

✓ 11.12.18 (E)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 902

I

Unique Paper Code : 32225101

Name of the Paper : Electricity and Magnetism

Name of the Course : **Physics : G.E. for Honours**

Semester : I

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **Five** questions.
3. Question No. 1 is compulsory.
4. **All** questions carry equal marks.

1. Attempt any **five** of the following : (3×5)

(a) State and write Stoke's theorem.

(b) Show that the vector $A = i(2xy + yz^2) + j(x^2 + xz^2) + k(2xyz)$ is irrotational.

(c) Distinguish between diamagnetic, paramagnetic and ferromagnetic materials.

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- (d) Show that energy associated with a capacitor C carrying charge Q is given by $\frac{1}{2}CV^2$.
- (e) Prove the conservative nature of electrostatic field.
- (f) Find the magnetic force between two parallel conductors carrying current i.
- (g) Show that $\nabla \cdot (\nabla \times \mathbf{A}) = 0$.
2. (a) Evaluate ∇r^n where r is position vector and n is a positive integer. (3×5)
- (b) If $\mathbf{A} = (3x^2 - 6yz)\mathbf{i} + (2y + 3xz)\mathbf{j} + (1 - 4xyz^2)\mathbf{k}$, evaluate $\int \mathbf{A} \cdot d\mathbf{r}$ from the (0,0,0) to (1,1,1) along the following $x = t, y = t^2, z = t^3$.
- (c) If A and B are irrotational vectors, then prove that $\mathbf{A} \times \mathbf{B}$ is solenoidal.
3. (a) Using Gauss law, establish the relationship $\mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P}$, where the symbols have their usual meaning. (8)
- (b) Explain the effect of dielectric on the capacitance of a parallel plate capacitor. (7)

4. (a) Using the Biot-Savart's law, show that $\nabla \cdot \mathbf{B} = 0$. Explain its physical significance. (8,2)
- (b) Calculate the self-inductance of a solenoid having 100 turns wound uniformly on a cylindrical paper tube of length 10 cm having a diameter of 2 cm in diameter. The medium is assumed to be air. (5)
5. (a) Derive an expression for the capacitance of cylindrical capacitor. (5)
- (b) Obtain an expression for electrical field due to uniformly charged plane sheet having a uniform charge density σ . (5)
- (c) The potential is given by $V(r) = -k \ln\left(\frac{r}{a}\right)$, where k and a are constants. Calculate electric field. (5)
6. (a) Write down the differential form of Maxwell's equations. Explain the physical significance of each equation. (4,4)
- (b) Obtain the expression for the self-inductance L of a solenoid having N turns. (7)
7. (a) Show that $\nabla \times \mathbf{B} = \mu_0 \mathbf{J}$. (10)

- (b) Obtain an expression for magnetic field at a distance s from a long straight wire carrying a steady current i . (5)
8. (a) Using Maxwell's equations obtain the expression for speed of EM wave travelling in vacuum. (10)
- (b) Prove the transverse nature of EM wave. (5)