DEPARTMENT OF PHYSICS, VINOBA BHAVE UNIVERSITY, HAZARIBAG

SYLLABUS: - DEET

Subject : - Physics

Mathematical Physics

Matrices, second order differential equations. Legendre, Bessel, Hermite and Lagaurre equations, series solution, Generating functions, Recursion relations, Laplace transform, Fourier integral and transforms and their applications.

Classical Mechanics

Constraints and D'Alembert's principle. Lagrange's and Hamilton's equations and their application. Principle of least action, Hamilton's principle and characteristics functions, Hamilton-Jacobi equation. Canonical transformation, Poisson bracket and theorem. Special theory of relativity – Lorentz transformations, relativistic Kinematics and mass – energy equivalence.

Quantum Mechanics

Harmonic oscillator (Schrodinger equation and operator method), Uncertainty relation. Hydrogen atom, Angular momentum, commutation relations, Eigen values and Eigen vectors. Pauli's spin matrices and spin eigenvectors, Addition of two angular momenta, Clebsch-Golden coefficients. Time -independent perturbation theory, stark effect, Time dependent perturbation theory, Fermi Golden rule. Partial wave analysis of scattering and phase shifts.

Statistical Mechanics

Entropy of mixing, Gibb's paradox. Liouville's theorem. Micro canonical, canonical and grand canonical ensembles, partition function and calculation of statistical quantities BE, FD and MB statistics and their applications, BE condensation. Phase transition, critical indices. Brownian motion.

Electrodynamics

Four vectors, Maxwell's field equation in four-vector, Retarded potential, Lienared-Wiechert potential, Electric and magnetic field due to uniformly moving charge, Cerenkov radiation, reaction force of radiation.

Atomic and Molecular Physics

Spectroscopic terms and selection rules, L-S and j-j coupling, Zeeman, Paschen-Back and Stark effect. Pure rotational and pure vibrational spectra, Raman spectra, Frank- Condon principle, ESR and NMR spectra, Mossbauer Effect.

Plasma Physics

Derivation of moment equation from Boltzmann equation. Plasma oscillations, Debye shielding, Plasma parameters, Plasma confinement. Hydrodynamical description of plasma. Hydromagnetic waves.

Appleton-Hartee formula and propagation through ionosphere and magnetosphere: Helicon, Whistler, Faraday rotation.

Electronics

BJT, JFET, MOSFET and MESFET. Tunnel diode Gunn diode and IMPATT-diode. Photoconductive devices (LDR), Diode photo detectors. Solar cell, LED, Diode Lasers. Electro-optic, magneto-optic and acousto-optic effects and devices. Liquid crystal devices. Static and dynamic random access memories. CMOS and NMOS. Magnetic, optical and ferroelectric memories. Charge coupled devices. Piezoelectric, Electrostatictive and magnetostictive effects and devices.

Condensed Matter Physics

Crystalline solids, unit cells, two and three dimensional Bravais lattices. Closed packed structure, Interaction of X-rays with matter, absorption of X-rays. Reciprocal lattice and applications to diffraction techniques. Weiss theory of ferromagnetism, Heisenberg model and molecular field theory, spin waves and magnons, Curie-Weiss law for susceptibility, Ferro and antiferro-magnetic order. Domains and Bloch-wall energy. Electron-phonon Interaction. Cooper pairing due to phonons.

Superconductivity: critical temperature, persistent current, energy gap, critical field, Meissner effect, Josephson Effect.

Nuclear and Particle Physics

Neutron- proton scattering at low energy, scattering length. Exchange forces, meson theory of nuclear forces. Spin-dependence and charge-independence, Yukawa interaction. Compound nucleus, Resonance scattering, Breit-Wigner one-level formula. Liquid drop model, Shell model, semi empirical mass formula, β-decay, Feml's theory, Gamma decay, multipole transitions in nuclei, lsospin formalism, nuclear lsomerism. Ionization chambers, G.M. counter, nuclear emulsions, cloud chamber, Cerenkov counter. Hadrons and Leptons, symmetry and conservation laws, CP and CPT invariance, Quark model.

Lasers

Quantum theory of radiation, Einstein's A and B coefficients, population inversion, Ruby Laser, CO_2 Laser, Non-linear interaction of light with matter, laser induced multiphoton processes and their applications, application of Lasers in medical and engineering. Principles of optical fiber communication.
