

7. (a) Define the term numerical aperture? Determine the numerical aperture and acceptance angle of a step index fibre when the core refractive index $n_1 = 1.5$ and the cladding refractive index $n_2 = 1.48$. (5)
- (b) Explain the basis principle of optical fibre. Describe step index and graded index fibres. (10)
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Roll No.

Total Pages : 4

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B.Sc. (Physics) VI SEMESTER
Electromagnetic Theory (BPH-601)

Time : 3 Hours]

[Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *Use of scientific calculator is allowed.*

PART-A

1. (a) Write Maxwell's equations in their integral form. (1.5)
- (b) Find the displacement current density for an electric field vector $E(s, t) = (\mu_0 I_0 \omega / 2\pi) \text{Sin}(\omega t) \log(a/s) \hat{z}$. (1.5)
- (c) Find the value of uniform magnetic field if magnetic vector potential is $B_0(-5y \hat{i} + 8x \hat{j})/2$, where \hat{i} and \hat{j} are unit vectors. (1.5)

- (d) Write the boundary conditions if there is no free charge or current at the interface of the two different medium. (1.5)
- (e) Find the wave equation for Electric (E) and Magnetic (B) field vectors in Vacuum? (1.5)
- (f) Show that Electric vectors of incident, reflected, transmitted waves are in same direction. (1.5)
- (g) Discuss Brewster's law to obtain plane polarized light by reflection. (1.5)
- (h) Find the thickness of a quarter wave plate of a quartz for to be used with sodium light 6000 \AA , (Given $\mu_0 = 1.544$ and $\mu_e = 1.553$). (1.5)
- (i) Show the structure of an optical fibre cable by suitable diagram. (1.5)
- (j) What is the value of magnetic field amplitude if the electric field of an electromagnetic wave is $E = 45 \cos(3z - 1.5 \times 10^9 t) \hat{X}$. (1.5)

PART-B

2. (a) Describe Poynting's theorem and calculate the expression for the Poynting vector and momentum in the electromagnetic field. (10)
- (b) What are Gauge transformations? Write the condition for Coulomb and Lorentz Gauge. What will be the value of α , if the vector potential $A = ax\hat{i} + 5y\hat{j} - 8z\hat{k}$, satisfied the coulomb gauge condition. (5)

3. (a) Calculate the reflection and transmission coefficient at normal incidence of EM wave between two linear media having dielectric constant 4 and 9 respectively. (5)
- (b) Define monochromatic plane waves? Find the expression for the average of energy, pointing vector and momentum in case of a monochromatic plane wave. (10)
4. (a) Derive an expression of Fresnel's equations for oblique incidence when electric field vector E is polarized parallel to the plane of incidence? (12)
- (b) What do you mean by skin depth? What will be the change in skin depth if frequency of an electromagnetic wave changes from 12 Hz to 48 Hz? (3)
5. (a) Explain the phenomena of Electromagnetic wave propagating through conducting medium and find the value of absorption coefficient of conducting medium. (10)
- (b) Define the term TE, TM and TEM in wave guide. Calculate the lowest cutoff frequency of a rectangular (10 cm height and 5 cm width) waveguide. (5)
6. (a) Explain the phenomenon of double refraction in calcite crystal. Describe the construction, working and use of the Nicol Prism. (10)
- (b) Discuss the concept plane polarized, circularly polarized and elliptically polarized light with suitable diagram. (5)