

Roll No.

Total Pages : 4

GSE/D-17

791

PHYSICS

(Electricity, Magnetism and Electromagnetic Theory)

Paper-II

Time : Three Hours]

[Maximum Marks : 40

Note : Attempt *five* questions in all. Question No. 1 is compulsory. Select *one* question from each unit. Attempt all parts of a question at one place only. Use of simple non-programmable calculator is allowed.

Compulsory Question

1. Attempt any *four* parts :

- (a) Distinguish between Solenoidal and Irrotational vector fields.
- (b) Why is steel a better choice than soft iron for making permanent magnets ?
- (c) What are Paramagnetic materials ? State Curie law for such a material.
- (d) Discuss the significance of Poynting theorem. Give S.I. unit of Poynting vector.
- (e) At what frequency, the capacitive reactance of a capacitor of $1 \mu\text{F}$ will be $1 \text{ k}\Omega$? (2×4=8)

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$$\int A \cdot dx = \iint_S (\vec{\nabla} \times \vec{A}) \cdot d\vec{s}$$

[P.T.O.]

UNIT-I

2. (a) Discuss physical significance of the gradient of a scalar function. 3
- (b) State and prove Stoke's theorem. 5
3. (a) State Gauss's law in Electrostatics. Derive Coulomb's law from it. 4
- (b) Derive expression for mechanical force and electrical pressure on the surface of a charged conductor. 4

UNIT-II

4. (a) Derive the relation $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$, where \vec{B} is magnetic induction and \vec{J} is current density vectors. 3
- (b) Describe Langevin's theory of diamagnetism, and derive relation for magnetic susceptibility of a diamagnetic material. 5
5. (a) What is Magnetic hysteresis ? Show that hysteresis loss per unit volume per cycle of magnetization in a ferromagnetic material is equal to the area under B-H curve. 4
- (b) What is Curie temperature of a ferromagnetic material ? 2
- (c) The magnetic susceptibility of platinum is 30×10^{-5} . Calculate its absolute and relative permeabilities. 2

UNIT-III

6. (a) Derive the following Maxwell's equations :

$$\vec{\nabla} \cdot \vec{D} = \rho \text{ and } \vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

- (b) Give their physical significance. 5

- (b) Derive relation for magnetic vector potential. 3

7. (a) Derive boundary condition for electric displacement \vec{D} at interface between two media. 4

- (b) What is Displacement current ? Explain. 2

- (c) How electric and magnetic fields are related to each other at a point in an electromagnetic wave ? 2

UNIT-IV

8. (a) Using j -operator, obtain relation for impedance and phase relationship between alternating e.m.f. and alternating current in a circuit containing capacitor 'C' and resistor 'R' in series. Draw the phasor diagram. 5

- (b) An electric lamp runs at 80 V d.c. and consumes 10 A. It is to be used with 100 V, 50 Hz a.c. supply. Calculate the inductance of choke required. 3

9. (a) Analyse a series resonant circuit to derive relation for its resonant frequency. Draw graph showing variation of a.c. with frequency, and explain the shape of graph. Discuss the applications of this type of circuits. 5

- (b) Define Root mean square value of a.c. and show that peak value of a.c. is $\sqrt{2}$ times the root mean square value.

3

$$1 + 30 \times 10^{-5}$$

$$\omega = \frac{d\theta}{dt}$$