

(DEC 214)

B. Tech. DEGREE EXAMINATION, MAY - 2015

(Examination at the End of Second Year)

ELECTRONICS & COMMUNICATIONS

Paper - IV : EMF Theory

Time : 3 Hours

Maximum Marks : 75

Answer question No.1 compulsory

Answer ONE question from each unit

(4 × 15 = 60)

- 1) a) State Coulombs law. (1)
- b) Write down the of Poisson's equations in a non-homogeneous and homogeneous region? (2)
- c) Explain the concept of Skin Depth. (2)
- d) State Ampere's circuital law and obtain third Maxwell's equation. (2)
- e) Does an isolated magnetic charge exists? Justify. (2)
- f) State curl's theorem. (1)
- g) Express divergence of electric field in integral form. (1)
- h) Find direction of propagation for the field $E = 50 \cos (10^8 t - \beta z) a_v$ V/m. (1)
- i) Define polarization. (1)
- j) State Poynting's Theorem. (1)
- k) Express magnetic scalar potential. (1)

UNIT - I

- 2) a) Derive the electric flux density for a surface charge using coulomb's law with relevant coordinate system. (8)
- b) i) Prove $\nabla \cdot D = \rho_v$.
- ii) A point charge 100 pC is located at (4, 1, - 3) while the x-axis carries charge 2 nC/m. If the plane $z = 3$ also carries 5 nC/m². Find E at (1, 1, 1). (7)

OR

- 3) a) Derive the expression for a capacitance of coaxial capacitor with neat schematic. (8)
- b) Derive the expression for energy stored in electrostatic fields. (7)

UNIT – II

- 4) a) State and derive Biot-Savart's law. Is Magnetostatic field conservative, explain and obtain M.E of divergence of magnetic field. (10)
- b) A steady state current of I amps flow in a conductor bent in the form of square loop of side 'a'. Find the 'H' at the center of the loop. (5)

OR

- 5) a) Derive the expression of H for surface current distribution with neat schematic? (10)
- b) Determine (5)
- i) J_d and
- ii) H for $E = 20 \cos(\omega t - 50z) a_y$ V/m in free space.

UNIT - III

- 6) a) Derive expression for a force between two current elements. A current element of length 2 cm is located at the origin in free space and carries current 12ma along a_z . A filamentary current of 15 a_z A is located along $x = 3, y = 4$. Find the force on a current filament. (10)
- b) Derive relaxation time. (5)

OR

- 7) a) Explain how the transformer emf and motional emf are produced. (8)
- b) Derive law of refraction of the electric field at a boundary form Maxwell's equations. (7)

UNIT – IV

- 8) a) Derive the expressions of α, β, η, E & H for a lossy medium. (10)
- b) A plane wave travelling in the +y direction in a lossy medium characterized by $\epsilon_r = 4, \mu_r = 1, \sigma = 10^{-2}$ mhos/m has $E = 30 \cos(10^9 \square t + (\square/4) a_z$ V/m at $y = 0$. (5)

Find

- i) E at $y = 1$ m and $t = 2$ ns
- ii) H at $y = 2$ m and $t = 2$ ns.

OR

9) a) Derive Poynting's Theorem using Maxwell's equations. (8)

b) In a non-magnetic medium $\mathbf{E} = 4 \sin(2\pi \times 10^7 t - 0.8x) \mathbf{a}_z$ V/m. find (7)

i) relative permittivity and η

ii) time average power carried by the wave

iii) the total power crossing 100 cm^2 of plate $2x + y = 5$.

