

# Joint Entrance Screening Test (JEST) 2016

## Physics Syllabus

### **Mathematical Methods**

Vector algebra and vector calculus; linear vector spaces, linear operators, matrices and Eigenvalue problem; SturmLiouville theory, classical orthogonal polynomials; linear ordinary differential equations, exact and series methods of solution ; linear partial differential equations, solution by separation of variables; complex variables, analytic functions, Taylor and Laurent expansions, contour integration; Fourier and Laplace transforms.

### **Classical Mechanics**

Newtons laws, conservation of energy and momentum, collisions; generalized coordinates, principle of least action, Lagrangian and Hamiltonian formulations of mechanics; symmetry and conservation laws; central force problem, Kepler problem; rigid body motion; small oscillations and normal modes; special relativity in classical mechanics.

### **Electromagnetic Theory**

Laws of electrostatics and magnetostatics, methods of solving boundary value problems, multipole expansion; fields in conducting, dielectric, diamagnetic and paramagnetic materials; Faradays law and time varying fields; conservation of charge, displacement current; Maxwells equations; energy and momentum of electromagnetic fields, Poynting theorem; propagation of plane electromagnetic waves, reflection and refraction of plane electromagnetic waves, electromagnetic waves in dispersive and conducting media; scalar and vector potentials, Coulomb and Lorentz gauge, wave equation in terms of electromagnetic potentials; radiation from moving charges, retarded and advanced potentials, Lienard-Wiechert potentials, multipole radiation, Larmors formula.

### **Quantum Mechanics**

The uncertainty principle; conceptual basis of quantum mechanics; Schrodinger equation, problems in one, two and three dimensions, bound states and tunnelling, particle in a box, harmonic oscillator, hydrogen atom; matrix formulation of quantum theory, unitary transformations and Hermitian operators and their properties; orbital and spin angular momenta, addition of angular momenta; time independent and time dependent perturbation theory, Fermi golden rule; elementary scattering theory

### **Thermodynamics and Statistical Physics**

Laws of thermodynamics; work and heat; thermodynamic potentials, Maxwells relations; statistical ensembles; partition function; classical ideal gas, harmonic oscillators; classical and quantum statistics; Fermi and Bose gases; black body radiation; first and second order phase transitions.

### **Solid State Physics**

Simple crystal structures and X-ray diffraction; lattice vibrations and thermal properties of solids; free electron theory; band theory of solids; metals, semiconductors and insulators; basic electrical, optical and magnetic properties of solids; elements of superconductivity. Electronics Diodes, rectifier circuits, junctions, transistors and field effect devices; device characteristics, frequency dependence and applications like active filters and oscillator circuits; solar cells, photo detectors, and LEDs; operational amplifiers and their applications; Boolean algebra, digital techniques and applications: registers, counters, comparators and similar circuits; A/D and D/A converters; microprocessor and microcontroller basics.

### **Nuclear and Particle Physics**

Structure of the nucleus; binding energy, nuclear fusion and fission; radioactive decay, barrier penetration by alpha particles; classification of elementary particles and fundamental interactions, leptons and hadrons, elementary ideas of quark model; conservation laws in particle reactions.

### **Atomic and Optical Physics**

Interference, diffraction and polarization of light; photoelectric effect; spectra of single and multiple electron atoms; Zeeman and Stark effects; electric dipole transition and selection rules; hyperfine structure; spontaneous and stimulated emission.

### **Experimental data and error analysis Probability theory**

Gaussian and Poisson distributions; error analysis; propagation of errors; significant figures; least square fitting.