DEPARTMENT OF PHYSICS
SYLLABI/COURSE CONTENTS FOR ENTRANCE TEST
M. Sc. (Physics)
B.Sc. level Physics syllabus

MECHANICS (2%)
Generalised coordinates, displacement, velocity, acceleration, momentum, force and potential. Hamilton's variational principle , Lagrange's equation of motion from Hamilton's Principle. Linear Harmonic oscillator, simple pendulum, Atwood's machine.

ELECTROMAGNETIC THEORY (2%)
Maxwell's equation and their derivations, Displacement Current. Vector and scalar potentials, boundary conditions at interface between two different media, Propagation of electromagnetic wave (Basic idea, no derivation). Poynting vector and Poynting theorem.

PROPERTIES OF MATTER AND RELATIVITY (3%)
Properties of Matter (Elasticity): Elasticity, Hooke's law, Elastic constants and their relations, Poisson's ratio, torsion of cylinder and twisting couple. Lorentz transformations, length contraction, time dilation, velocity addition theorem, variation of mass with velocity and mass energy equivalence.

ELECTRONIC DEVICES (3%)
Series and parallel resonant circuit. Quality factor (Sharpness of resonance). Intrinsic and extrinsic semiconductor, Photo conduction in semiconductors, Solar Cell: P-N junction, half wave and full wave rectifier. Junction Transistors, (C-B, C-E, C-C mode). Feed-back in amplifiers, advantages of negative feedbacks Emitter follower. Principle of Oscillation, Hartley oscillator.

THERMODYNAMICS (2%)
Derivation of Clausius - Claperyron latent heat equation. Phase diagram and triple point of a substance. Development of Maxwell thermodynamical relations. Thermodynamic functions : Internal energy (U), Helmholtz function (F), Enthalpy (H), Gibbs function (G) and the relations between them.

OPTICS (5%)
Fresnel's Biprism and its applications to determination of wave length of sodium light and thickness of a mica sheet, Lloyd's mirror, phase change on reflection. Colour of thin films, wedge shaped film, Michelson's interferometer and its applications, Fresnel's half period zones, zone plate, One slit diffraction, Two slit diffraction, Rayleigh's criterion, resolving power of telescope and a grating. Polarisation and Double Refraction, Polarisation by scattering, Malus law, Huygen's wave theory of double refraction, Analysis of Palorised light: Nicol prism, Quarter wave plate and half wave plate, production and detection of (i) Plane polarized light (ii) Circularly polarized light and (iii)Elliptically polarized light, Polarimeters

STATISTICAL MECHANICS (3%)
Bose-Einstein statistics, Application of B.E. Statistics to Plancks's radiation law, B.E. gas, Fermi-Dirac statistics, M.B. Law as limiting case of B.E. Degeneracy and B.E. Condensation, F.D. Gas, electron gas in metals. Zero point energy. Specific heat of metals and its solution.

SOLID STATE PHYSICS (20%)
Crystalline and glassy forms, liquid crystals. Crystal structure, periodicity, lattice and basis, crystal translational vectors and axes. Unit cell and primitive cell, Winger Seitz primitive Cell, symmetry operations for a two dimensional crystal, Bravais lattices in two and three dimensions. Crystal planes and Miller indices, Interplanner spacing; Crystal structures of Zinc sulphide, Sodium Chloride and diamond, X-ray diffraction, Bragg's Law and experimental x-ray diffraction methods, K-space. Reciprocal lattice and its physical significance, reciprocal lattice vectors, reciprocal lattice to a simple cubic lattice, b.c.c and f.c.c. Specific heat: Specific heat of solids, Einstein's theory of specific heat, Debye model of specific heat of solids.

QUANTUM MECHANICS (20%)

Failure of (Classical) E.M. Theory, quantum theory of radiation (old quantum theory), Photon, photoelectric effect and Einsteins photoelectric equation compton effect (theory and result). Inadequacy of old quantum theory, de-Broglie hypothesis. Davisson and Germer experiment. G.P. Thomson experiment. Phase velocity group velocity, Heisenberg's uncertainty principle. Time-energy and angular momentum; position uncertainty Uncertainty principle from de-Broglie wave, (wave-partice duality). Gamma Ray Maciroscope, Electron diffraction from a slit. Derivation of time dependent Schrodinger wave equation, eigen values, eigen functions, wave functions and its significance. Normalization of wave function, concept of observable and operator. Solution of Schrodinger equation for harmomic oscillator ground states and excited states. Application of Schrodinger equation in the solution of the following one-dimensional problems: Free particle in one dimensional box (solution of Schrodinger wave equation, eigen function, eigen values, quantization of energy and momentum, nodes and antinodes, zero point energy).

ATOMIC, MOLECULAR AND LASER PHYSICS (20%)

Vector atom model, quantum numbers associated with vector atom model, penetrating and nonpenetrating orbits (qualitative description), spectral lines in different series of ailkali spectra, spin orbit interaction and doublet term seperation LS or Russel-Saunder Coupling jj coupling (expressions for inteaction energies for LS and jj coupling required). Zeeman effect (normal and Anormalous) Zeeman pattern of D1 and D2 lines of Na-atom, Paschen. Back effect of a single valence electron system. Weak field Strak effect of Hydrogen atom. Discrete set of electronic energies of molecules. quantisation of Vibrational and rotational energies, Raman effect (Quantitative description) Stoke's and anti Stoke's lines. Main features of a laser: Directionality, high intensity, high degree of coherence, spatial and temporal coherence, Einstein's coefficients and possibility of amplification, momentum transfer, life time of a level, kinetics of optical absorption. Threshold condition for laser emission, Laser pumping, He-Ne laser and RUBY laser (Principle, Construction and Working).

NUCLEAR PHYSICS (20%)

Nuclear mass and binding energy, systematic nuclear binding energy, nuclear stability, Nuclear size, spin, parity, statistics magnetic dipole moment, quadrupole moment (shape concept), Interaction of heavy charged particles (Alpha particles), alpha disintegration and its theory Energy loss of heavy charged particle (idea of Bethe formula, no derivation), Energetics of alpha -decay, Range and straggling of alpha particles. Geiger-Nuttal law. Introduction of light charged particle (Beta-particle), Origin of continuous beta-spectrum (neutrino hypothesis) types of beta decay and energetics of beta decay, Energy loss of beta particles (ionization), Range of electrons, absorption of beta-particles. Interaction of Gamma Ray, Nature of gamma rays, Energetics of gamma rays, passage of Gamma radiations through matter (photoelectric, compton and pair production effect) electron position annihilation. Absorption of Gamma rays (Mass attenuation coefficient) and its application. Nuclear reactions, Elastic scattering, Inelastic scatting, Nuclear disintegration, photonuclear reaction, Radiative capture, Direct reaction, heavy ion reactions, conservation laws. Q-value and reaction threshold. Nuclear Reactors General aspects of Reactor design. Nuclear fission and fusion reactors (Principles, construction, working and use) Linear accelerator, Tendem accelerator, Cyclotron and Betatron accelerators. Ionization chamber, proportional counter, G.M. counter, scintillation counter and semiconductor detector.