Exam.Code:0002
Sub. Code: 0149

2071

B.A./B.Sc. (General) Second Semester

Physics

Paper – B: Vibrations, Waves and EM Theory – II

Time allowed: 3 Hours Max. Marks: 44

NOTE: *Attempt five questions in all, including Question No.7 (Unit- III) which is compulsory and selecting two questions each from Unit I - II. Use of non-programmable calculator is allowed.*

x-x-x

UNIT – I

I. a) What do you mean by characteristic impedance of the string? Show that it is given by product of mass per unit length of string and wave velocity.

b) Prove that total energy and intensity of progressive wave is independent of x and t. (6,3)

II. a) Prove that for transverse wave propagating from one medium to another, sum of reflection and transmission coefficient of energy is unity.

b) Two strings of linear densities 0.5 g/cm and 2.5 g/cm joined together and stretched by certain force. Calculate

i) Ratio of wave speed in the two strings

ii) Reflection and transmission coefficient of energy. (5,4)

III. a) Define the term wave velocity and group velocity. Find the relation between wave velocity and group velocity. How this relation become for a medium having normal, anomalous and no dispersion.

b) Define Standing Wave Ratio (SWR). Derive expression for it in term of reflection coefficient.

c) Two sinusoidal waves

$Y_1 = 0.03 \cos (7t - 10x)$ m

$Y_2 = 0.03 \cos (5t - 7x)$ m (5,2,2)

are superimposed. Calculate group velocity.

P.T.O.

UNIT - II

IV. a) Write four Maxwell equations along with their significance. Using Maxwell equations, prove that electromagnetic waves are transverse in nature.

b) Using Maxwell equations, derive the wave equation of e.m. waves in the medium having finite permeability and permittivity but no conductivity ($\sigma = 0$). (5,4)

V. a) Derive the expression for impedance of conducting medium to the e. m. waves.

b) If a 1000 W laser beam is concentrated by lens into crosssection area of 10^{-10} m^2, find the Poynting vector and amplitude of electric field vector. Given $\varepsilon_0 = 9 \times 10^{-12}$ SI units.

c) Define skin depth. Prove that skin depth for perfect conductor is zero. (3x3)

VI. a) Discuss reflection and transmission of plane e. m. wave incident normally at the boundary separating two media of different impedances.

b) Calculate the coefficient of reflection and transmission of energy of normally incident e.m. waves on surface of water. Given relative electric permittivity ($\varepsilon_r = 81$).

c) Does refractive index of a medium depend on frequency of wave? Explain. (5,3,1)

UNIT - III

VII. Attempt any eight of the following:-

a) A wave of frequency 400 Hz is travelling with velocity of 800 ms^{-1}. How far two point situated whose displacements differ in phase by $\pi/4$?

b) Differentiate between progressive wave and stationary wave.

c) Differentiate normal and anomalous dispersion with examples.

d) Sound travel faster in rainy day. Explain.

e) Write down units and dimension of $\sqrt{\mu\varepsilon}$

f) What is the value of impedance of dielectric to e. m. waves in vacuum?

g) What is the phase difference between electric field (E_o) and magnetic field (B_o) of e. m. wave in conducting medium?

h) Differential between conduction current and displacement current.

i) A plain radio wave has $E_o = 10^{-4}$ Vm^{-1}. Calculate B_o.

j) As the conductivity increases, a conductor behaves like a short circuit to incident e.m. waves. Justify (8x1)

x-x-x