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6 SEM TDC PHYH (CBCS) C 13

2024

(May)

PHYSICS

(Core)

Paper : C-13

(Electromagnetic Theory)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct option of any *five* of the following : 1×5=5
- (a) The value of wave impedance in free space is
- (i) 390 ohm
 - (ii) 480 ohm
 - (iii) 377 ohm
 - (iv) 230 ohm

(b) The Brewster's angle for light incident on glass with refractive index 1.6 is

- (i) 90°
- (ii) 70°
- (iii) 58°
- (iv) None of the above

(c) Nicol prism is made up of

- (i) calcite crystal
- (ii) quartz
- (iii) mica
- (iv) nickel

(d) The angle of rotation depends upon

- (i) length of the substance
- (ii) concentration of the substance
- (iii) Both (i) and (ii)
- (iv) None of the above

(e) Which of the following cannot occur in a hollow waveguide?

- (i) TM wave
- (ii) TE wave
- (iii) TEM wave
- (iv) All of the above

(f) Which of the following is wrong?

(i) $n \propto \sqrt{\epsilon_r}$

(ii) $\frac{\epsilon}{B} = c$

(iii) $n \propto \frac{1}{\sqrt{\epsilon_r}}$

(iv) $\text{Div } \vec{B} = 0$

2. Answer any five of the following : 2×5=10

- (a) What are electromagnetic potentials?
- (b) Determine the numerical aperture of a step-index fibre when the core and cladding refractive indices are respectively 1.5 and 1.4.
- (c) Classify the optically active substances with examples.
- (d) Obtain an expression for the electromagnetic energy density in free space.
- (e) What is optic axis? Give an example of a crystal having two optic axes. 1+1=2
- (f) Find the reflection and transmission coefficients for normal incidence in glass-air interface. Given refractive index of glass is 1.5. 1+1=2

(4)

3. (a) State the Poynting theorem and write its mathematical form. Hence discuss the physical significance of the theorem.

1+1+2=4

Or

Explain how Maxwell modified Ampere's equation for electromagnetic field. 4

- (b) Obtain the boundary conditions for tangential components of electromagnetic field vectors at the interface of two media. 2+2=4

4. (a) Show that electromagnetic waves in free space are transverse in nature. 3

- (b) Find an expression for conductivity of ionized region on the basis of propagation of electromagnetic waves through ionized gas. 4

5. Explain the phenomenon of total internal reflection with the help of electromagnetic theory. What are evanescent waves? 4+2=6

Or

Obtain the Fresnel's equations for non-conducting media when the electric field vector is normal to the plane of incidence. 6

(5)

6. (a) Discuss how circular and elliptical polarization of electromagnetic waves can be obtained. 3+2=5

Or

Describe the action of Nicol prism as analyser with the help of proper diagram. 5

- (b) Derive the eigenvalue equation for a plane dielectric waveguide. 4

7. Write short notes on any two of the following : 4×2=8

- (a) Double refraction
(b) Laurent's half-shade polarimeter
(c) Half-wave plate
