Syllabus Physics (Subject Code PO4)

Unit – I – Vector Fields

General expression for gradient, divergence curl and Laplace operators in orthogonal curvilinear Co-ordinates and their explicit form in Cartesion, spherical coordinates, Stokes theorem and Gauss theorem.

Matrix theory

Algebraic operation – Rank of a matrix, Eigen values and Eigen vectors – characteristic equation – Cayely Hamilton theorem – Diagonalisation and Diagonalizability of unitary orthogonal. Hermitian and symmetric matrices.

Special functions

Legendre, Hermite and Lagune equation basic properties = Gamma and Beta functions.

Unit – II – Probability and Theory of errors

Basic concept of probability distribution – Exclusive events and addition – Compounds events and products – Binomial – Poisson and Guassian distribution – Normal distribution of error – Standard error – Principles of least squares – Application of solution of linear equation – Curve fitting.

Group theory

Definition – Sub groups - Homomorphism and isomorphism – Group representations – Irreducible representation – Unitary representation.

Unit – III – Classical mechanics

Generalised coordinates – D Alembert's principle, Lagrangian equation of motion – Hamiltonian equation – Conservative and non conservative systems – Hamilton equation, cyclic variables, principles of least action – Theory of small oscillations – Normal co-ordinates and normal modes – Linear Triatomimolecule – Rigid bodies – Moments and products of inertia – Euler's angle – Euler's equation of motion Symmetric top.

Unit – IV – Statistical Mechanics

Maxwell Boltzmann statistics Maxwellian distribution of velocities – Mean – root mean square and most probable velocities Bose – Einstein statistics – Distribution function – Phonon gas – Black body radiation – Fermy – Dirac statistics – Distribution function – Electron gas – Pauli paramanetism – Thermionic emission – Elementary idea of phase transition – Properties of liquid Helium – phase space, Liouville's theorem – statistical equation – micro canonical ensembles – Equation of state thermodynamic functions of an ideal gas equipartition of energy.

Unit – V – Electromagnetic theory

Coulomb law – Gauss law – Poisson's equation – Laplace equation and solution to boundry value problem – Electrostatics of dielectric media – Molecular polarisability and its application – Vector – Scalar potential

– B and H in a magnetic material – Maxwell's equations and their significance – Poynting theorem – Radiation of oscillating dipole.

Relativistic Mechanics

Based ideas – Lorentz transformation, Time dilation and Lorentz contraction – Velocity addition law – Momentum and energy in relativistic Mechanics – Centre of mass system for two relativistic particles.

Unit – VI – Spectroscopy

Rotation spectra – Vibration spectra – Rotation vibration spectra of diatomic and linear molecules – Raman Spectra – experimental techniques and classical theory of Raman Scattering – Electronic state of diatomic molecules – Frank Condon principle – Hund's coupling scheme – Evaluation of molecular constant from vibrational spectra data. Interaction between nuclear spin and magnetic field – Nuclear resonance – Chemical shift Dipole interaction – Spin lattice interaction.

Unit – VII – Solid State Physics

Energy levels and density of states in one, two and three dimensions – Electrical and Thermal conductivities – Wiedmann – Franz law, Energy bands in Solids – Transport phenomena in semiconductors operational functions of a junction diode – Schottky diode – Bloch theorem – Krong Penny model – Brillouin zones – Wave equation of an electron in a periodic potential.

Thermal Properties of solids

Laws of Thermodynamics – Maxwell's relations and their applications – Phase transitions – Production and measurement of low temperature – Einstein and Debye theory of specific heats of solids.

Magnetic properties of materials

Langevin's theory of dia-para-magnetism – Quantum theory of para – magnetism – Ferro – magnetism – Ferri – magnetism – superconductivity – Meissner effect – Thermodynamics of superconducting materials – London equation – B.C.S. theory – Josephson's effect.

Unit – VIII – Quantum mechanics

Schrodinger's wave equation – Free particle – Particle in a potential well and barrier penetration – the probability interpretation – Expectation value – Eigen functions and eigen values – Stationery states – Wave packet – Uncertainty principle – Linear Harmonic oscillator – angular momentum and addition of angular momenta.

Peturbation theory – Transition probability – Constant and harmonic perturbation – Scattering theory – Differential and total scattering cross section – Born approximation – Partial wave analysis and phase shift analysis – Relativistic wave equations – Klein – Gordon equations – Dirac equation and its free particle solution.

Unit – IX – Nuclear Physics

Binding energy – Semi empirical formula – Stability of nuclei – Nuclear forces – Ground state of deuteron – Alpha decay – B decay – Fermi's theory – Selection rules – Liquid drop model – Nuclear fission – Shell model – Collective models.

Nuclear Instrumentation

Cyclotron – Synchro cyclotron – Proton synchrotron – Detectors – G.M. Counter – Scintillation Counter – Bubble chamber – Nuclear reactors – Neutron cross section – Fission product – Energy release – Chain reaction – Multiplication factor – Moderator – Natural Uranium – Diffusion equation.

Unit X – Electronics (Digital electronics)

Binary - Decimal – Octal and Hexadecimal numbers – 8421 Excess–3 - Gray Codes – Logic gates – Laws Boolean algebra – Half and full adders – Subtractors – RS, RST, JK and M/S Flip-flops – Ripple counter – Decade counter –Up-down counter – Serial and parallel registers.

Operational amplifier

Differential amplifier – Parameters – Applications – Analog integration and differentiation – Analog computation – Comparators – Sample and hold circuits – Oscillator – Hartley-Colpitt-Phase Shift - Wien's bridge oscillators – Astable mono -Bistable multivibrators – Clipping and clamping circuits.

Microwave Physics

Microwave generation – Klystron – Magnetron – Travelling wave tubes – Microwave in rectangular and cylindrical wave guides – Characteristics of Antennas – Short dipole radiation – Antenna gain – Directivity – Radiation resistance – Radiation intensity.

Microprocessor

Evolution of Microprocessors – Organisation of micro-computers- Preliminary concepts – Basic concepts of programming – Architecture – Address – Data and control buses – Memory decoding – Memory mapped I/O and I/O mapped I/O.

Machine and instruction cycles – Addressing modes – Use of arithmetic logical data – Transfer stack and I/O instructions – Instruction set and assembly programming of 8085 microprocessor – Fetch – Execute – overlap – Instruction cycles – Instruction forward – Memories – RAM-PROMS, EPROMSEEPROMS – Static and Dynamic RAM.