# CSM : 14

## PHYSICS

## PAPER - I

Time Allowed : 3 hours | Full Marks : 100

*Marks for each question is indicated against it.*

*Attempt any 5 (five) questions taking not more than 3 (three) questions from each Part.*

### PART A

**1.** (a) What are the central forces? Discuss the characteristic features of central forces. Show that the angular momentum of a body moving under the influence of a central force remains constant. **(1+5+5=11)**

(b) State and explain Kepler's laws of planetary motion. Using Newton's laws of gravitation establish Kepler's third law. **(3+6=9)**

**2.** (a) State Hooke's law and define the relevant elastic constants. Establish the inter-relationship among the elastic constants of an isotropic solid. **(2+4+7=13)**

(b) State and explain Bernoulli's principle. Mention one of the practical applications of Bernoulli's principle and explain its working. **(5+2=7)**

**3.** (a) Describe Michelson-Morley experiment and its significance. Show as to how the negative results obtained from this experiment are interpreted. **(5+3+3=11)**

(b) On the basis of Lorentz transformation, discuss the kinematic effect of length contraction. **(5)**

(c) The half-life of a particle as measured in the laboratory comes out to be $4.0\times10^{-8}$ sec when its speed is 0.80c and $3.0\times10^{-8}$ sec when its speed is 0.6c. Find its actual lifetime. **(4)**

**4.** (a) Using Van der Waal's equation of state for real gases obtain expressions for the critical constants in terms of the Van der Waal's constants. **(10)**

(b) Discuss the theory of Joule-Kelvin effect and explain its significance in the process of liquefaction of gases. **(7+3=10)**

## PART B

**5.** (a) Discuss mathematically the phenomena of forced vibration and explain the term sharpness of resonance. **(7+4=11)**

(b) What do you mean by group and phase velocity? Establish the relation between them. **(2+2+1=5)**

(c) Explain the phenomena of refraction from Huygen's principle. **(4)**

**6.** (a) Discuss the Fraunhofer diffraction pattern due to a single slit. Derive the condition for production of maxima and minima and their position. Find the expression for the width of central maxima. **(3+4+3=10)**

(b) What is a zone plate? Show that the radii of its half period zones are proportional to the square root of natural numbers. Derive an expression for its focal length and show that a zone plate has multiple foci. **(3+3+2=8)**

(c) Two spectral lines with average wavelength 6000AU are resolved in second order by a grating having 500 lines per cm. The least width of the grating is 2cm. Find the difference in wavelength of the lines. **(2)**

7. (a) An alternating e.m.f. $E_0 \sin wt$ is applied to a LCR series circuit. Obtain an expression for the instantaneous current, impedance, phase angle, condition for resonance and quality factor. **(5+2+2+2+3=14)**

(b) Use Biot and Savart's law to find an expression for the magnetic field at a point on the axis of a current carrying soleniod. Hence prove that the magnetic field at the end is half the magnetic field at the centre of a long soleniod. **(4+2=6)**

**8.** (a) State and derive Poynting's theorem. Discuss the physical significance of each term in the resulting equation. **(3+4+3=10)**

(b) Write the Maxwell's equation of Electromagnetic theory and identify the symbols used. Using these equations, derive the general wave equation for electric and magnetic vectors for electromagnetic waves in vacuum. **(6+4=10)**

* * * * * * *