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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 x10 = 20

a) 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**.

b) Explain Faraday's Law.

c) Define electric dipole moment.

d) What are dielectrics? Briefly explain its types.

e) State and explain Coulomb's inverse square law in electrostatics. What is the direction of electrical force between two point charges?

f) What are the types of magnet? State the properties of magnetic flux lines. Use suitable diagrams if required.

g) What is loss Tangent? Define loss angle.

h) What is Displacement current?

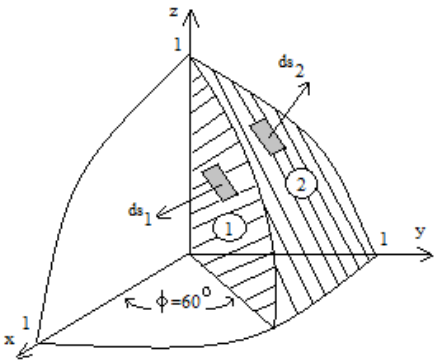
i) Write the expressions for energy stored in a magnetic field?

j) Write the expression for transformer's EMF.

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a) 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.



b) Explain and derive the electrostatic boundary conditions for conductor–free space interface.

c) 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 $\varepsilon_r = 1$, $\mu_r = 20$, and $\sigma = 3$ S/m, find α, β, and **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

a) State and prove Stoke's theorem.

b) Explain Gradient, Divergence and Curl. With expression in Different Coordinate system.

c) State & prove Divergence Theorem.

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) Derive an expression for the electric field due to an infinite sheet carrying uniform charge of charge density ρ_s on x-y plane.

(b) (i) An electric Field at a point P expressed in cylindrical Coordinate system is Given by $\mathbf{E} = 6r^2\sin\varphi\ \mathbf{a_r} + 2r^2\cos\varphi\ \mathbf{a_\varphi}$ 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

(a) State Ampere's circuital law. Using Ampere's circuital law, find the magnetic field intensity produced by an infinitely long filament carrying a current.

(b) 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

a) Derive the expression for α and β in a conducting medium. Explain the terms skin effect and depth of penetration.

b) A circular loop located on $x^2 + y^2 = 9$, $z = 0$ carries a direct current of 10 A along $\mathbf{a_\phi}$. Determine **H** at (0, 0, 4) and (0, 0, -4).

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) 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.

(b) 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.