

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0324

Roll No.

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B.Tech.

(SEMESTER-III) THEORY EXAMINATION, 2012-13

ELECTROMAGNETIC FIELD THEORY

Time : 3 Hours]

[Total Marks : 100

1. Attempt all questions. 2 × 10 = 20
 - (a) Write Stokes Theorem.
 - (b) Find the ratio of the forces between two small spheres with constant charges (a) in air (b) in a medium of dielectric constant K.
 - (c) Define equipotential surface.
 - (d) The angle of incidence of the electric field at a plane dielectric boundary is 20 degree. The angle of refraction within the medium of dielectric constant of 1.25 is _____ (Fill in the blanks).
 - (e) Write Laplace equation in cartesian, cylindrical and spherical coordinate system.
 - (f) State Biot Savart's Law.
 - (g) Write wave equations for conducting medium.
 - (h) Define magnetic vector potential.
 - (i) Use Maxwell's equation to establish the charge current equation of continuity.
 - (j) Define characteristic impedance of a transmission line.

2. Answer any three : 3 × 10 = 30
 - (a) (i) Verify the divergence theorem for a vector field $A = 3x \hat{a}_x + (3y + z) \hat{a}_y + (3z - x) \hat{a}_z$ in the region bounded by the cylinder $x^2 + y^2 = 9$ and the planes $x = 0, y = 0, z = 0$ and $z = 2$.
 - (ii) State and proof Green's theorem. 6 + 4 = 10
 - (b) Explain the applications of Gauss law for point charge, line charge, coaxial cable and uniformly charged sphere.
 - (c) Determine magnetic field intensity due to finite length current elements and on the axis of a circular loop.

- (d) (i) A plane electromagnetic wave is propagating in z direction in a dielectric medium of relative permittivity $\epsilon_r = 5$. The electric field is in x direction and has an rms value of 0.1 (V/m). What is the direction and magnitude of magnetic field ? Calculate the frequency of the wave. Given wavelength $\lambda = 5\text{m}$. 6 + 4 = 10
- (ii) Write wave equations for conducting medium. 6 + 4 = 10
- (e) (i) Deduce the voltage and current equation of a transmission line. 6 + 4 = 10
- (ii) Find the input impedance for a lossless transmission line. 6 + 4 = 10

Attempt **all** questions :

5 × 10 = 50

3. (i) Explain double stub matching with suitable diagram.
- (ii) A transmission line with characteristic impedances of 400Ω is terminated in a purely resistive load. While making standing wave ratio measurement the meter reads a maximum voltage of $8 \mu\text{V}$ and a minimum of $5 \mu\text{V}$. What should be the load resistance ? 6 + 4 = 10

OR

Describe the process of impedance matching by quarter wave transformer. Discuss how the transmission line acts as circuit elements.

4. What is skin effect ? In a lossless dielectric for which $\eta = 60\pi$, $\mu_r = 1$, and $H = -0.1 \cos(\omega t - z) a_x + 0.5 \sin(\omega t - z) a_y$ A/m, calculate, ϵ_r , ω and E .

OR

Define skin depth, intrinsic impedances, phase velocity and pointing vector.

5. Derive an expression for magnetic field intensity due to long hollow conducting cylinder.

OR

Derive an expression for inductance of solenoid and toroid. Also discuss about diamagnetic, paramagnetic and ferromagnetic substances.

6. Use Laplace equation to obtain the capacitance of a cylindrical capacitor.

OR

Derive Poisson's equation and discuss its applications in electrostatics.

7. Write short notes on (a) Convection and conduction current (b) Polarization in dielectrics.

OR

Write short notes on (a) Continuity equation and relaxation time (b) Resistance of a conductor.