

## PHYSICS Paper-B

(Vibrations, Waves and E.M. Theory-II)

Time : 3 Hours

Max. Marks : 44

- Note:** (i) Attempt *five* questions in all, selecting *two* questions from each of the Section A and Section B.
- (ii) Section C is compulsory.
- (iii) The use of non-programmable calculator is allowed.
- (iv) Logarithmic tables may be asked if needed.
- (v) After evaluation of answer books out of 44 marks, the marks will be given out of 22.

### Section – A

1. (a) Derive the wave equation for transverse wave in a string.
- (b) Prove that total energy and intensity of progressive wave are independent of  $x$  and  $t$ .
- (c) Two strings of linear densities  $0.5 \text{ g cm}^{-1}$  and  $2.0 \text{ g cm}^{-3}$  are joined together and stretched by certain force. Calculate ratio of wave speed in two strings. 4,3,2

2. (a) Prove that for wave propagating from one medium to another, the sum of the reflection and transmission coefficient of energy is unity.
- (b) Differentiate between wave velocity and group velocity. Obtain relation between them and discuss it for normal, anomalous and no dispersion.
- (c) Obtain expression for standing wave on a string of fixed length. Determine the location of nodes and antinodes. 3,3,3
3. (a) Derive an expression for characteristics impedance of a string.
- (b) Two sinusoidal waves :

$$y_1 = 5 \sin(8t - 10x) \text{ m}$$

$$y_2 = 5 \sin(3t - 5x) \text{ m}$$

are superimposed. Calculate the group velocity. 6,3

#### Section – B

4. (a) Prove that electromagnetic waves are transverse in nature.
- (b) Show that in the electromagnetic wave the electrostatic energy density is equal to magnetic energy density. 5,3,1
- (c) Define Poynting vector. Write its unit. 3,3,3
5. (a) Prove that the amplitude of electromagnetic wave decreases exponentially with the distance of penetration.
- (b) Calculate the coefficients of reflection and transmission of energy of the normally incident electromagnetic wave on the surface of medium having refractive index is 5.
- (c) Derive an expression for the impedance of dielectric to the electromagnetic waves. 3,3,3
6. (a) Define skin depth. Show that it is inversely proportional to square root of conductivity of medium and frequency of electromagnetic waves.
- (b) Show that for electromagnetic wave in free space, the electric field vector at any instant is 377 times the value of magnetic field vector.
- (c) Derive an expression for average value of Poynting vector of electromagnetic wave in a conductor. 3,2,4

#### Section – C

7. Attempt any *eight* questions :
- (a) Find the path difference between the two points having phase difference in  $\pi/4$ , for a wave having wavelength 2m.
- (b) Define skin effect.
- (c) Define refractive index.
- (d) What are the uses of impedance matching?
- (e) Differentiate between progressive and stationery waves.
- (f) What is the significance of Gauss's law of magnetism ?

- (g) Find the value of skin depth for a perfect conductor.
- (h) Calculate the value of Poynting vector for 50 watt lamp at a distance of 1m from it.
- (i) Write differential form of first and second Maxwell equation in free space.
- (j) Electric and magnetic fields are closely related to each other. Explain.

8×1=8