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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 : $2 \times 5 = 10$

(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

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(Continued)

(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

$$\vec{E} = \epsilon_0 \vec{E}$$

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