Roll No. ☐☐☐☐☐☐☐☐☐☐☐☐ **Total No. of Pages : 03**

Total No. of Questions : 09

B.Tech.(EE) (2018 Batch) (Sem.–3)

ELECTROMAGNETIC FIELDS

Subject Code : BTEE-304-18

M.Code : 76384

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) Obtain the expression for Laplacian of a scalar field for spherical coordinate system.

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

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

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

e) Find $\nabla \times (\vec{A} \times \vec{B})$.

f) 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).

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

h) Find the magnetic field intensity at the center of a regular n-sided polygon carrying a steady current I. Assume R to be the distance from the center to any side.

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

j) Distinguish between magnetic scalar and vector potential.

SECTION-B

2. State Triangle Law of vector addition. Apply it to verify Coulomb's law of electrostatics.

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. 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 $x = 12$.

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. A vector field is given by

$$Q = \frac{\sqrt{x^2 + y^2 + z^2}}{\sqrt{x^2 + y^2}} (x - y) a_x + (x + y) a_y$$

   Evaluate the following integrals :

   a) $\int_L$ Q.dl where *L* is the circular edge of the volume in the form of an ice-cream cone shown in Figure.

   b) $\int_{s_1} (\nabla \times Q).dS$ where S_1 is the top surface of the volume

c) $\int_{s_2} (\nabla \times Q).d\text{S}$ where S_2 is the slanting surface of the volume

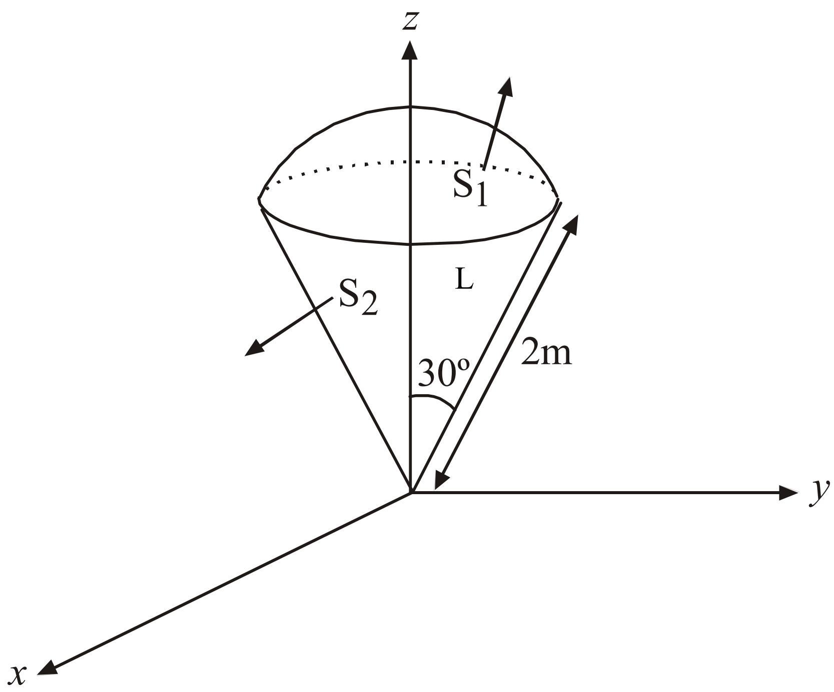

Fig.1

d) $\int_{s_1} Q.d\text{S}$

e) $\int_{s_2} Q.d\text{S}$

f) $\int_v \nabla.Q\, dv$

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 :

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

A non-magnetic medium has an intrinsic impedance of $240\angle 30^\circ$. 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.