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 types, 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, Nacl, cs cl, 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 of 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, Ionic 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, Single 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 α, β and γ 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 low 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.