

SET B

Unique Paper Code: 42221201

Name of Course: B.Sc. (Prog.) -CBCS

Name of Paper: Electricity, Magnetism and EMT

Semester:II

Duration: 3 Hours

Maximum Marks: 75

Attempt four questions in all, including Question No. 1, which is compulsory

Q.1 Answer any six of the following:

- (a) Give the statement of Gauss-Divergence theorem.
- (b) Electric lines of force never cross. Why?
- (c) Explain the Lenz's Law of electromagnetic induction.
- (d) Define and prove the Gauss's Law in electrostatic.
- (e) State Poynting Theorem. Write its mathematical form.
- (f) For position vector $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$. Find the value of $\text{grad}(\mathbf{r} \cdot \mathbf{r})$.
- (g) Give the physical significance of $\text{curl } \mathbf{B} = \mu_0 \mathbf{J}$ and $\text{div } \mathbf{B} = 0$.
- (h) Differentiate between ferromagnetic and paramagnetic materials (mention any two points). Give two examples of each.
- (i) Show that work done in moving an electric charge in an electric field is path independent.

6 × 5 = 30

Q.2 (a) Show that $\nabla^2(r^4) = 0$, where \mathbf{r} is a position vector. **5**

(b) Find out the unit vectornormal to the plane, $\phi = x^2yz + 4xz^2$ at (1,-2,3). Hence find out the directional derivative in the direction of $2\mathbf{i} - \mathbf{j} - 2\mathbf{k}$. **5**

(c) Find the total work done in moving a particle in a force field given by

$\mathbf{F} = 3xy\mathbf{i} - 5z\mathbf{j} + 10x\mathbf{k}$ along the curve $x = t^2 + 1, y = 2t^2, z = t^3$ from $t = 1$ to $t = 2$. **5**

Q.3 (a) Derive an expression for the capacitance of a parallel plate capacitor filled with a dielectric. **7**

(b) Derive the relation between \mathbf{E} , \mathbf{P} and \mathbf{D} for a dielectric. Explain the significance of each term. **8**

Q.4 (a) What do you mean by magnetostatic field, \mathbf{B} ? Show that $\nabla \cdot \mathbf{B} = 0$. **7**

(b) Find out force on a point charge 'q', moving with uniform velocity $\mathbf{v} = v \hat{i}$ in the field $\mathbf{B} = B \hat{k}$. **3**

(c) State and prove Ampere's circuital theorem. **5**

Q.5 Derive an expression for electric field and potential due to an electric dipole. **15**

Q.6 (a) Calculate the speed of the electromagnetic wave propagating through the dielectric medium (μ_r, ϵ_r). **9**

(b) Prove that em waves are transverse in nature. **6**

Q.7 (a) Write down the differential form of Maxwell's equations and give physical interpretation of each equation. **8**

(b) Explain modification of Ampere's law by Maxwell? How displacement current is different from conduction current? **7**