National Institute of Technology Calicut
NITC Campus P.O, Kozhikode – 673601, Kerala, India
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DEPARTMENT OF PHYSICS

Syllabus for Written Test for the post of Assistant Professor Grade II (Pay Level -10) with notified specialization other than Electronics

Mathematical Physics

Vector calculus. Linear vector space: basis, orthogonality and completeness; matrices; similarity transformations, diagonalization, eigenvalues and eigenvectors. Linear differential equations: second order equations and solutions. Complex analysis: Cauchy-Riemann conditions, Cauchy's theorem, singularities, residue theorem. Laplace and Fourier transforms. Tensor analysis.

Classical Mechanics

Lagrangian formalism, Euler-Lagrange equation, Hamilton's principle, calculus of variations, symmetry and conservation laws, central force motion, small oscillations, rigid body dynamics, Hamiltonian and Hamilton's equations of motion, Liouville's theorem, canonical transformations, Poisson brackets, Hamilton-Jacobi equation, special theory of relativity: Lorentz transformations, relativistic kinematics.

Electromagnetic Theory

Electrostatics: Gauss's law and applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space, Poynting vector, energy and momentum of electromagnetic waves. Dielectrics and conductors. Dynamics of charged particles in static and uniform electromagnetic fields.

Quantum Mechanics

Postulates of quantum mechanics, uncertainty principle, Schrodinger equation, Dirac bra-ket notation, states and operators in Hilbert space; one dimensional potentials: step potential, finite rectangular well, tunnelling, particle in a box, harmonic oscillator; two and three dimensional systems, hydrogen atom; angular momentum and spin; addition of angular momenta; variational method, time independent perturbation theory.

Thermodynamics and Statistical Physics

Laws of thermodynamics, thermodynamic potentials, Maxwell relations, chemical potential, macrostates and microstates, phase space, ensembles, partition function, free energy, calculation of thermodynamic quantities, classical and quantum statistics, degenerate Fermi gas, black body radiation and Planck's distribution law, Bose-Einstein condensation.

Atomic and Molecular Physics

Spectra of one-and many-electron atoms; spin-orbit interaction, LS and JJ couplings, fine and hyperfine structures, Zeeman and Stark effects, electric dipole transitions and selection rules, rotational

and vibrational spectra of diatomic molecules, electronic transitions in diatomic molecules, Franck-Condon principle, Raman effect, X-ray spectra, lasers, Einstein coefficients.

Condensed Matter Physics

Elements of crystallography, diffraction methods, bonding in solids, lattice vibrations and thermal properties of solids, free electron theory, band theory, metals, semiconductors and insulators, conductivity, mobility and effective mass, optical properties of solids, dielectric function, polarizability, ferroelectricity, magnetic properties of solids, superconductivity: Type-I and Type II superconductors, Meissner effect, London equation, BCS Theory.

Electronics

Semiconductors in equilibrium: electron and hole statistics in intrinsic and extrinsic semiconductors, metal-semiconductor junctions, Ohmic and rectifying contacts, PN diodes, bipolar junction transistors, field effect transistors. Operational amplifiers, subtractor, differentiator, integrator active filters. Logic gates and Boolean algebra: OR, AND, NOT, XOR, XNOR, NOR and NAND gates. Combinational logic circuits - adders- half and full adders, flipflops, timers, counters, registers.

Nuclear and Particle Physics

Nuclear radii and charge distributions, nuclear binding energy, electric and magnetic moments, semiemperical mass formula, nuclear models, liquid drop model, nuclear shell model, alpha decay, betadecay, Rutherford scattering, nuclear reactions, conservation laws, fission and fusion, particle accelerators and detectors, elementary particles, photons, baryons, mesons and leptons, quark model, conservation laws, isospin symmetry, charge conjugation, parity and time-reversal invariance.

NOTE:

- Selection process for the post of Assistant Professor Grade II (Pay Level-10) consist of three stages, namely, Written Test, Teaching Presentation and Personal Interview.
- The use of non-programmable scientific calculator is permitted for the written test.