Berhampur University,Bhanja Bihar

Syllabus for M.Phil./ Ph.D. Entrance Examination : Physics

Paper -1(GENERAL)

Research Methodology

1. **Research Aptitude**
   Research : Meaning, characteristic and types; Steps of research Methods of research; Research Ethics Paper, article, workshop, seminar, conference and symposium;
   Thesis writing: its characteristics and format.
2. **Reasoning**
   Number series; letter series; codes; Relationships; Classification.
3. **Logical Reasoning**
   Understanding the structure of arguments; Evaluating and distinguishing deductive and inductive reasoning;Verbal analogies : Word analogy — Applied analogy;
   Verbal classification ;ReasoningLogical Diagrams Simple diagrammatic relationship, multi- diagrammatic relationship;Venn diagram; Analytical Reasoning.
4. **Data Analysis:** data Preparation - Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis - Cross tabulations and Chi-square test including testing hypothesis of association.
5. **Interpretation of Data and Paper Writing:** Layout of a Research Paper, Journals in Physics, Impact factor of journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
6. **Reporting and Thesis writing:** Structure and components of scientific reports - Types of report - Technical reports and thesis - Significance - Different steps in the preparation - Layout, Structure and Language of typical reports - Illustrations and tables - Bibliography, referencing and footnotes - Oral presentation - Planning - Preparation - Practice - Making presentation - Use of visual aids - Importance of effective communication

Paper-II
Subject Concerned Syllabus
Physics

1.Quantum Mechanics: Schrödinger equation, Particle in potential wells, harmonic oscillator, hydrogen atom. Operators and state vectors, orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Perturbation theory, Interaction of radiation with matter, Scattering theory, Born approximation, Scattering by a rigid sphere and square-well potential.

2.Mathematical Methods: Vectors and operators, Hermitian and unitary operators, Analytical functions, residues, contour integration, Special Functions, Differential equations ,. interpolation, extrapolation,integration by trapezoid and Simpson's rule, Solution of first order differential equation using Runge-Kutta method. Finite difference methods. Tensors

3.Classical Mechanics: Lagrangian and Hamiltonian formalisms, symmetries and conservation laws, motion in the central force fields, collision and scattering, rigid body dynamics. Small oscillation and normal modes.

4.Electrodynamics: Laplace and Poisson equations, boundary value problem, multipole expansions, dielectrics, Ampere's theorem, Biot-Savart law, electromagnetic induction, Maxwell's equation in free space, Scalar and vector potentials, Gauge invariance, E.M. waves, reflection, refraction, dispersion, Diffraction and polarization. Motion of a charged particle in electric and magnetic fields, Radiation from moving charges, Radiation from a dipole.

5.Electronics: Physics of p-n junction, diode characteristics, BJT, UJT, FET, JEET, MOSFET transistors solar cell, photodiodes, LED, phototransistors, AC and DC amplifiers, RC coupled amplifiers, feedback in amplifiers and oscillators, OP-amp and its applications, integrator, differentiator, comparator, Schmitt trigger, active filters, NAND, NOR, XOR, gates, llip-flops, shift registers, counters, A/D and D/A converter.

6.Nuclear and particle Physics: Basic nuclear properties: size, shape, charge distribution, spin and parity; Binding energy, semi-empirical mass formula; Liquid drop model; Nuclear stability, radioactive decay, fission and fusion; Nature of the nuclear force, form of nucleon-nucleon potential; Charge-independence and charge-symmetry of nuclear forces; Isospin; Deuteron problem; Low energy N-N scattering; Evidence of shell structure, single- particle shell model, its validity and limitations; Rotational spectra; Elementary ideas of alpha, beta and gamma decays and their selection rules; Nuclear reactions, reaction mechanisms, compound nuclei and direct reactions; Classification of fundamental forces; Elementary particles (quarks, baryons, mesons, leptons); Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction.

7.Condensed Matter Physics:Bravais lattices; Reciprocal lattice, diffraction and the structure factor; Defects and dislocations; Ordered phases of matter, translational and orientational order, kinds of liquid crystalline order, Quasicrystals and glasses. Bonding of solids; Elastic properties, phonons, lattice specific heat; Free electron theory, electronic specific heat, Pauli paramagnetic susceptibility; Response and relaxation phenomena; Drude model; Hall effect and thermoelectric power; Electron motion in a periodic potential, band theory of metals, insulators and semiconductors, tight- binding approximation, impurity levels in doped semiconductors; Diamagnetism, paramagnetism, and ferromagnetism;

Superconductivity, Meissner effect, type – I and type - II superconductors, London theory of superconductivity, Josephson junctions.

8. **Statistical Mechanics,** Free energies. Phase space formulation of statistical mechanics, Microstates and macrostates, Microcanonical, canonical, grand-canonical ensembles, Quantum statistics, Density operator, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einestein statistics, Ideal Fermi gas and ideal Bose gas, Bose-Einstein condensation.