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Paper Id: 3030

Roll No.

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

Time: 3 Hours

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

SECTION A

1. Attempt *all* questions in brief.

- 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 \mathbf{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:

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 .

Total Marks: 100

 $2 \times 10 = 20$

$10 \ge 3 = 30$

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- d) A uniform plane wave www.fitstRanker.com has $\mathbf{E} = 2$ www.fitstRanker.com
 - 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:

 $5 \ge 2 = 10$

- 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: $10 \ge 10 = 10$

(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: $10 \ge 10 \ge 10$

- (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: $10 \ge 10 \ge 10$

- 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}_{ϕ} . 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 \mathcal{E}_1 and permeability μ_1 is incident normally to the surface of a prefect dielectric medium with permittivity \mathcal{E} and permeability μ_2 .Derive the expression for the reflection and transmission coefficients for the electric and magnetic fields.