

PHYSICS

1. Write critical notes on any four of the following:

(4x7½=30)

- (a) Elastic and Inelastic Collisions
- (b) Joule-Kelvin Effect
- (c) Fourier Theorem
- (d) Quality Factor of a circuit (Q-factor)
- (e) Cyclotron
- (f) Logic Gates

Part I

- 2.(a) State the fundamental postulates of special theory of relativity and deduce the Lorentz Transformations. (12)
- (b) Write Bernoulli's theorem for the flow of an ideal liquid. Use it to prove that the velocity of efflux of a liquid emerging from a hole in the wall of a vessel is $(2gh)$. Where h is the height of the liquid level above the hole. (12)
- (c) Prove that the centre of mass of two particles subject to their mutual interaction alone (central force) moves with a constant velocity. (6)
- 3.(a) State and explain Maxwell's law of distribution of velocities. Briefly explain 'conduction', 'mean free path' and 'viscosity' on the basis of kinetic theory. (12)
- (b) Summarize the characteristics of black body radiation. Derive Planck's law of black body radiations and obtain Stefan's fourth power law from it. (12)
- (c) The luminosity of a star is 20,000 times that of the sun. If the surface temperature of the sun is 6000°K , find the surface temperature of the star ? (6)
- 4.(a) Solve the differential equation of a damped harmonic oscillator. Investigate the conditions under which the oscillations are said to be under damped overdamped and critically damped. (12)
- (b) Explain the process of stimulated emission. Draw a neat diagram to represent the component of 'Ruby Laser'. Briefly explain the operation. (12)
- (c) A diffraction grating which has 4000 lines to a cm is used at normal incidence. Calculate the dispersive power of the grating in the third order spectrum in the wavelength region 5000\AA . (6)

Part II

- 5.(a) Define Faraday's law of electromagnetic induction. Express Faraday's law in integral and differential forms. Obtain an expression for induced e.m.f. (12)
- (b) State and prove Gauss's law in electrostatics. Obtain an expression for electric field due to a charged cylindrical conductor. (12)
- (c) A 50 Hz A.C. circuit has a 10 mH inductor and a 2 ohm resistor in series. What is the power factor ? (6)
- 6.(a) Write down Schrodinger equation for a particle in a box. Solve it to obtain eigen functions and show that the eigen values are discrete. (12)
- (b) Describe briefly different mechanisms through which γ -rays are absorbed in matter. (12)
- (c) Compute the value of Planck's constant h if photo-electron ejected from the surface of certain metal by light of frequency 2.2×10^{15} Hz are fully retarded by a reverse potential of 6.6V and those ejected by light of frequency 4.6×10^{15} Hz are stopped by a reverse potential of 16.5V. (6)
- 7.(a) Find the hole and electron concentrations in a p-type semiconductor, if the acceptor density is 10^{20} Atoms/ m^3 and the intrinsic concentration is 2.5×10^{19} per m^3 at 300°K . (8)
- (b) A full-wave P-N diode rectifier uses load resistor of 1500 ohms. No filter is used. Assume each diode to have idealized characteristics with $R = 10$ ohms and $R = \infty$. Since wave voltage applied to each diode has amplitude of 30 volts and frequency 50 Hz. Calculate peak current, dc load current and rms load current. (10)
- (c) What is an Oscillator ? Explain the essentials of a transistor oscillator. (12)