Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

B.Tech. (EE) (Sem.–5)

ELECTROMAGNETIC FIELD THEORY

Subject Code : EE-303

M.Code : 57023

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Write briefly :

a) State triangle law of vector addition.

b) Establish the relation between unit vectors of cylindrical and spherical coordinates.

c) Discuss the significance of displacement current in the context of Maxwell's equations.

d) Show that in a good conductor, skin depth is always much shorter than its wavelength.

e) State Stoke's theorem.

f) Determine the self-inductance of a coaxial cable in inner radius 'a' and outer radius 'b' using the concept of magnetic energy.

g) Define Poynting vector.

h) Find the equivalent inductance of two coils connected in series. Assume the fluxes to be aiding each other.

i) Distinguish between magnetic scalar and vector potential.

j) Explain the physical significance of divergence and curl operator.

SECTION-B

2. Infinite line $x = 3$, $z = 4$ carries 16nC/m and is located in free space above the conducting plane $z = 0$. Use method of images to obtain the induced surface charge density on the conducting plane at (5, –6, 0).

3. If $\vec{r} = x\hat{a}_x + y\hat{a}_y + z\hat{a}_z$ is the position vector of (x, y, z), $r = |\vec{r}|$ and 'n' is an integer, evaluate –

   a) $\nabla \times (r^n \vec{r})$

   b) $\nabla^2(\ln r)$

4. If a lightening stroke with current 50 kA occurs 100 m away from your house, calculate the magnetic flux density at your house due to the lightening stroke.

5. Derive the expression $\frac{\tan \theta_1}{\tan \theta_2} = \frac{\epsilon_1}{\epsilon_2}$ using appropriate diagram.

6. Find the capacitance per unit length of a coaxial transmission line.

SECTION-C

7. Find $\vec{D}$ at P (6, 8, –10) because of –

   a) point charge of 50 mC at origin

   b) a uniform line charge ρ_L =30 μC/m on z-axis.

   c) a uniform surface charge density ρs = 27.2 μC/m^2 on a plane $x = 12$.

8. State and derive the integral and differential forms of Maxwell's equations for time-varying fields.

9. Write the following time-harmonic field in phasor form :

$$\vec{E} = 4\cos(\omega t - 3x - 10°)\hat{a}_y - 5\sin(\omega t + 3x + 20°)\hat{a}_z$$

   A non-magnetic medium has an intrinsic impedance of 240 ∠30°. Find –

   a) Loss tangent

   b) Complex permittivity

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.