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B.TECH.
(SEM V) THEORY EXAMINATION 2017-18
FUNDAMENTALS OF ELECTROMAGNETIC THEORY

Time: 3 Hours

Total Marks: 100

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt all questions in brief.

2 x 10 = 20

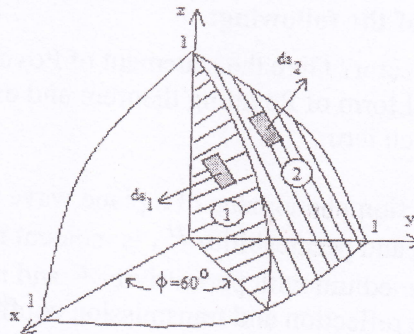
- Given Vector $\mathbf{A} = 5\mathbf{a}_x - 2\mathbf{a}_y + \mathbf{a}_z$ Find the expression of a unit vector \mathbf{a}_B such that \mathbf{a}_B is parallel to Vector A.
- Explain Faraday's Law.
- Define electric dipole moment.
- What are dielectrics? Briefly explain its types.
- State and explain Coulomb's inverse square law in electrostatics. What is the direction of electrical force between two point charges?
- What are the types of magnet? State the properties of magnetic flux lines. Use suitable diagrams if required.
- What is loss Tangent? Define loss angle.
- What is Displacement current?
- Write the expressions for energy stored in a magnetic field?
- Write the expression for transformer's EMF.

SECTION B

2. Attempt any three of the following:

10 x 3 = 30

- Use spherical coordinate to find the area of part of the sphere marked 1 and 2 in figure given below. Dimensions are marked in diagram.



- Explain and derive the electrostatic boundary conditions for conductor-free space interface.
- State and explain Biot-Savart's law. Derive a relation for the force between two conductors carrying currents I_1 and I_2 .

- d) A uniform plane wave propagating in a medium has $\mathbf{E} = 2e^{-\alpha z} \sin(10^8 t - \beta z) \mathbf{a}_y$ V/m. If the medium is characterized by $\epsilon_r = 1$, $\mu_r = 20$, and $\sigma = 3$ S/m, find α , β , and \mathbf{H} .
- e) Write and explain Maxwell's equations in integral and differential form.

SECTION C

3. Attempt any *two* parts of the following: 5 x 2 = 10
- State and prove Stoke's theorem.
 - Explain Gradient, Divergence and Curl. With expression in Different Coordinate system.
 - State & prove Divergence Theorem.
4. Attempt any *one* part of the following: 10 x 1 = 10
- Derive an expression for the electric field due to an infinite sheet carrying uniform charge of charge density ρ_s on x-y plane.
 - (i) An electric Field at a point P expressed in cylindrical Coordinate system is Given by $\mathbf{E} = 6r^2 \sin\phi \mathbf{a}_r + 2r^2 \cos\phi \mathbf{a}_\phi$ Find the value of divergence of the field if the location of point P is given by (5,5,5) in Cartesian Coordinate.
(ii) Express $\mathbf{B} = 10/r \mathbf{a}_r + r \cos\theta \mathbf{a}_\theta + \mathbf{a}_\phi$ into cylindrical co-ordinates at (5, $\pi/2$, -2)
5. Attempt any *one* part of the following: 10 x 1 = 10
- State Ampere's circuital law. Using Ampere's circuital law, find the magnetic field intensity produced by an infinitely long filament carrying a current.
 - Derive a relation to determine the energy present in an assembly of charges; hence derive electrostatic energy density in joules per cubic meter.
6. Attempt any *one* part of the following: 10 x 1 = 10
- Derive the expression for α and β in a conducting medium. Explain the terms skin effect and depth of penetration.
 - A circular loop located on $x^2 + y^2 = 9, z = 0$ carries a direct current of 10 A along \mathbf{a}_ϕ . Determine \mathbf{H} at (0, 0, 4) and (0, 0, -4).
7. Attempt any *one* part of the following: 10 x 1 = 10
- What is Poynting vector? Give the statement of Poynting theorem and Drive the formula for integral form of Poynting theorem and explain the physical interpretation of each term.
 - Consider the reflection phenomena of a plane wave travelling through a medium of permittivity ϵ_1 and permeability μ_1 is incident normally to the surface of a prefect dielectric medium with permittivity ϵ and permeability μ_2 . Derive the expression for the reflection and transmission coefficients for the electric and magnetic fields.