Code-16

PHYSICS

Time: 3 Hours.

Maximum Marks: 150

Note: Attempt *Five* questions in all. All questions carry equal marks i.e. 30. Q. No.1 is compulsory. Answer two questions from **Part I** and two questions from **Part II**. The parts of the same question must be answered together and must not be interposed between answers to other questions.

Q.No.1. Write critical notes on any four of the following: $(4 \times 7\frac{1}{2})$

(a) Precession of a top
(b) Joule-Kelvin effect
(c) Ruby laser
(d) Poynting vector
(e) Compton effect
(f) Logic gates

PART- I

Q.No.2. (a) Distinguish between streamline and turbulent flow of a liquid. Water flows through a horizontal pipe having a tapering bore. The velocity of water is 2 m/sec. at the broader end and the pressure is 1 kilo-newton/m^2 . less at the narrow end. What is the velocity of water at the latter end? (10)

(b) What is impact factor parameter? Obtain an expression for the differential scattering cross-section in the case of α - particle striking a thin gold foil and undergoing elastic collisions. (20)

Q.No.3. (a) Show that

$$Cp - Cv = TE\alpha^2 V$$

Where T is the absolute temperature, E is the isothermal bulk modulus, α is coefficient of volume expansion and V is the specific volume. (10)

(b) Give the various thermodynamic potentials and deduce the

following Maxwell's equations:

(a) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(b) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$ (10)

(c) The probability function that a molecule can have its velocity components v_x along x-axis is:

$$p(v_x) = \left(\frac{m}{2\pi kT}\right)^{1/2} e^{-\frac{mv_x^2}{2kT}}$$

Using this expression find the value of v_x for which the probability falls to

(i) $\frac{1}{2}$ times, (ii) $\frac{1}{4}$ times of the maximum value. (10)

Q.No.4.(a) The total energy of a particle executing a simple harmonic motion of period 2π sec. is 10240 ergs. After $\pi/6$ sec. the particle passes the mid point of the swing, its displacement is 8 cm. Calculate the amplitude of the motion and the mass of the particle. (10)

(b) Distinguish between Fresnel and Fraunhofer classes of diffraction. Give an account of the diffraction effects produced by a slit. Explain what happens when the slit width is gradually increased and also when the screen is gradually moved away from the slit. (10)

(c) What is Raleigh's Criterion for resolution and also explain resolving power of grating? (10)

PART - II

Q.No.5.(a) Write down Laplace's equation in spherical coordinate and use it to obtain potentials inside and outside a dielectric sphere in a uniform field. (20)

(b) Distinguish between the characteristic features of

ferromagnetism, anti-ferromagnetism and ferrimagnetisms. Give an example of each type of materials. Comment on the temperature variation of susceptibility for all types of materials. (10)

Q.No.6.(a) What are α, β and γ rays? Describe their characteristic properties? (10)

(b) A nucleon (neutron or proton) is confined to nucleus of radius 5×10^{-15} meters. Calculate the minimum uncertainty in the momentum of the nucleon. Also calculate the minimum kinetic energy of the nucleon. (10)

(c) What is the photo-electric effect and how did Einstein explain it? For photo-electric emission establish the Einstein equation

$$\tfrac{1}{2}mv^2 = h(\upsilon - \upsilon_0).$$ (10)

Symbols are in their usual meanings.

Q.No.7.(a) What is Zener diode? Explain the avalanche and Zener breakdown mechanisms. How can Zener diode be used to stabilize the voltage? (10)

(b) What is Energy band? Distinguish between a metal, semiconductor and an insulator on the basis of band theory. (10)

(c) Describe the working of a full-wave rectifier with capacitor filter and derive an expression for the ripple factor. (10)