definition.

Applications of conductivity measurements : Determination of degree of dissociation, determination of solubility product of a sparingly soluble salt.

### **UNIT-XI: ELECTROCHEMISTRY-II**

Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, electrode reactions, Nernst equation, Concept of single electrode potential, standard hydrogen electrode, reference electrode, standard electrode potential, Sign conventions.

Electrolytic and galvanic cells-reversible and irreversible cells.

Concentration cell with and without transport (derivation not required), Applications of concentration cells.

Definition of pH and  $pK_a$ , determination of pH using hydrogen electrode.

Buffers, mechanism of buffer action, Henderson-Hassel equation.

Hydrolysis of salts.

### **UNIT-XII : SPECTROSCOPY**

Introduction, electromagnetic radiations, regions of the spectrum, Elementary idea of infrared, rotational and vibrational spectrum, Raman spectrum.

### **UNIT–XIII : PHOTOCHEMISTRY**

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry : Beer's law and Stark-Einstein law.

Quantum yield and reasons for low and high quantum yields of photochemical reactions.

Definitions of fluorescence, phosphorescence and photosensitization.

### **UNIT–XIV : DILUTE SOLUTIONS AND COLLIGATIVE PROPERTIES**

Colligative properties, Raoult's law of relative lowering of vapour pressure, molecular weight determination,

Elevation of boiling point and depression of freezing point, relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining molecular weights from elevation of boiling point and depression in freezing point.

vant' Hoff factor.

### **UNIT XV: PHYSICAL PROPERTIES AND MOLECULAR STRUCTURE**

Polar and non polar molecules, dipole moment, its determination and applications, magnetic properties of substances.

## Organic Chemistry II

SC-119

### UNIT-I : ALCOHOLS AND PHENOLS

**Alcohols** : Classification and nomenclature.

**Monohydric alcohols** : Nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, reactions of alcohols.

**Dihydric alcohols** : Nomenclature, methods of formation and chemical reactions.

**Trihydric alcohols** : Nomenclature and methods of formation, chemical reactions of glycerol.

Nomenclature, preparation of phenols, physical properties and acidic character, comparative acidic strength of alcohols and phenols, Reactions of phenols. Mechanism of Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction.

Methods of preparation and properties of picric acid.

### UNIT-II : CARBOXYLIC ACIDS

Methods of formation and chemical reactions of tartaric acid, citric acid, malic acid, malonic acid, benzoic acid, salicylic acid, anthranilic acid.

### UNIT-III: ORGANOMETALLIC COMPOUNDS AND AROMATIC SULPHONIC COMPOUNDS

Grignard reagents : Formation and chemical reactions, organolithium and organosulphur compounds, thiols and sulphanol.

Sulphonation, preparation and properties of benzene sulphonic acid, saccharin, chloramines-T

### UNIT-IV: POLYNUCLEAR HYDROCARBONS AND HETEROCYCLIC COMPOUNDS

**Polynuclear hydrocarbons:** Naphthalene and its constitution, preparation, properties and uses, Anthracene: preparation, properties and uses.

**Heterocyclic compounds:** Introduction, aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution preparation, properties and uses of indole, quinoline, and isoquinoline. Fischer-indole synthesis

#### **UNIT-V : REACTIVE METHYLENE COMPOUNDS**

Acidity of  $\alpha$ -hydrogens. Synthetic applications of diethyl malonate and ethyl acetoacetate. Synthesis of diethyl malonate and ethyl acetoacetate. Claisen condensation, keto-enol tautomerism of ethyl acetoacetate.

#### **UNIT VI : SULPHA DRUGS**

Sulpha drugs, mechanism of their action, synthesis and uses of sulphacetamide, sulphaguanidine, sulphapyridine, sulphadiazine, sulphathiazole, sulphamethazine.

### **SC-120**

#### **Practical Chemistry-II**

#### **I-INORGANIC CHEMISTRY**

##### **Volumetric Analysis**

- Estimation of iron using
- Estimation of copper sulphate using sodium thiosulphate
- Estimation of silver nitrate using ammonium thiocyanate or sodium chloride

#### **II-ORGANIC CHEMISTRY**

##### **(i) Qualitative Analysis**

- Identification of an aliphatic and aromatic organic compound (including N, S and halogen containing compounds) through the functional group analysis, determination of melting point/boiling point and preparation of suitable derivatives.

##### **(ii) Paper Chromatography**

- To separate and identify the sugars present in the given mixture by the technique of paper chromatography and report the values.

- To separate and identify amino acids (glycine, aspartic acid, glutamic acid and tyrosine in a mixture of amino acids with the help of paper chromatography).

### **III-PHYSICAL CHEMISTRY**

#### **(i) Transition Temperature**

- Determination of the transition temperature of the given substance by thermometric method (e.g.,

#### **(ii) Solubility**

- To determine the solubility of benzoic acid at 40°C and at a temperature lower than the room temperature by titration method.
- To determine the solubility of in water at 30°, 40°, 50° and 70°C and thus plot a solubility curve also.

#### **(iii) Adsorption**

- To study the adsorption of acetic acid on charcoal and prove the validity of Freundlich's adsorption isotherm.

#### **(iv) Thermochemistry**

- To determine the enthalpy of neutralization of a strong acid versus strong base.

## **SC-121**

### **Practical Physics**

#### **Experiment Name**

1. To determine the coefficient of apparent expansion of a liquid (water) with a weight thermometer.
2. To determine the coefficient of real expansion of liquid (water) by upthrust method.
3. To determine the specific heat of liquid (glycerine) by the method of cooling.
4. To determine the latent heat of steam by Jolly's steam calorimeter.
5. To determine the mechanical equivalent of heat (J) with the help of Joule's calorimeter.
6. To determine the coefficient of thermal conductivity of a metal by using Searle's apparatus.
7. To determine the thermal conductivity of a nonmetallic solid (bad conductor) by Lee's disc method.
8. To determine the thermal conductivity of rubber in the form of a tube.
9. To determine Planck's constant, by measuring radiation in fixed spectral range.
10. To determine the critical temperature and critical pressure of a gas.
11. To measure temperature with the help of Jolly's constant volume air thermometer.
12. To determine the refractive index of the material of the prism for the given colors of mercury light with the help of a spectrometer.
13. To determine the dispersive power of the material of the prism for violet and yellow colors of mercury light with the help of a spectrometer.
14. To determine the angle between crystal surfaces by a spectrometer.

15. To determine the refractive indices  $\mu_o$  and  $\mu_e$  of calcite (or quartz) for the ordinary and extra ordinary rays using a spectrometer and sodium light.
16. To determine (i), the wavelength of sodium yellow light (ii), the difference between the wavelengths of two sodium D-lines, with the help of Michelson interferometer.
17. To determine the separation between plates of a Fabry-Perot Etalon.
18. To determine the wavelength of prominent lines of mercury by plane diffraction grating.
19. To determine the wavelength of monochromatic light by diffraction at a straight edge.
20. To determine the resolving power of a telescope.
21. To determine the resolving power of a grating.
22. To verify Fresnel's formulae for the reflection of light.
23. To determine the radii of curvature of the surfaces of a convergent lens and hence to calculate its refractive index.
24. To determine the refractive index of the material of a concave lens.
25. To determine the refractive index of a liquid using Pulfrich refractometer.

## **MATHEMATICS-I**

SC-127

### **CHAPTER I**

Sequence, Theorems on limits of sequences, Bounded and monotonic sequences, Cauchy's convergence criterion. Series of non-negative terms, Comparison tests, Cauchy integral test, Ratio test, Raabe's, logarithmic, De-Morgan and Bertrand's tests. Alternating series, Leibnitz's theorem, Absolute and conditional, uniform convergence.

### **CHAPTER II**

Reimann integral, Integrability of continuous and monotonic function. The fundamental theorem of integral calculus. Mean value theorems of integral calculus.

### **CHAPTER III**

Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's test, Series of arbitrary terms, Convergence, divergence and oscillation, Abel's and Dirichlet's tests.

### **CHAPTER IV**

Complex numbers as ordered pairs, Geometric representation of complex numbers, Continuity and differentiability of a complex functions. Analytic function, Cauchy-Riemann equations, Harmonic function.



## **MATHEMATICS–II**

SC-128

### **CHAPTER I**

Ring, Subring, integral domain, fields, Ring homomorphism, Ideals and Quotient Rings, Field of Quotients of integral domains. Euclidean Rings.

### **CHAPTER II**

Vector spaces, Subspaces, Sum and direct sum of subspace, Linear span, linear dependence, independence and their basic properties, Bases, Finite dimensional vector space. Existence theorem for basis. Dimension of sum of subspaces. Quotient space and its dimension.

### **CHAPTER III**

Linear transformations and their representation matrices. The Algebra of linear transformations, The rank nullity theorem, Change of basis, Dual space.

### **CHAPTER IV**

Definition of metric spaces with examples, Neighborhoods, Limit point, Interior points, Open and closed sets. Closure and interior, Boundary points.

SC-129

## **Atomic & Nuclear Physics**

### **Unit-I-Atomic Physics**

Bohr model of hydrogen atom, Spectral series of atomic hydrogen, Effect of nuclear motion, Frank-Hertz experiment, Sommerfeld theory of elliptical orbits, Vector atom model, L-S and J-J coupling.

Structure of alkali spectra, Doublet fine structure, Stern-Gerlach experiment concept of quantum numbers and Pauli's exclusion principle.

X-Ray spectrum and its dependence on voltage, Duane and Hunt's law, Characteristic X-Ray spectrum, Moseley's law, Doubled structure of X-ray spectra, X-ray absorption spectra.

## **Unit-II-Molecular Physics**

Discrete set of electronic energies of molecules, Types of molecular spectra, quantization of vibrational and rotational energies, Determination of internuclear distance. Pure rotational and rotation-vibration spectra.

Dissociation limit for the ground and other electronic states, Transition rules for pure vibration and electronic vibration spectra isotope effect.

Raman Effect, Stokes and anti-stokes lines, Complementary character of Raman and Infra-Red Spectra, Experimental arrangement for Raman Spectroscopy.

## **Unit-III-Quantum Mechanics**

Origin of quantum theory : Failure of classical physics to explain the phenomenon such as black-body spectrum, Planck radiation law, photoelectric effect, Einstein's explanation of photoelectric effect.

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 and X and its extension to energy and time.

Wave function, position probability, Schrodinger's equation, postulational basis of quantum mechanics operators, expectation value, eigen value and eigen function, Solution of Schrodinger equation for a particle in a rigid one and three dimensional boxes, linear harmonic oscillator.

## **Unit-IV-Laser Physics**

Purity of a spectral line, Coherence length and coherence time, spatial coherence of a source, Einstein's 'A' and 'B' coefficients, spontaneous and induced emissions,

Conditions for laser action, population inversion, pumping process, pulsed and tunable lasers, spatial coherence and directionality, estimates of beam intensity, temporal coherence and spectral energy density, population inversion in three and four level laser systems, types of lasers ruby laser, Helium-Neon laser.

## **Unit-V-Nuclear Physics**

Interaction of charged particles and neutrons with matter working of nuclear detectors, Ionization Chamber, proportional counter, G.M. counter and scintillation counter.

Structure of nuclei, basic properties angular momentum, parity, magnetic dipole moment electric quadruple moment, general concept of nuclear forces, Alpha decay and Beta decay.

Nuclear reactions, Q-value of nuclear reaction, Theories of nuclear reactions-compound nucleus, Liquid drop model, fission and fusion (concepts), Shell Model.

## **ELECTRONICS**

SC-130

### **CHAPTER-1 : CRYSTAL STRUCTURE AND DIFFRACTION**

Crystalline and amorphons solids, Crystal structure, periodicity, lattice and bases fundamental translation vectors, unit cell, Wigner-Seitz cell, symmetry operations, Bravais lattice in two and three dimensions sc, bcc and fcc lattice, lattice planes in a crystal, Miller indices and interplaner spacing, common crystal structures, NaCl, CsCl, Diamond and hcp.

X-Ray diffraction Bragg's law, Laue method, Rotating Cylinder and powder method for crystal structure.

### **CHAPTER-2 : SOLID STATE DEVICES**

Intrinsic semiconductors, electrons and holes, fermi level, temperature dependence of electron and hole concentration, Doping, impurity states, *n*- and *p*-type semiconductors conductivity and mobility, *p-n* junction, majority and minority carriers, junction diode. Zener diode, tunnel diode, light emitting diode, photodiode, Scottky diode and solar cells.

Load line concept, half wave and full wave rectifiers, ripple factor and efficiency, filters, zener diode voltage regulator, IC voltage regulators.

### **CHAPTER-3 : BIOPOLAR TRANSISTOR**

PNP and NPN transistor, working and characteristics of a transistor in CB, CE and CC mode, graphical analysis of CE configuration, low frequency equivalent circuits *h*-parameters, transistor biasing (fixed bias and voltage divider bias) and stabilization.

### **CHAPTER-4 : FIELD EFFECT TRANSISTORS**

Construction, working and Volt-ampere curves of JFET, a.c. operation of JFET, Depletion and enhancement mode MOSFET, biasing MOSFET, FET as variable voltage resistor Operational Amplifier (Op-app) Characteristics of Ideal Op-amp, parameter of Op-amp. Op-amp as inverting and non-inverting amplifier.

### **CHAPTER-5 : SMALL SIGNAL AMPLIFIERS**

General principles of operation, classification of amplifiers, R.C. coupled amplifiers gain-frequency response, equivalent circuit at low, medium and high frequencies input and output impedance, multistage amplifiers, transformer coupled amplifiers (qualitative analysis).

Low frequency common source and common drain amplifier, feedback in amplifiers emitter follower and low frequency common source amplifier.

## **ENVIRONMENTAL STUDIES** **SC-131**

### **Unit – I**      **The Multidisciplinary Nature of Environmental Studies**

Environment, Natural resources, Forest resources, Mining and its effects, Water resources, Floods, Drought, Dams, Mineral resources, food resources, Energy resources, land resources.

### **Unit – II**      **Ecosystem, Biodiversity and its conservation**

Concept of ecosystem, energy flow in ecosystem, ecological succession, different ecosystems, biodiversity, India as a mega diversity nation, levels of biodiversity, value of biodiversity, threats to biodiversity, endangered and endemic species, conservation of biodiversity, hot spots of biodiversity, biodiversity at global, national and local levels.

### **Unit – III**      **Environmental Pollution**

Pollution and pollutants, water pollution, air pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards, solid waste management, disaster management, pollution control, formation and depletion of ozone in the stratosphere, lapse rate and temperature inversion, acid rain, greenhouse effect, photochemical smog.

### **Unit – IV**      **Social Issues and the environment**

Sustainable development, urban problems related to energy, water conservation, rain water harvesting, water land management, resettlement and rehabilitation of people, environment ethics, wasteland reclamation, consumerism and waste products, environmental protection act, issues involved during enforcement of environmental laws.

### **Unit – V**      **Human Population and Environment, Environmental Management**

Population growth, family welfare programs, environment and human health, HIV/AIDS, human rights, value education, women and child welfare, role of information technology in environment and human health.

Concept of ecological balance, measures for ecological balance.

### **Unit – VI**     Phytogeographic regions.

Major plant communities of the world, soils of India, climate of India, vegetation of India.

## **SC-132**

### **Industrial Chemistry**

#### **Unit-I-Introduction To Unit Operations And Unit Process**

Introduction, Conveying, Crystallization, Distillation, Drying, Evaporation, Filtration, Leaching, Liquid-liquid extraction, Membrane separation, Particle size reduction and enlargements, Solid-solid separation.

Alkylation, amination by ammonolysis, amination by reduction, Calcination, Carbonylation, Double decomposition, Esterification, Halogenation, Hydrogenation, Hydroformylation, Hydrolysis, Nitration, Oxidation, Polymerization, Sulphonation.

#### **Unit-II-Petrochemicals And Polymers**

Introduction to Petrochemicals, Manufacture of Petrochemicals, Major Petrochemical Industries in India.

Introduction to Polymers, Nomenclature and Classification, Methods of preparation, Classification of polymerization reactions, polymerization techniques, Utilization of Commercial Polymers, Thermoplastic and thermosetting polymers, Rubber, Inorganic Polymers, Scenario of polymer industries in India.

#### **Unit-III-Dyes And Drugs**

**Dyes :** Introduction, Color and chemical constitution, Classifications of dyes, Picric acid, Methyl orange, Congo red, Para red, Aura mine G, Malachite green, Para aniline, Rosaniline, Crystal violet, Phenolphthalein, Fluoreseein, Eosin, Mercurochrome, Indophenols, Quinoline, Indigo, Alizarin, Manufacture of dyes (Rhodamine B).

**Drugs :** Introduction, Sulphonamides, Sulphamethizole, Sulphacetamide, Sulphagunidine, Sulphanilamide, Sulphapyridine, Sulphathiazole, Sulphamerazine, Phenacetin, Acetanilide, Aspirine, Salol, Salicylamide, Oapsone, Paracetamol, Antipyrine, Chloroquin, Paludrine, Antibiotics with penicillin, Chloromycetin and streptomycin as examples, Manufacture of drugs by taking example of aspirins.

#### **Unit-IV-Inorganic Chemicals And Industrial Gases**

Alumina, Aluminum sulphate, Fluorocarbons, Bromine, Sodium, dichromate, Sodium Silicate, Sodium, dichromate thiosulphate nitrate, Sodium sulphide, Sodium bisulphite,

Sodium bisulphate, Copper sulphate, Potassium permanganate, Potassium bromide, Potassium nitrate, Potassium dichromate, Urea, Ammonium sulphate Ammonium nitrate, Bromine and fluorocarbon industries in India.

Introduction to industrial gases, Nitrogen, Oxygen, Hydrogen, Carbon dioxide, Industrial gases industries in India.

### **Unit-V-Pigments, Cement And Lime**

**Pigments :** Introduction, White pigments, Black pigments, Blue pigments, Red pigments, Green pigments, Brown pigments, Toners and lakes, Metallic powders as pigments, Scenario of dyes and pigment industries in India.

**Cement and lime :** Introduction, Cement, Lime, Cement and lime industries in India.

## **SC-134 Practical Physics**

### **CONTENTS**

- To draw the characteristics of PN Junction Diode.
- To draw characteristics of a PNP junction transistor () in common emitter configuration and determination of current gain  $\beta$ .
- To plot the characteristics of a Zener Diode.
- To draw the characteristics of a Tunnel Diode.
- To plot output characteristics of FET and measure pinch off voltage.
- To design and study amplifying characteristics of a single stage RC coupled amplifier.
- To study response characteristics of a transistorized RC coupled amplifier with and without negative current feed back.
- To determine the frequency response of a single stage LC coupled amplifier.
- To design and study amplifying characteristics of a single stage transformer coupled amplifier.
- To study a push pull amplifier using transistors.
- To study voltage gain, input impedance, output impedance, and power gain of an emitter follower.
- (i) To study thermal effects on the output of a transistor amplifier.  
(ii) To study effect of emitter bypass resistor for bias stabilization.
- Measurement of h-parameters of a transistor (AC-126) at 1 kc/s.
- To determine the band gap in a semiconductor using a PN junction diode.

- To study OP-AMP in (a) inverting mode (summing amplifier) (b) non-inverting mode (c) integrator (d) differentiator (e) difference amplifier.
- To find the value of  $e/m$  for an electron by Thomson's method using bar magnets.
- To determine the electronic charge by Millikan's method.
- To find the value of plank's constant and photo electric work function of the material of the cathode using a photo electric celle.
- To verify inverse square law of radiation using a photo electric cell.
- To study the characteristics of a photo-voltaic cell solar cell ?
- To study the voltage current ( $V - I$ ) Power load ( $VI - R$ ) areal and azimuthal characteristics of a photo voltalic cell.
- To draw the plateau curve for a Geiger Muller counter.
- To find the dead time of a G.M. counter.
- To find the half life period of a given radioactive substance using a G.N. counter.
- To study double slit interference by Helium Neon laser.
- To determine the wavelength of laser light by using transmission diffraction grating.