POST M.Sc. DIPLOMA IN RADIOLOGICAL PHYSICS – 2020

ENTRANCE TEST SYLLABUS

PART–A (40 Marks)

MATHEMATICAL PHYSICS AND NUMERICAL METHODS

Legendre's Differential Equations: Power series Solution – Legendre Functions of the first and second kind – Generating function – Rodrigues' Formula – Orthogonal Properties – Recurrence Relations. Bessel's Differential Equations: Power series Solution – Bessel functions of First and Second kind – Generating Function – Orthogonal Properties – Recurrence Relations. Fourier Transforms: Infinite Fourier Sine and Cosine transforms – Properties of Fourier transforms. Laplace transforms and its properties - Inverse Laplase transforms. Errors: Round off Errors – Truncation Errors – Absolute Errors – Relative Errors – Propagation of Errors – Convergence of Iterative Processes – Error estimation. Root Finding Methods: Bisection method - Newton Raphson method. Numerical Differentiation: Forward Difference Quotient – Central Difference Quotient – First and Higher order derivatives - Errors in derivatives. Numerical Integration: Newton-Cotes methods - Simpson's One third and Three eighth methods. Interpolation: Linear interpolation – Lagrange Interpolation - Newton Interpolation – Divided Difference. Curve Fitting: Linear regression – Transcendental regression – Polynomial regressional analysis. System of Linear Equations: Gauss Elimination method – Gauss Jordon method. Ordinary Differential Equations: Taylor Series method – Euler's method.

CLASSICAL MECHANICS

Newtonian Formalism: Inertial frames and Galilean transforms – Non-inertial frames-conservation theorems - Description of rotations in terms of Euler angles-Euler equations and application to motion of symmetric top. Lagrangian Formalism: Constraints – generalized coordinates - Principle of virtual work and D'Alembert's principle – Applications of D'Alembert's principle - Lagrange's equations from D'Alemberts principle - Hamilton's principle. Hamiltonian Formalism: Principle of Least Action and Hamilton's equations - Cyclic coordinates and conservation theorems – Canonical coordinates and Canonical transformations.

QUANTUM MECHANICS

Fundamental Concepts: Basic Principles of Quantum Mechanics - Hilbert–State vectors and operators – Ket, Bra notation - Superposition Principle – Hermitian operators and their properties – Eigen vectors and eigen values – compatible and incompatible observables – projection operator and its physical significance - Uncertainty principle. Theory of Angular momentum: Orbital angular momentum - ladder operators and commutation relations - Generalized angular momentum. Approximation Methods: Time-Independent perturbation theory - Non–degenerate case – first and second order corrections - Perturbed harmonic oscillator and ground state helium atom - Degenerate case – linear Stark effect - Variation method – application to ground state of Helium atom – WKB approximation – alpha decay. Relativistic Quantum Mechanics: Klein-Gordon equation - plane wave solutions and equation of continuity – Dirac equation – probability density – Dirac matrices – plane wave solutions - Significance of Negative energy states.

PART–B (60 Marks)

EM THEORY

Derivation of Maxwell's equation - General wave equation - Poynting vector - Work energy theorem in electrodynamics - Propagation of plane electromagnetic waves in free space - Propagation of E.M. waves in homogeneous isotropic dielectric medium -Propagation of E.M. waves in a conducting medium - Attenuation and Skin effect. Boundary conditions for E,D,B and H - Reflection and Refraction of plane E.M waves at plane interface between two dielectrics - Laws of reflection and refraction - Fresnel's equations – Reflection and Transmission coefficients - Brewester's angle - Total internal reflection - Metallic reflection and its applications.

ELECTRONICS

Semiconductor Devices: Characteristics of Junction diode - Zener diode - Tunnel Diode – BJT - JFET. Amplifiers: h-parameter model of BJT - Biasing of Transistor - Self bias - Single Stage RC coupled amplifier and its frequency response. Wave Shaping: Integration and differentiation using passive elements - Clipping and Clamping circuits using diodes. Feedback Amplifiers: Classification of Amplifiers - The concept of feedback - positive and Negative feedback - Advantages of Negative feedback - Emitter follower and Darlington pair. Sinusoidal Oscillators (Using BJT's): Criterion for oscillations - Phase shift, Wein bridge, Hartley and Colpitts Oscillators - Crystal Oscillator - Collector coupled Astable, Monostable, Bistable multivibrators and Schmitt trigger. Operational Amplifiers: Characteristics of Ideal operational Amplifier - Block diagram of an IC Op-Amp - Analysis of inverting amplifier - Non-inverting amplifiers – Integrator – Differentiator -summing amplifier - Difference amplifier.

NUCLEAR PHYSICS

Nuclear decay processes & Elementary particles. Alpha-Spectrum: Gamow's theory of alpha-decay. Beta-spectrum: Neutrino hypothesis - Fermi theory of beta-decay - Fermi-Kuri plots - Selection rules for beta-decay. Gamma-emission: Multipole radiation – selection rules for gamma-decay. Classification of elementary particles – Fundamental interactions - conservation laws. Nuclear Radiation & Detection: Interaction of charged particles with matter - Bohr's formula – Belthe's modification Range-Energy relation - Stopping power - Straglling Boremsstralung - interaction of gamma-radiation with matter (photo electric effect, comption effect, pair – production).

SOLID STATE PHYSICS

Crystalline state: Crystal translational vectors - unit cell - Bravais lattices - Crystal systems - Miller indices - symmetry operations - Point groups - Space groups and their notation - Crystal structures of BCC, CsCl, NaCl, HCP, Diamond and ZnS - Bragg's Law, Van Laue treatment of X-ray diffraction and its equivalence with Bragg's law - Atomic structure factor - Geometrical structure factor and Debye Wallar factor - Concept of Reciprocal lattice - Concept of Brillouin zones - Experimental methods of x-ray diffraction of crystals – Laue and Powder methods - Bloch theorem - behaviour of electron in periodioc potentials - Kronig–Penney model - E vs K relation - density of states in a band - effective mass of electron - negative effective mass and concept of hole - Distinction between metals, semiconductors and insulators - Intrinsic semiconductors - band model - Fermi level - Hall effect in semiconductors.