2022

B.A./B.Sc.

Sixth Semester

CORE – 13

PHYSICS

Course Code: PHC 6.11

(Electromagnetic Theory)

Total Mark: 70 *Pass Mark: 28*

Time: 3 hours

Answer five *questions, taking* one *from each unit.*

UNIT–I

1. (a) Derive the Maxwell's fourth equation by using the concept of the equation of continuity. 7
   (b) What is a displacement current? Explain its characteristics. 2
   (c) Discuss the physical significance of Maxwell's fourth equation. 3
   (d) Write two properties of Maxwell's equation. 2

2. (a) Establish the boundary condition for the normal component of the electric displacement vector. 6
   (b) A long coaxial cable, of length l consists of an inner conductor space (radius a) and an outer conductor (radius b). It is connected to a battery at one end and a resistor at the other end. The inner conductor carries a uniform charge space per unit length A and a steady current l to the right; the outer conductor has the opposite charge and current . What is the electromagnetic momentum stored in the fields? 5
   (c) Calculate the magnitude of Poynting vector at the surface of the sun of radius 7×10^8 m. The power radiated by the sun is 3.8×10^{26} watts. 3

UNIT–II

3. (a) Show that electromagnetic waves travel at the speed of light. 6

(b) Discuss the propagating of electromagnetic waves in an isotropic dielectric medium and show that the waves are transverse in nature. 8

4. (a) Derive an expression for the wave impedance when an electromagnetic wave is propagating in a isotropic medium. 7
   (b) Calculate the skin depth for electromagnetic wave of frequency 100 MHz in copper of conductivity 6.25×10^7 mho/m ($\mu_0 = 4\pi \times 10^{-7}$ H/m) 4
   (c) Calculate the intrinsic impedance of copper at a frequency of 3×10^9 hertz and conductivity of 5.8×10^7 mho/m. ($\mu_r = 1$, $\varepsilon_r = 1$) 3

UNIT–III

5. (a) Establish the law of reflection and the law of refraction for an electromagnetic wave propagating at oblique incidence. 6
   (b) Explain evanescent wave. Show that the transmitted electromagnetic wave is propagated only parallel to the surface and attenuated exponentially beyond the interface. 2+6=8

6. (a) Determine the reflection coefficient during the propagation of electromagnetic waves at a conducting surface. 7
   (b) Derive an expression for the Brewster's angle during the propagation of electromagnetic waves. 7

UNIT–IV

7. (a) Write a short note on dichroism. 3
   (b) Discuss the construction and action of a Nicol prism with necessary figure. 6
   (c) What is a quarter wave plate? Give the theory and construction of a quarter wave plate. 1+4=5

8. (a) A small angled wedge of quartz is placed between two crossed Nicols. A parallel beam of wavelength 6000 Å is incident on the plate cut with its optic axis parallel to the edge of the wedge. Interference fringes observed on the faces of quartz are 1.52 cm apart. Calculate the wedge angle of quartz plate. (Given $\mu_0 = 1.544$ and $\mu_E = 1.533$) 6

(b) Establish the theory of plane, elliptical and circularly polarized light. 8

UNIT–V

9. (a) What is the principle of the propagation of light signals in optical fibre? 1

(b) Explain briefly about numerical aperture. 2

(c) What are the different types of optical fibre, based on the modes of light propagation. Explain any one of them. 1+3=4

(d) Discuss the Fresnel's theory of optical rotation. 7

10. (a) A 20 cm long tube containing sugar solution is placed between crossed Nicols and illuminated by a light of wavelength 6000 Å If the specific rotation of sugar is 60 degrees and the optical rotation is 12 degrees, calculate the strength of the solution. 4

(b) A step index fibre is with a core of refractive index 1.56 and cladding of refractive index 1.50. Calculate the intermodal dispersion per kilometre of length of the fibre and the total dispersion in a 10 km length of the fibre. 3

(c) State the Biot's Laws. 4

(d) Explain briefly the phenomenon of optical rotation. 3

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