

Paper ID [A0414]

(Please fill this Paper ID in OMR Sheet)

B.Tech. (Sem. - 5th)**ELECTROMAGNETIC FIELD THEORY (EE - 303)**

Time : 03 Hours

Maximum Marks : 60

Instruction to Candidates:

- 1) Section - A is **Compulsory**.
- 2) Attempt any **Four** questions from Section - B.
- 3) Attempt any **Two** questions from Section - C.

Section - A

Q1)

(10 × 2 = 20)

a) What is the physical significance of Divergence of a vector field \vec{A} .

b) Show that

$$\vec{i} \times (\vec{r} \times \vec{i}) + \vec{j} \times (\vec{r} \times \vec{j}) + \vec{k} \times (\vec{r} \times \vec{k}) = 2\vec{r}$$

$$\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$$

- c) What is equipotential surface. Draw equipotential surface for two closely placed positive point charges.
- d) Calculate capacitance of a coaxial transmission line per unit length having inner and outer radii 1 mm and 5 mm respectively and dielectric constant of intervening medium 3.
- e) Define Ampere in terms of magnetic force.
- f) What is analogy between electric field and magnetic field.
- g) What is displacement current.
- h) What do you mean by polarized and unpolarised electromagnetic waves.
- i) What is dissipation factor of dielectric.
- j) Find the velocity of plane wave in a lossless medium having dielectric constant 5 relative permeability unity.

Section - B

(4 × 5 = 20)

- Q2)** State and prove Gauss Divergence Theorem and explain its physical significance.
- Q3)** (a) Prove that the electric field intensity is equal to the negative gradient of the potential.
(b) Derive the expression for the capacitance of an infinite single wire runs parallel to ground.
- Q4)** Explain in detail the inconsistency of Ampere's law and make necessary Maxwell's modification.
- Q5)** (a) State and explain Poynting Theorem.
(b) At what distance in wavelength, is the radiation component of magnetic field twice the induction component.
- Q6)** (a) Explain that electromagnetic wave is transverse in nature.
(b) Calculate propagation constant γ for a material with $\mu_r = 1$, $\epsilon_r = 8$ and $\sigma = 0.25$ pS/m, if wave frequency is 1.6 MHz.

Section - C

(2 × 10 = 20)

- Q7)** (a) Derive Laplace's equation for electrostatic field. Write down this equation in spherical co-ordinate and obtain a general solution for the same.
(b) Find the volume charge density inside a sphere of radius a.
Given electric field intensity $E_r = A r^4$ $r < a$
 $E_r = A r^{-2}$ $r > a$
- Q8)** (a) Using vector potential concept, find the magnetic intensity about a long straight wire carrying current I.
(b) A plane electromagnetic wave having a frequency of 10 MHz has an average pointing vector of 1 W/m². If the medium is lossless with relative permeability 2 and relative permittivity 3. Find (i) velocity of propagation (ii) the wavelength (iii) impedance of the medium (iv) r.m.s. electric field.
- Q9)** (a) Discuss reflection of electromagnetic wave from a perfect insulator incident Obliquely.
(b) Calculate skin depth, propagation constant, wave velocity at a frequency of 1.6 MHz in aluminium where $\sigma = 38.2$ MS/m and $\mu_r = 1$.
