ALIGARH MUSLIM UNIVERSITY, ALIGARH

FACULTY OF SCIENCE

SYLLABUS FOR

M.SC. PHYSICS

Mechanics & Special Relativity

Inertial and non-inertial frames, Fictitious forces, Conservative and non-conservative forces, Centre of mass for a system of particles, Motion of the centre of mass, Kinetic energy, Linear and angular momentum for a system of particles, Central forces, Coriolis force, Moment of inertia, Kepler's laws, Simple harmonic motion, Forced oscillations, Quality factor, Lissajous figures. Differential equation of wave motion, Plane progressive waves, Stationary waves, Phase and group velocities.

Special theory of relativity, Lorentz transformation, Minkowski space-time, Four vectors, Velocity addition, Length contraction and time dilation, Mass-energy equivalence.

Electromagnetism & Optics

Gauss' law, Dielectrics, Continuity equation, LCR circuits, Thevenin's, Superposition and Maximum power transfer theorems, Series resonance, Sharpness of resonance and Q-factor, Power factor, Electromagnetic waves, Maxwell equations, Poynting theorem.

Chromatic and spherical aberrations, Coma, Astigmatism, Curvature of the field, Distortion, Interference of light waves, Coherence, Newton's rings, Michelson's interferometer, Polarization of light waves, Brewster's law, Malus law, Double refraction, Quarter and half wave plates, Fraunhofer diffraction at two and N-slits, Diffraction grating, Grating spectrum, Rayleigh criterion of resolution, Resolving power of grating.

Electrodynamics

Four potential, Gauge transformations and Gauge-fixing conditions, Lorentz and Coulomb Gauge, Electromagnetic wave propagation in unbounded and bounded media, Larmor's formula, Optical Fibres.

Thermal & Statistical Physics

Laws of thermodynamics, Heat capacities, Internal energy, Carnot cycle, Efficiency of reversible heat engine and refrigerator, Entropy, Enthalpy, Helmholtz and Gibb's functions, Maxwell's relations.
Macrostates and microstates, Idea of ensemble, Maxwell-Boltzmann distribution,

Partition Function, Thermodynamics of two-level system, Bose-Einstein and Fermi-Dirac statistics.

Mathematical Physics

Directional derivatives and normal derivative, Gradient of a scalar field, Divergence and curl of a vector field. Del and Laplacian operators, Vector identities, Ordinary integrals of vectors, multiple integrals, Jacobian, Line, Surface, Volume elements and integrals, Flux of a vector field, Gauss' divergence theorem, Green's and Stokes theorems and their applications.

Functions of complex variables, Analyticity and Cauchy-Riemann conditions, Poles and branch points, Cauchy's integral formula, Residue theorem, Taylor and Laurent series. First order differential equations, Exact differential equations, Integrating factors, Existence and uniqueness theorems, Higher order linear differential equations, Solutions of homogenous and non-homogenous equations, Method of variation of parameters, Operator method, Legendre equation, Bessel equation and Bessel functions of first kind, Fourier series and Fourier transform.

Covariant, contravariant, mixed tensors and their transformation properties, Contraction, Raising and lowering of indices with metric tensors.

Quantum Mechanics

Wave functions, Probability density, Operator algebra, Heisenberg's uncertainty principle, Time dependent and independent Schrodinger equations, Stationary states, Continuity equation, Particle in a box, Potential step and barrier (tunnelling), Finite square well, Linear harmonic oscillator, Schrodinger equation in spherical coordinates, Orbital angular momentum operators and their commutation relations, Eigen values and eigen functions, Time independent and dependent perturbation theories, Klein-Gordon equation, Dirac equation.

Electronics

Semiconductors, pn junction, Zener diode, BJT transistor, Amplifiers, Q-point, Stability factor, Feedback, Op-Amp and applications, Number systems, Logic gates, Truth tables, Karnaugh maps, Sequential circuits and timers.

Atomic Molecular and Laser Physics

Electronic configuration and atomic states, Spin-orbit interaction, Fine structure, Intensity rules for structure doublets, Selection rules, LS and jj coupling, Terms and levels Hund's rules, Zeeman effect, Vibrational rotational, electronic and Raman spectra of diatomic molecules, Basic principle and properties of laser, Ruby and He-Ne lasers, Electronic spectra of diatomic molecules, Frank-Condon principle.

Solid State Physics

Lattice, Basis, Unit cell, Bravais lattices, Common Crystal structures, Miller indices, Reciprocal lattice, Bragg law, Brillouin zones, Bonding in crystals, Lattice vibrations, Acoustical and optical modes, Dulong-Petit law, Einstein and Debye theories of specific heat, Electrical and thermal conductivities, Hall effect, Semiconductors, Magnetism and superconductivity.

Nuclear & Particle Physics

Nucleus: Constituents, Size, Charge and Mass; Mass defect and binding energy, Fission and fusion, Nuclear forces and their properties, Alpha, beta and gamma-decays, Photoelectric effect, Compton effect and pair production, Weizsacker's semi-empirical mass formula, Ghoshal's experiment, Shell model.
Basic interactions and their mediating quanta, Classification of particles, Fermions and Bosons, Leptons and Hadrons, Particles and antiparticles, Conservation rules in fundamental interactions.