

AS/2051

## Paper-II: Vibrations and Waves

7/2/MH

Time Allowed: 3 Hrs

Maximum Marks: 30

**Note:** The candidates are required to attempt two questions each from Section A and B carrying 5 marks each and five questions from Section C consisting of 7 short answer type questions carrying 2 marks each. Section C is compulsory.

## Section –A

1. Show that the total energy in a stiffness coupled oscillator remains constant. (5)
2. Discuss the inductive coupling of two electrical oscillators. (5)
3. (a) Show that the wave equation in case of transverse waves on a string is given by

$$\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2} \frac{\partial^2 y}{\partial t^2}$$

Where  $v = \left(\frac{T}{\mu}\right)^{1/2}$ , T being tension on the string and  $\mu$  is the linear density of the string. (1 1/2)

(b) When a plane wave traverses in a medium, the displacement of the particles of the medium are given by  $y = 0.05 \sin 2\pi (0.01 x - 100 t)$ ,

Where, x and y are in metres and t is in seconds. Calculate (i) the amplitude (ii) wavelength (iii) velocity and (iv) frequency of the wave. (3 1/2)

4. Show that the total energy intensity of progressive wave is independent of space and time coordinates. (5)

## Section –B

5. What is Poynting vector? State the Poynting vector theorem and describe its significance. (5)
6. Show that the impedance of free space for EM waves is 377 ohm. (5)
7. Calculate the coefficients of reflection and transmission of energy of the normally incident e. m. waves on the surface of water. Given dielectric constant of water = 81. (5)
8. Derive an expression for an impedance of a conducting medium to e.m. wave and hence show that the phase difference between electric field and magnetic field of e.m.waves in a conductor is  $\frac{\pi}{4}$ . (5)

## Section –C

- (a) What is the meaning of Degree of freedom?
- (b) What is the velocity of e.m. wave in glass? ( For glass refractive index is  $n = 1.5$ )
- (c) How does an electromagnetic wave differ from mechanical wave?
- (d) What are the nodes and antinodes in stationary waves?
- (e) What do you understand by normal dispersion and anomalous dispersion?
- (f) Write differential form of Maxwell's equations.
- (g) What is electromagnetic spectrum?