

Serial No. : 12719

Roll NO. _____

Unique Paper Code : 32221201

Name of the Paper: : Electricity, Magnetism and EMT

Name of Course : B.Sc. Prog.-CBCS_Core

Semester : II

Duration : 3 Hours

Maximum Marks: 75

Instructions for Candidates

Write your Roll no. on the top immediately on receipt of this question paper.

Attempt **Five** questions in all.

Question No. 1 is compulsory. Attempt four questions from the rest of the paper.

Use of non-programmable scientific calculator is allowed.

Q.1 Attempt any Five of the following:

(5x3=15)

(a) If a vector $\vec{A}$ is irrotational, show that $\vec{A} \times \vec{r}$ is solenoidal where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$.

(b) Differentiate between diamagnetic and paramagnetic materials (mention any two points). Give two examples of each.

(c) Assuming earth to be spherical conductor of radius 6400 km, calculate its capacitance.

(d) What is relative permeability of a magnetic material? How it is related to magnetic susceptibility?

(e) What is the charge density on the surface of a conducting sphere if the electric field near its surface is 1000 Vm^{-1} .

(f) Using the example of a parallel plate capacitor, show that the

concept of displacement current preserves the notion of continuity of current.

- (g) Prove that electric field at any point can be expressed as the negative gradient of potential at that point.

- Q.2 (a) Evaluate $\iint_S \vec{A} \cdot \hat{n} \, ds$, where $\vec{A} = 4xz \hat{i} - y^2 \hat{j} + yz \hat{k}$ and S is the surface of the cube bounded by $x=0, x=1, y=0, y=1, z=0, z=1$. (7)
- (b) Suppose S is any surface enclosing a volume V and $\vec{A} = ax\hat{i} + by\hat{j} + cz\hat{k}$. Prove that $\iint_S \vec{A} \cdot \hat{n} \, dS = (a + b + c)V$. (5)
- (c) State Stoke's theorem of vectors. (3)
- Q.3 (a) Define Biot-Savart's Law and using Bio-Savart's law, derive an expression for the magnetic field due to a long straight wire carrying current I . (10)
- (b) A solenoid of length 0.5 cm has radius of 1 cm and is made up of 500 turns. It carries current of 5 A. what is magnitude of magnetic field inside solenoid? (5)
- Q.4 (a) State Faraday's law of electromagnetic induction and Lenz law. (5)
- (b) Derive an expression for energy stored in magnetic field of Inductor. (5)
- (c) A coil of wire of certain radius has 500 turns and a self-inductance of 80 mH. What will be the self-inductance of a second similar coil with 600 turns. (5)
- Q.5 (a) Derive expression for electrostatic potential inside and outside of a uniformly charged non-conducting solid sphere. Hence derive expression for electric field from the potential obtained for uniformly charged non-conducting solid sphere. (10)
- (b) Calculate the capacity of parallel plate capacitor. What will be the capacity if the space between the plates is completely filled with a slab of thickness t and dielectric constant k . (5)
- Q.6 (a) What do you understand by dielectric and dielectric polarization? Derive a relation between Electric field intensity E , polarization vector P , and electric displacement vector D . (8)

(b) Derive an expression for Gauss's Law in Dielectrics. (3)

(c) Deduce an expression for energy stored in Dielectrics. (4)

Q.7 (a) Write integral and differential forms of Maxwell's equations for free space. Give physical significance of each equation. (9)

(b) Starting from the differential form of Maxwell's equations for free space, obtain the wave equations for $\vec{E}$ and $\vec{H}$ vectors associated with a plane electromagnetic wave propagating through free space. Hence obtain the expression for the velocity of the wave. (6)

Physical Constants:

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ C/N-m}^2;$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ Wb/A-m};$$

$$c = 3 \times 10^8 \text{ m/s}.$$