B.Sc. Part -I (Physics)

Paper I –Mechanics and wave Motion

Unit -I

Inertial reference frame, Newton's laws of motion, Dynamics of particle in rectilinear and circular motion, Conservative and Non –conservative forces, Conservation of energy, liner momentum and angular momentum, Collision in one and two dimensions, cross section .

Unit -II

Rotational energy and rotational inertia for simple bodies, the combined translation and rotational and motion of a rigid body on horizontal and inclined planes, Simple treatment of the motions of a top. Relations between elastic constants, bending of Beams and Torsion of Cylinder.

Unit -III

Central forces, Two particle central forces problem, reduced mass, reduced mass, relative and centre of mass motion, Law of gravitation, Kepler's laws, Motions of planets and satellites, geo-stationary satellites.

Unit -IV

Simple harmonic motion, differential equation of S. H. M. and its solution, uses of complex notation, damped and forced vibrations, composition of simple harmonic motion.

Differential equation of wave motion, plane progressive waves in fluid media, reflection of waves ,phase change on reflection , superposition , stationary waves ,pressure and energy distribution , phase and group velocity.

Paper II -Circuit fundamentals and basic electronics

Unit-I

Growth and decay of currents through inductive resistances ,charging and discharging in R.C. and R.L.C. circuits , Time constant , Measurement of high resistance.

Alternating currents in R.L.C. circuits, complex impedances, phase diagrams, Q factor, series and parallel resonant circuits, theory of coupled circuits, Transformers, Reflected Impedance and impedance matching.

A.C. Bridges, Maxwell's and Scherings Bridges , Wien Bridge .

Unit -II

Semiconductors, Intrinsic and extrinsic semiconductors, n-type and p-type semiconductors, Unbiased diode Forbard bias and Reverse bias diodes , Diode as a rectifier , diode characteristics ,Zener diode , Avalanche and Zener Breakdown , Power supplies ; rectifier , Bridge rectifier , capacitor input filter , Voltage regulation , Zener Regulator.

Bipolar transistors, three doped regions, forward and reverse bias , DC alpha , DC beta transistor curves.

Unit –III

Transistor biasing circuits: base bias , emitter bias and voltage divider bias, DC load line .

Basic AC equivalent circuits , Low frequency model ,small singal amplifiers , common emitter amplifier, common collector amplifers ,and common base amplifiers , Current and Vottage gain , R.C. coupled amplifer Qualitative treatment only , Frequency response.

Unit-IV

Feedback in amplifiers Input and Output impedance of negative feedback amplifiers, Transistor as an Oscillator, General discussion and theory of Hartley oscillator only.

Elements of transmission and reception, Basic Principles of amplitude modulation and demodulation. Principle and design of linear multimeters and their application, Cathode ray Oscilloscope and its simple applications.

Paper III – Optics

Unit-I

Coherence and Interference of light , Biprism , Thin films , Newton's Rings , Michelson's and Fabry Perot interferometers , Lummer Plate , Multiple beam interference , filters.

Unit-II

Fresnels diffraction, Fresnel's zones and propagation of light , Zone plate , Fresnel's diffraction at straightedge and narrow wire , Fraunhofer diffraction at multiple slits , limiting cases – single and double slits.

Unit-III

Resolving power – criterion, expressions for resolving powers of telescope, grating.
Polarization, Double refraction in uniaxial crystals, Nicol prism, polaroids and retardation plates, Babinet's compensator. Analysis of polarised light.

Unit-IV

Optical activity and Fresnel's explanation, Half shade and Biquartz polarimeters .
Matrixr representation of plane polarized waves, matrices for polarizers, retardation plates and rotators, Application to simple systems.

B.Sc. Part - II (Physics)

Paper I – Electricity, Magnetism

Electrostatics

Coulomb's law, Electric Field and potentials, Field due to a uniform charged sphere, Derivations of Poisson and Laplace Equations, Gauss Law and its application: The Field of a conductor . Electric dipole, Field and potential due to an electric dipole, Dipole approximation for an arbitrary charged distribution, Electric quadruple, Field due to a quadruple , Electrostatic Energy of a charged uniform sphere , Energy of a condenser .

Unit -II

Magnetostatics

Magnetic field , Magnetic force on a current , Magnetic Induction and Bio – Savart Law , Lorentz Force , Vector and Scalar Magnetic potentials , Magnetic Dipole , Magnetomotive force and Ampere's Circuital theorem and its applications to calculate magnetic field due to wire carrying current and solenoid .

Unit –III

Electromagnetic Induction

Laws of Induction, Faraday's laws and Lanz's Law. Mutual and Self Induction , Vector potential in varying Magnetic field , Induction of current in continuous media , Skin effect , Motion of Electron in changing magnetic field , Betatron , Magnetic energy in field , Induced magnetic field (Time varying electric field) ,Displacement current , Maxwell's equations, Electromagnetic waves in free space , Poynting Vector , Theory and working of moving coil ballistic galvanometer .

Unit –IV

Dielectrics

Dielectric constant, polarication , Electronic polarization , Atomic or ionic Polarisation , Polarisation charges , Electrostatic equation with dielectrics , Field , force and energy in Dielectrics .

Magnetisation Properties of Matter

Intensity of magnetization and magnetic susceptibility, Properties of Dia , Para nd Ferromagnertic materials , Curie temperature , Hysteresis and its experimental determination.

Paper II – Thermal Physics

Unit – I

Thermal equilibrium, Zeroth law of thermodynamics, Temperature concept, Equations of State, Van der Waal's equation, Critical constants, principle of corresponding states.

Unit –II

First law of thermodyanamics , Absolute scale of temperature Entropy , Degradation of energy , Enthalpy Helmholtz function , Gibbs function , Maxwell's thermodynamics relations and their application.

Unit –III

Differential and Integral Joule Thomson effect, Inversion temperature, Liquification of gasses (no Experimental details). Adiabatic demagnetization, He I and II. Clausius Clapeyron equation.

Unit – IV

Kinetic theory, Maxwell – Boltzmann law, Equipartion of energy, Mean free path, transport phenomena, Brownian motion Avogadro number.

Thermodynamic and Kinetic temperature, Blackbody radiation, Stefan Boltzmann's law , Plsnck's law and its verification .

Paper III – Elements of Quantum Mechanics and Atomic Spectra.

Unit –I

Inadequacies of classical mechanics , Photoelectric phinomena , Compton effect , Wave-particle duality , de Briglie matter waves and their experimental verification , Heisenberg's Uncertainty principle , Complementary principle , Principle of superposition , Motion of wave packets .

Unit –II

Schr'odinger wave equation , Interpretation of wave function , Expectation values of dynamical variables , Ehrenfest theorem , Orthonormal properties of wave functions , One diomensional motion in step potential , Rectangular barrier , Square well potential , Particle in a box normalization .

Unit –III

Bohratomic model, Sommerfeld elliptic orbits, Spin and orbital magnetic moments, Stern – Gerlach experiment, Pauli's exclosion principle and periodic table. Optical spectra of alkali and alkaline earth elements, Fine structure of spectral lines, Coupling schemes (LS and JJ) for two electron systems.

Unit -IV

Normal and anomalous Zeeman Effect and Paschen Back effect of one electron systems, Experimental observation, X-ray spectra – continuous and characteristic, their generation and uses, Spin and screening doublets.

Books Recommended:

1. A Beiser- Concept of Modern Physics, McGraw-Hill, New York.
2. R.M. Eisberg – fundamentals of Modern Physics, Wiley, New York.
3. H.E. White – Introduction to Atomic Spectra, McGraw-Hill, New York.

B.Sc. – III (Physics)

Paper – I Elements of Relativistic, Classical & Statistical Mechanics:

Unit – I

Relativistic Mechanics:

Earth as a reference frame, Galilean transformation, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformations, Lorentz contraction and time dilation, Law of addition of velocities, variation of mass with velocity, Principle of equivalence of mass and energy.

Unit – II

Classical Mechanics:

Mechanics of a system of particles, generalized co-ordinates, D'Alembert's principle. The Lagrangian formulation and Lagrange's equations of motion. Calculus of variation and it's applications. The Hamiltonian formulation and Hamilton's equation of Motion.

Unit – III

Classical Mechanics & Statistical Mechanics:

The rigid body motion, Force-free motion of symmetrical rigid body. Two – body central force problem, reduction to equivalent one-body problem, the equation on motion and first integrals, Classification of orbits, Orbit for integrable power-law potentials, Inverse square law-Kepler problem. Inadequacy of Classical Mechanics, phase space, Liouville's theorem, connection between statistical and thermodynamic quantities.

Unit – IV

Statistical Mechanics:

Ensembles, the microcanonical, the canonical and grand canonical ensembles, Maxwell-Boltzmann statistics, Partition function, Maxwell Velocity distribution and mean values, equipartition theorem, Statistics of interacting systems, Van der Waal's gas, Statistics of identical particles, Fermi-Dirac and Bose-Einstein Statistics, simple applications, electron gas and Planck's oscillator.

Paper – II – Solid State and Nuclear Physics:

Unit – I

Crystal Structure:

Lattice translation vectors and lattice, Symmetry operations, Basis and crystal structure, Primitive Lattice cell, Two-dimensional lattice type, systems, Number of lattices, Point groups and plane groups, Three dimensional lattice types, System, Number of Lattices, Points groups and space groups, Index system for crystal planes-Miller indices, Simple crystal structures, NaCI, hep, diamond, Cubic ZnS and hexagonal ZnS, Occurrence of Nonideal crysal structures, random stacking of polytyprism, glasses.

Crystal Diffraction and Reciprocal Lattice:

Incident beam, Bragg law, Experimental diffraction method, Laue method, Rotating-crystal method, Powder method Derivation of scattered wave amplitude, Fourier analysis, Reciprocal lattice vectors, Diffraction conditions, Ewald

method, Brillouin zones, Reciprocal lattice to sc, bcc and fcc lattices, Fourier analysis os the basis and atomic form factor.

Unit – II

Crystal Bindings:

Crystal of inert gases, Van der Walls-London interaction repulsive interaction, Equilibrium lattice constants, Cohesive energy, compressibility and bulk modulus, Lonic crystal, Madelung energy evaluation of Madelung constant, Covalent crystals, Hydrogen-bonded crystals, Atomic radii.

Lattice Vibrations:

Lattice Heat capacity, Einstein model, Vibrations of monatomic lattice, derivation of dispersion relation, First brillouin zone, group velocity, continuum limit, Force constants, Lattice with two atoms per primitive cell, derivation of dispersion relation, Acoustic and optical modes, Phonon momentum.

Free electron theory, Fermi energy, density of states, Heat capacity of electron gas, Paramagnetic susceptibility of conduction electrons Hall effect in metals.

Origin of band theory, Qualitative idea of Bloch theorem, Kronig-Penney model, Number of orbitals in a band, conductor, Semi-conductor and insulators, Effective mass, Concept of holes.

Unit – III

Nuclear Physics:

1. **General Properties of Nucleus:**
   Brief survey of general Properties of the Nucleus, Mass defect and binding energy, charges, Size, Spin and Magnetic moment, Bainbridge mass spectrograph.

2. **Nuclear Forces:**
   Saturation phenomena and Exchange forces, Deutron ground state properties.

3. **Nuclear Models:**
   Liquid drop model and bethe Weiszacher mass formula, Sungle particle shell model (only the level scheme in the context of reproduction of magic numbers).

4. **Natural Radioactivity:**
   Fundamental laws of radioactivity, Soddy-fajan's displacement law and law of radioactive disintegration, Basic ideas about $\alpha, \beta \, and \, \gamma$ decay.

Unit – IV

1. **Nuclear Reactions:**
   Nuclear reactions and their conservation laws, Cross section of nuclear reactions, Theory of fission (Qualitative), Nuclear reactors and Nuclear fusion.

2. **Accelerators and detectors:**
   Vande Graff, Cyclotron and Synchrotron, Interaction of charged particles and gamma rays with matter (qualitative), GM counter, Scintillation counter and neutron detectors.

3. **Elementary Particles:**
   Basic classification based on rest mass, Spin and half life, particle interactions (gravitational, Electromagnetic, week and strong Interactions).

Paper – III – Electronics:

Unit – I

Network Theorems and Circuit Analysis:

Thevenin, Norton and superposition theorems and their applications, T and // Network characteristics Interactive and image impedances, Constant K and derived-m type filters, transmission lines Characteristics impedances and attenuations Reflection coefficients.

Diodes:

Diffusion of minority carrier in semiconductor, work function in metals and semiconductors Junctions between metal and semiconductors, Semiconductor and semiconductor, p.n. Junction, Depletion layer, Junction Potential Width of depletion layer, Field and Capacitance of depletion layer, Forward A.c. And D.C. resistance of junction Reverse Breakdown.

UNIT – II

Diode:

Zener and Avalanche diodes, Tunnel diodes, Point contact diode, their importance at High frequencies, LED photodiodes, Effect of temperature on Junction diode Thermistors.

Transistors:

Transistors parameters, base width modulation transit time and life-time of minority carriers base Emitter resestance Collector conductance, Base spreading resistance, Difusion capacitance, Reverse feedback ratio, Equivalent circuit for transistors, Basic Model, hybrid model and Y parameter equivalent circuit Input and output impedances.

UNIT – III

Current and Voltage gain, Biasing formulae for transistors, Base bias, emitter bias and mixed type bias and mixed type biasing for small and large signal operation.

Transistor circuit application at law frequencies, their AC and DC equivalent for three different modes of operation, Large signal operation of transistors, Transistor Power amplifiers, Class A and B operation, Maximum power output Effect of temperature, heat sinks, thermal resistance Distorsion in amplifiers, cascading of stages, Frequency response, Negative and positive feedback in transistor amplifiers.

UNIT – IV

Field effect transistors and their characteristics biasing of FET, use in preamplifiers MOSFET and their simple uses.

Power Supplies:

Electronically regulated law and high voltage power supplies, Inverters for battery operated equipments.

Miscellaneous:

Basic linear integrated circuits phototransistors, Silicon Controlled rectifiers, Unijunction transistor and their simple uses.