Roll No. ..... Total Pages : 3

GSE/D-20 **790**

PHYSICS

(Electricity, Magnetism and Electromagnetic Theory)

Paper–II

Time : Three Hours] [Maximum Marks : 40

Note : Question No. 1 is compulsory. Attempt *four* more questions, selecting *one* question from each unit. Attempt all parts of *one* question at one place only. Use of scientific (non-programmable) calculator is allowed.

Compulsory Question

1. (a) Divergence of magnetic induction $\vec{B}$ is always zero. Why ? 2

(b) Transformer cores are made of soft iron. Why not of steel ? 2

(c) Discuss the origin of displacement current. 2

(d) Frequency of alternating e.m.f. in mains is 50 Hz. A capacitor offers reactance of 64 Ω. Find capacity of the capacitor when connected with mains. 2

UNIT–I

2. (a) Prove that curl of gradient of a scalar function is always zero. 3

(b) State and prove Stoke's theorem. How is it different from Gauss's divergence theorem ? 5

3. (a) Derive relation for mechanical force and electrical pressure on the surface of a charged conductor. 4

(b) Derive an expression for increase in radius of soap bubble of radius 'r' when 'q' charge is supplied to it. 2

(c) Find the value of constant 'a' for which $\vec{V} = (x + 3y)\hat{i} + (y - 2z)\hat{j} + (x + az)\hat{k}$ is solenoidal. 2

UNIT–II

4. (a) Show that $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$ where letters have their usual meanings. 3

(b) Discuss the general properties of a paramagnetic substance. 4

(c) What is Curie temperature in a ferromagnetic substance ? 1

5. (a) Discuss Languin's theory of paramagnetism and derive relation for magnetic susceptibility of a parametic gas. 5

(b) Discuss the importance of study of hysteresis in ferromagnetic materials by taking a suitable example. 3

UNIT–III

6. (a) Write *four* Maxwell's equations for electromagnetic fields. Derive the fourth maxwell equation which represents generalised form of Ampere's circuital law. 4

(b) State and prove Poynting theorem. 4

7. (a) Discuss the properties of e.m. waves. 3

(b) Derive relations for boundary conditions applicable to electric field ($\vec{E}$) and electric displacement ($\vec{D}$) at interface between two media. 5

UNIT–IV

8. (a) Derive phase relation between alternating e.m.f. and a.c. for a circuit containing capacitance (C) and resistance (R) connected in series by using j-operator. What is impedance of this circuit ? 5

(b) What are uses of series and parallel resonant circuits ? 3

9. (a) What is root mean square (r.m.s) value of alternating current ? Derive a relation between peak value and root mean square value of alternating current. 4

(b) Discuss graphical variation of :

(i) inductive reactance of an inductor,

(ii) capacitive reactance of a capacitor and

(iii) impedance of a series LCR circuit with frequency of applied alternating voltage. 3

(c) Why do we say that a capacitor blocks d.c. ? 1