Koneru Lakshmaiah Education Foundation
(Deemed to be University estd. u/s. 3 of the UGC Act, 1956)
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SYLLABUS FOR M.SC (PHYSICS) ENTRANCE EXAMINATION

I. ELECTRICITY, MAGNETISM AND ELECTRONICS

Electrostatics: Gauss's law statement and its proof- Electric field intensity due to (1) Uniformly charged sphere and (2) an infinite conducting sheet of charge. Electrical potential – equipotential surfaces- potential due to i) a point charge, ii) charged spherical shell and uniformly charged sphere.

Dielectrics: Electric dipole moment and molecular polarizability- Electric displacement D, electric polarization P – relation between D, E and P- Dielectric constant and susceptibility. Boundary conditions at the dielectric surface.

Capacitance: Derivation of expression for capacity due to i) a parallel plate capacitor with and without dielectric, ii) a spherical capacitor. Energy stored in a capacitor, electric capacitance

Magneto statics: Moving charge in electric and magnetic field, Biot-Savart's law, explanation and calculation of B due to long straight wire, a circular current loop and solenoid – Lorentz force – Hall effect – determination of Hall coefficient and applications.

Varying and alternating currents: Alternating current - Relation between current and voltage in LR and CR circuits, vector diagrams, LCR series and parallel resonant circuit, Q –factor, power in ac circuits.

Electromagnetic induction: Faraday's law-Lenz's law- Self and mutual inductance, coefficient of coupling, calculation of self-inductance of a long solenoid, energy stored in magnetic field. Transformer - energy losses - efficiency.

Maxwell's equations and electromagnetic waves: Idea of displacement current - Maxwell's equations (integral and differential forms) (no derivation), Maxwell's wave equation (with derivation), Transverse nature of electromagnetic waves. Poynting theorem (statement and proof), production of electromagnetic waves (Hertz experiment).

Basic Electronics: PN junction diode, Zener diode, Tunnel diode, I-V characteristics, PNP and NPN transistors, CB, CE and CC configurations – Relation between α, β and γ - transistor (CE) characteristics-Determination of hybrid parameters, Transistor as an amplifier.

Digital Principles and Logic gates: Number systems - Conversion of binary to decimal system and vice versa. Binary addition and subtraction (1's and 2's complement methods).Laws of Boolean algebra - De Morgan's laws-statement and proof, Basic logic gates, NAND and NOR as universal gates, exclusive- OR gate, Half adder and Full adder, Parallel adder circuits.

II. THERMODYNAMICS AND OPTICS

Kinetic theory of gases: Introduction –Deduction of Maxwell's law of distribution of molecular speeds, experimental verification. Transport phenomena – Mean free path - Viscosity of gases-thermal conductivity-diffusion of gases.

Thermodynamics: Introduction- Isothermal and adiabatic process- Reversible and irreversible processes- Carnnot's engine and its efficiency-Carnot's theorem-Second law of thermodynamics. Kelvin's and Claussius statements-Entropy, physical significance –Change in entropy in reversible and irreversible processes-Entropy and disorder-Entropy of Universe–Temperature-Entropy (T-S) diagram and its uses - Change of entropy of a perfect gas- change of entropy when ice changes into steam.

Thermodynamic potentials and Maxwell's equations: Thermodynamic potentials-Derivation of Maxwell's thermodynamic relations-Clausius- Clayperon's equation-Derivation for ratio of specific heats-Derivation for difference of two specific heats for perfect gas.Joule Kelvin effect-expression for Joule Kelvin coefficient for perfect and vander Waal's gas.

Quantum theory of radiation: Blackbody-Ferry's black body-distribution of energy in the spectrum of black body-Wein's displacement law,Wein's law, Rayleigh-Jean's law-Quantum theory of radiation-Planck's law-Measurement of radiation-Types of pyrometers-Disappearing filament optical pyrometer-experimental determination –Angstrompyrheliometer-determination of solar constant, Temperature of Sun.

Aberrations: Aberrations in lenses-Chromatic Aberration-Achromatic Combination of lenses- Monochromatic defects-Spherical aberration-Astigmatism-Coma-Curvature and Distortion- Minimizing aberration.

Interference: The superstition principle, Condition for Interference, Classification of Interferences methods- Young's double slit experiment-Theory. Interference with white light and appearance of Young's interference fringes-Intensity in interference pattern-Optical Path length, Lloyd's single mirror-Phase change on reflection, Interference due to plane parallel wedge shaped films, Colours in thin films-Newton rings, Determination of wavelength of light. Michelson's interferometer.

Diffraction: The Fresnel and Fraunhoffer diffraction phenomena-Fraunhoffer diffraction of single Slit normal incidence and oblique incidence – Resolving power –limits of resolution for telescopes and microscope- Fraunhoffer diffraction by double slit-Intensity-pattern-Diffraction grating- Wavelength determination (Normal incidence and Minimum deviation).

Polarization: Types of Polarized light-Polarization by reflection, Brewster's law-Dichroism the Polaroid- double refraction- the calcite crystal-the principal plane-O and E rays-the Nicol Prism, Polariserand Analyser, Law of Malus –the quarter wave plate and halfwave plate Plane, Circularly, elliptically polarized light-Production and analysis -Optical activity-Specific rotatory power –Polarimeter.

Laser, Fiber Optics and Holography: Lasers: Laser characteristics, Population Inversion, Einstein coefficients, applications of lasers.

Holography: Basic principle of holography-Gabor hologram and its limitations, applications of holography. Introduction- different types of fibres, rays and modes in an optical fibre, fibre material, principles of fiber communication (qualitative treatment only), applications.

III. MECHANICS, WAVES AND OSCILLATIONS

Vector Analysis: Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field with derivations and physical interpretation. Vector integration (line, surface and volume), Statement and proof of Gauss and Stokes theorems.

Mechanics of Particles: Laws of motion, motion of variable mass system, Equation of motion of a rocket. Conservation of energy and momentum, Collisions in two and three dimensions, Concept of impact parameter, scattering cross-section, Rutherford scattering-derivation.

Mechanics of rigid bodies: Definition of rigid body, rotational kinematic relations, equation of motion for a rotating body, angular momentum, Euler equations and its applications, precession of a top, Gyroscope, precession of the equinoxes.

Mechanics of continuous media: Elastic constants of isotropic solids and their relations, Poisson's ratio and expression for Poisson's ratio in terms of y, n, k. Classification of beams, types of bending, point load, distributed load, shearing force and bending moment, sign conventions.

Central forces: Central force- Definition& examples- General Characteristics of central forces-Conservative nature of central forces, Planetary motion-Kepler's laws (Statements & Explanation), Newton's law of gravitation from Kepler's law, Geostationary Satellite Motion.Uses of communication satellites.

Special theory of relativity: Moving reference frames-Inertial and Non-inertial reference frames-Galilean relativity – Special theory of relativity-Statements of the two basic postulates- (Elementary treatment and application only) Lorentz transformation equations-length contraction-time dilation- addition of velocities-Momentum and relativistic mass-Mass –Energy equation, rest mass & momentum of a particle.

Fundamentals of vibrations: Simple harmonic oscillator and solution of the differential equation-Physical characteristics of SHM, torsion pendulum-measurements of rigidity modulus, compound pendulum- measurement of 'g', Principle of superposition, beats, combination of two mutually perpendicular simple harmonic vibrations of same frequency and different frequencies. Lissajous figures**.**

Damped and forced oscillations Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, comparison with un-damped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance and velocity resonance.

Vibrations of bars: Longitudinal vibrations in bars-wave equation and its general solution. Special cases (i) bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end. Tuning fork.

Vibrating Strings: Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones and harmonics. Energy transport and transverse impedance.

Ultrasonics: Ultrasonics, properties of ultrasonic waves, production of ultrasonic by piezoelectric and magnetostriction methods, detection of ultrasonic, determination of wavelength of ultrasonic waves. Applications of ultrasonic waves.

IV. MODERN PHYSICS

Atomic and molecular physics: Introduction –Drawbacks of Bohr's atomic model-Sommerfeld's elliptical orbits-relativistic correction (no derivation).Vector atom model and Stern-Gerlach experiment - quantum numbers associated with it. L-S and j- j coupling schemes.Zeeman effect and its experimental arrangement. Raman Effect, hypothesis, Stokes and Anti Stokes lines. Quantum theory of Raman Effect. Experimental arrangement – Applications of Raman effect.

Matter waves & Uncertainty Principle: Matter waves, de Broglie's hypothesis - wavelength of matter waves, Properties of matter waves - Davisson and Germer experiment – Phase and group velocities. Heisenberg's uncertainty principle for position and momentum (x and p), & energy and time (E and t). Experimental verification - Complementarity principle of Bohr.

Quantum (wave) mechanics: Basic postulates of quantum mechanics-Schrodinger time independent and time dependent wave equations-derivations. Physical interpretation of wave function. Eigen functions, Eigen values. Application of Schrodinger wave equation to particle in one dimensional infinite box.

General Properties of Nuclei: Basic ideas of nucleus -size, mass, charge density (matter energy), binding energy, angular momentum, parity, magnetic moment, electric moments. Liquid drop model and Shell model (qualitative aspects only) - Magic numbers.

Radioactivity decay: Alpha decay: basics of α-decay processes. Theory of α-decay, Gamow's theory, Geiger Nuttal law.β-decay, Energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.

Crystal Structure: Amorphous and crystalline materials, unit cell, Miller indices, reciprocal lattice, types of lattices, diffraction of X-rays by crystals, Bragg's law, experimental techniques, Laue's method and powder diffraction method.

Superconductivity: Introduction - experimental facts, critical temperature - critical field - Meissner effect – Isotope effect - Type I and type II superconductors - BCS theory (elementary ideas only) - applications of superconductors.

Exam Pattern – Multiple Choice Questions

Sl. No.	Subjects	No. of Questions	Marks
1	Electricity, Magnetism and Electronics	27	27
2	Thermodynamics and Optics	27	27
3	Mechanics and Waves and Oscillations	27	27
4	Modern Physics	27	27
	Total	**108**	**108**

Duration: 180 Minutes