Syllabus for Sandip University Joint Entrance Exam(SU-JEE)

Exam Name – SU-JEE M.Sc. Physics

Sr. No.	Unit Name	Number of questions
1	**Mathematical Physics** rectangular, spherical and cylindrical polar coordinates. Scalar and vector quantities, laws of vector addition, and properties, Scalar and Vector Fields, Scalar product and vector product, Gradient of a Scalar and its geometrical interpretation, Divergence and Curl of Vector, Physical interpretation of Curl and Divergence. Line integral, surface integral, volume integral, vector identities, divergence theorem. Stoke's theorem	10
2	**Mechanics** Newton's laws of motion, Mechanics of a Particle, Mechanics of a system of particles; angular momentum and energy of a system. Motion in a central force field: Equivalent one body problem, equations of motion in central force field. Motion in an inverse square law force field, Constraints, Generalized coordinates, Lagrangian equations, Lagrangian of some simple systems (simple pendulum, spherical pendulum,). Newtonian relativity. Michelson-Morley experiment, Special theory of relativity, Lorentz Transformations and their consequences (Relativity of simultaneity, Lorentz-FitzGerald length contraction, time dilation). Variation of mass with velocity, mass energy relation.	10
3	**Waves, oscillations and sound** wave motion and types. Equation of progressive wave. Oscillations: Simple harmonic motion and its properties examples of SHM; Damped harmonic oscillator, Forced oscillations; resonance. **Sound** effect of various factors on velocity, characteristics of sound waves like pitch, quality, Loudness, Doppler effect, beats,	10

	Acoustics, intensity of sound, loudness, acoustical requirements, factors affecting acoustical properties of waves, Sabine's formula, Ultrasonic, production of ultrasonic waves, detection of ultrasonic wave, properties and applications.	
4	**Kinetic theory Thermodynamics & statistical mechanics** Basic concepts, Degrees of freedom, Equipartition of energy. Specific heat of monatomic diatomic and tri-atomic gases, behavior at low temperatures, Maxwell's velocity distribution, distribution of speeds; mean values. Deviation from perfect gas behavior, van der Waals' equation of state, nature of Vander Waals forces, Concept of thermal equilibrium, internal energy. The thermodynamic scale of temperature, its identity with the perfect gas scale, impossibility of attaining the absolute zero, Third law of thermodynamics. Thermodynamic relationships: Thermodynamic variables; Extensive and Intensive, The Statistical basis of thermodynamics: Probability and Thermodynamic probability, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein Statistics.	10
5	**Optics** Interference of light: The principle of superposition, two-slit interference, Intensity distribution, Displacement of fringes. Interference in thin parallel films, Non-reflecting films, Interference in wedge shaped film, Newton's ring. Diffraction at a slit, the intensity distribution. Diffraction at a circular aperture. Diffraction gratings: Diffraction at N parallel slits, intensity distribution at an N parallel slits. Plane diffraction grating, Resolution of images, Rayleigh criterion, resolving power of telescope, grating. Polarization: Polarization by reflection, Malus's law. Double refraction, Calcite crystal, Fresnel's theory of double refraction, Refraction in Uniaxial crystals. Half wave plate and quarter wave plate. Optical activity,	15

	Rotation of plane of polarization. Origin of optical rotation in liquids and in crystals	
6	**Crystal structure and solids** Crystal lattice, the unit cell, Bravais lattice and seven crystal systems. Point groups, space groups, non-Bravais lattice. Crystal planes and Miller indices. Simple crystal structures; Sodium Chloride, Diamond, Zinc sulfide. X-ray diffraction Bragg's law. The Laue method. Lattice vibrations: Elastic waves, Specific heat; Einstein and Debye models. Electrical conductivity, electrical resistivity versus temperature. Band Structure: Energy bands in solids, Metals, insulators and semiconductors. Fermi dirac probability distribution function, Fermi level, Semiconductor theory: Band structure, intrinsic semiconductors; temperature dependence of carrier concentration. Impurity states (acceptor and donor), extrinsic semiconductors, conductivity, temperature dependence. Hall Effect.	10
7	**Modern Physics** Black body radiation; Planck's radiation law, Photoelectric effect, Compton Effect. Wave properties of particles: De-Broglie's matter wave, the concept of wave packets and group velocities, , Davison-Germer Experiment, Heisenberg's uncertainty relation for p and x, its extension to energy and time, applications of uncertainty principle. Schrödinger's wave equation **Atomic Structure:** Bohr atom model, Vector atom model, Electron spin, Stern-Gerlach experiment, various quantum number, Pauli's exclusion principle, Normal Zeeman Effect, Stark effect, Raman Effect: Stokes and anti-Stokes lines, **Structure of Nuclei:** Nuclear composition, nuclear properties(size, spin, magnetic moment), Stable Nuclei (Nuclear decay, Binding energy), Liquid drop model, Shell model. Meson theory of nuclear forces. Radioactive decay: Half-life, radioactive series. Alpha decay (Tunneling effect), beta-decay, gamma- decay.	10

	Nuclear Reactions: Cross section, Nuclear Fission, Nuclear reactor. Nuclear Fusion; Nuclear Fusion in Stars.	
8	**Electrostatics, Current Electricity and transients:** Coulomb's law, Electric field and potential, relation between electric field and potential, Steady Current, Current Density J, Non-Steady Currents and Continuity Equation, Rise and Decay of Current in LR and RC circuits, Decay Constants, Transients in LCR Circuits, rms, average value of AC quantities, AC circuits, Complex Numbers and their applications in solving AC circuit problems, Complex Impedance and Reactance, Series and Parallel Resonance, Q factor, Power Consumed by an AC circuit, Power Factor	10
9	**Electronic Devices and circuits** p-n junction, VI characteristics, rectification property, bipolar junction transistor, its working, Tunnel diode, zener diode, Zener diode as a voltage regulator. Bridge rectifier, ripple factor, passive filters, regulated power supply. Input and output characteristic of transistor, α, β load line, Transistor biasing techniques (Voltage divider), bias stability, thermal runaway. Transistor equivalent circuits, h-parameters; h-parameter equivalent circuit for CE configuration, FET and its characteristics, MOSFET; types and characteristics, applications of MOSFET. Two-stage RC coupled amplifier; Gain at mid –frequency. Transformer coupled amplifiers, gain at mid-frequency. Negative feedback and its effect on gain, bandwidth, input and output impedance etc, Oscillator- Phase shift, Wien Bridge Oscillator, RC coupled, LC Oscillator (Hartley, colpit, clap oscillator).	15
	Total	**100**