

This question paper contains 3 printed pages.

4608-A

Your Roll No.

B.Sc. Prog. / III

AS

Paper PH-301 : PHYSICS

(Electromagnetic Theory)

Time : 3 hours

Maximum Marks : 75

*(Write your Roll No. on the top immediately
on receipt of this question paper.)*

Attempt any five questions.

All questions carry equal marks.

1. (a) State and prove Gauss's law in electrostatics and hence show that $\text{div } \mathbf{E} = \frac{\rho}{\epsilon_0}$. 10
(b) Two point charges $+8 \times 10^{-9}$ C and -2×10^{-9} C are separated by 4 m. What is the electric field intensity midway between them? ($\epsilon_0 = 8.85 \times 10^{-12}$ Coulomb²/newton-m².) 5
2. (a) State and prove Ampere's circuital law. 8
(b) Use Ampere's circuital law to obtain an expression for the magnetic field due to a solenoid. 7
3. (a) State and explain Kirchhoff's laws in a.c. circuits. 5

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- (b) What is a series resonant circuit? Derive the expression for the instantaneous current in the circuit. Obtain the condition of resonance and explain sharpness of resonance in terms of the Q factor for the circuit. 10
4. (a) State and prove Poynting theorem. Explain the meaning of each term in the theorem. 8
- (b) Show that the expression for time-average Poynting vector for time-varying fields is given by:
- $$\langle \mathbf{S} \rangle = \frac{1}{2} \operatorname{Re} [\mathbf{E} \times \mathbf{H}^*]$$
- where \mathbf{H}^* is the complex-conjugate of the vector \mathbf{H} . 7
5. (a) Derive the electromagnetic wave equation in free space, using Maxwell's equations. Find the expression for the velocity of these waves in free space. 10
- (b) Calculate the intrinsic impedance of free space. 5
6. (a) Derive Fresnel's relations for reflection and refraction of plane electromagnetic waves at an interface between two dielectric media when electric vector of the incident wave is normal to the plane of incidence. 10
- (b) A plane polarized wave propagates from air into a

dielectric at Brewster angle of 75° . Find relative permittivity ϵ_r . 5

7. (a) What do you understand by plasma? Obtain an expression for plasma oscillation frequency. 9

(b) Explain how to produce plane, elliptically and circularly polarized light from a beam of unpolarized light. 6

8. Write short notes on any *two* of the following:

(a) Skin depth

(b) Mutual inductance

(c) Optical fiber

(d) Hall effect.

7½×2