YVUCET-2019: SYLLABUS

TEST-111: PHYSICS/ MATERIAL SCIENCE AND NANOTECHNOLOGY

COMMON ENTRANCE EXAMINATION – 2019 FOR ADMISSION INTO (M.Sc., PHYSICS / M.Sc. MATERIAL SCIENCE AND NANOTECHNOLOGY)

SECTION – A (Marks-30)
Mechanics, Waves and Oscillations

1. **Vector Analysis:** Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and Curl of a vector field and related problems.
2. **Mechanics of particles:** Laws of motion, motion of variable mass system, motion of a rocket, conservation of energy and momentum, Collisions in two and three dimensions, concept of impact parameter, scattering cross section, Rutherford scattering.
3. **Special theory of relativity:** Galilean relativity, absolute frames, Michelson-Morley experiment, Postulates of Special theory of relativity, Lorentz transformation.
4. **Simple harmonic oscillations:** Simple harmonic oscillator, and solution of the differential equation- physical characteristics of SHM, torsion pendulum, measurements of rigidity modulus, compound pendulum, measurement of 'g', combination of two mutually perpendicular simple harmonic vibrations of same frequency and different frequencies, Lissajous figures.
5. **Ultrasonics:** Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezoelectric and magnetostriction methods, detection of ultrasonics, determination of wavelength of ultrasonic waves.

SECTION B (Marks -30)
Thermodynamics and Optics

1. Thermodynamics: Reversible and irreversible processes – Carnot's engine and its efficiency – Carnot's theorem – Second law of thermodynamics, Kelvin's and Claussius statements – Thermodynamic scale of temperature – Entropy, physical significance – Change in entropy in reversible and irreversible processes – Entropy and disorder – Entropy of universe –Temperature- Entropy (T-S) diagram.

2. Thermodynamic potentials and Maxwell's equations: Thermodynamic potentials –Maxwell's thermodynamic relations – Clausius- Clayperon's equation –Ratio of specific heats – Expression for Joule Kelvin coefficient for perfect and Van der waal's gas.

3. Low temperature Physics: Joule Kelvin effect – liquefaction of gas using porous plug experiment. Joule expansion – Distinction between adiabatic and Joule Thomson expansion – Expression for Joule Thomson cooling – Liquefaction of helium, Adiabatic demagnetization – Production of low temperatures.

4. Quantum theory of radiation: Black body-Ferry's black body – distribution of energy in the spectrum of Black body –Wein's displacement law, Wein's law, Rayleigh-Jean's law – Quantum theory of radiation – Planck's law – deduction of Wein's law, Rayleigh-Jeans law from Planck's law.

5. Interference: Principle of superposition – conditions for Interference of light - Fresnel's biprism – determination of wave length of light. Determination of thickness of a transparent material using Biprism – change of phase on reflection – Lloyd's mirror experiment.

6**. Diffraction:** Distinction between Fresnel and Fraunhoffer diffraction Fraunhoffer diffraction:- Diffraction due to single slit – double slit – n slits (diffraction grating).

7. Polarization: Polarization by reflection, refraction, double refraction, selective absorption , scattering of light – Brewster's law – Malus law – Nicol prism polarizer and analyzer - Quarter wave plate, Half wave plate – Babinet compensator – Optical activity - polarimeter.

SECTION C (Marks-40)

Electrostatics, Magnato statics

1. Electrostatics: Gauss law proof and its applications- Uniformly charged sphere, an infinite conducting sheet of charge. Electric potential – Potential due to a charged spherical conductor, electric field strength from the electric dipole.

2. Capacitance: Capacitance of concentric spheres and cylindrical condenser, capacitance of parallel plate condenser with and without dielectric. Electric energy stored in a charged condenser.

3. Moving charge in electric and magnetic field: Hall effect, cyclotron, synchrocyclotron and synchrotron – force on a current carrying conductor placed in a magnetic field, force and torque on a current loop, Biot –Savart's law and calculation of B due to long straight wire, a circular current loop and solenoid.

4. Electromagnetic induction: Faraday's law –Lenz's law – expression for induced emf – self and mutual inductance, coefficient of coupling, calculation of self inductance of a long solenoid – toroid – energy stored in magnetic field – transformer.

5. Basic electronics: Formation of electron energy bands in solids, classification of solids in terms of forbidden energy gap. Intrinsic and extrinsic semiconductors, Fermi level, continuity equation – p-n junction diode, Zener diode characteristics and its application as voltage regulator. Half wave and full wave rectifiers and filters, ripple factor (quantitative) – p- n- p and n- p- n transistors, current components in transistors, CB, CE and CC configurations – Transistor hybrid parameters determination of hybrid parameters from transistor (CE) characteristics.

Modern Physics

1. Atomic physics: Introduction – Drawbacks of Bohr's atomic model - Sommerfeld's elliptical orbits – relativistic correction (no derivation). Stern and Gerlach experiment, Vector atom model and Quantum numbers associated with it. L-S and j-j coupling schemes. Zeeman Effect.

2. Matter waves: De Broglie's hypothesis – wavelength of matter waves, properties of matter waves. Phase and group velocities. Davisson and Germer experiment. Double slit experiment. Standing de Brogile waves of electron in Bohr orbits.

3. Uncertainty principle: Heisenberg's uncertainty principle for position and momentum (x and px), Energy and time (E and t). Gamma ray microscope. Diffraction by a single slit. Position of electron in a Bohr orbit. Particle in a box. Complementary principle of Bohr.

4. Nuclear physics: Nuclear structure: Basic properties of nucleus – size, charge, mass, spin, magnetic dipole moment and electric quadrupole moment. Binding energy of nucleus, deuteron binding energy,. Nuclear models – liquid drop model, shell model. Nuclear decay – α, β, γ rays - range of alpha particles, Geiger – Nuttal law. Gammow's theory of alpha decay. Geiger – Nuttal law. Beta spectrum – neutrino hypothesis. Nuclear Detectors – GM counter, Wilson cloud chamber and Bubble chamber.

5. Laser: Spontaneous emission – Stimulated emission – Population inversion. Laser principle – Einstein coefficients – Types of Lasers – He-Ne laser – Ruby laser – Applications of lasers.