

RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS FOR COMPETITIVE EXAMINATION FOR THE POST OF ASSISTANT PROFESSOR IN PHYSICS FOR COLLEGE EDUCATION DEPARTMENT

PAPER-II

I. Mathematical Methods of Physics-

Dimensional analysis; Vector algebra and vector calculus; Linear algebra, matrices, Cayley Hamilton theorem, eigen value problems; Linear differential equations; Special functions (Hermite, Bessel, Laguerre and Legendre); Fourier series, Fourier and Laplace transforms; Elements of complex analysis; Elementary ideas about tensors; Introductory group theory; Elements of computational techniques: roots of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, solution of first order differential equations using Runge-Kutta method; Finite difference methods; Elementary probability theory, random variables, binomial, Poisson and normal distributions.

II. Classical Mechanics-

Newton's laws; Phase space dynamics, stability analysis; Central-force motion; Kepler's laws, Gravitational field and potentials; Two-body collisions, scattering in laboratory and centre-of-mass frames; Rigid body dynamics, Angular momentum, moment of inertia tensor, non-inertial frames and pseudoforces; Variational principle, Lagrangian and Hamiltonian formalisms and equations of motion; Poisson brackets and canonical transformations; Symmetry, invariance and conservation laws, cyclic coordinates; Periodic motion, small oscillations and normal modes; Damped harmonic oscillations, Driven harmonic oscillations; Waves in media, Superposition of waves; Special theory of relativity, Lorentz transformations, relativistic kinematics and mass-energy equivalence. Kinematics of moving fluids: Bernouli's theorem, Viscosity, Surface tension.

III. Quantum Mechanics-

Wave-particle duality; Wave functions in coordinate and momentum representations; Commutators and Heisenberg's uncertainty principle; Matrix representation; Dirac's bra and ket notation; Schroedinger equation (time-dependent and time-independent); Eigen value problems such as particle-in-a-box, harmonic oscillator, etc.; Tunneling through a barrier; Motion in a central potential; Orbital angular momentum, Angular momentum algebra, spin; Addition of angular momenta; Hydrogen atom, spin-orbit coupling, fine structure; Time-independent perturbation theory and applications; Variational method; WKB approximation; Time dependent perturbation theory and Fermi's Golden Rule; Selection rules; Semi-classical theory of radiation; Elementary theory of scattering, phase shifts, partial waves, Born approximation; Identical particles, Pauli's exclusion principle, spin-statistics connection; Relativistic quantum mechanics: Klein Gordon and Dirac equations.

IV. Thermodynamic and Statistical Physics-

Laws of thermodynamics and their consequences; Thermodynamic potentials, Production of low temperature and its applications; Maxwell relations; Chemical potential, phase equilibria; Phase space, micro- and macro states; Micro canonical, canonical and grand-canonical ensembles and partition functions; Free Energy and connection with thermodynamic quantities; First and second-order phase transitions; Classical and quantum statistics, ideal Fermi and Bose gases; Principle of detailed balance; Blackbody radiation and Planck's distribution law; Bose-Einstein condensation; Random walk and Brownian motion; Introduction to non-equilibrium processes; Diffusion equation.

V. Nuclear and Particle Physics-

Basic nuclear properties: size, shape, charge distribution, spin and parity; Binding energy, semi-empirical mass formula; Liquid drop model; Fission and fusion; Nature of the nuclear force, form of nucleon-nucleon potential; Charge-independence and charge-symmetry of nuclear forces; Isospin; Deuteron problem; 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; Particle accelerators and detectors.

Note:- Pattern of Question Paper

- 1. Objective type paper**
- 2. Maximum Marks: 75**
- 3. Number of Questions: 150**
- 4. Duration of Paper: Three Hours**
- 5. All questions carry equal marks.**
- 6. There will be Negative Marking.**
- 7. Medium of Competitive Exam: Bilingual in English and Hindi**