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10EE44

Fourth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Field Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. State and explain the Coulomb's law of electrostatic force between two point charges. **(05 Marks)**

b. A point charge $Q_1 = 25nC$ is located at $P_1(4, -27)$ and a charge $Q_2 = 60nC$ is at $P_2(-3, 4, -2)$ in free space. Find electric field $\vec{E}$ at $P_3(1, 2, 3)$. **(05 Marks)**

c. Evaluate both sides of the divergence theorem for the field $\vec{D} = 2xy\vec{a}_x + x^2\vec{a}_y \, c/m^2$, the surface is a rectangular parallelepiped formed by planes $x = 0$ and $x = 1$, $y = 0$ and $y = 2$ and $z = 0$ and $z = 3$. **(10 Marks)**

2 a. Find the potential V due to a line charge density ρ_l c/m, bent in the form of a circular ring of radius 'a'. **(05 Marks)**

b. Given the potential $V = 2x^2y - 5z$. Determine the expression for electric field intensity $\vec{E}$, the flux density $\vec{D}$ and volume charge density ρ_v. Find the numerical values of V, E, D, ρ_v at a given point P(-4, 3, 6). Given $\epsilon_0 = 8.854 \times 10^{-12}$ F/m. **(10 Marks)**

c. Define capacitance and evaluate capacitance of two concentric spherical conducting shells of radius a and b with $b > a$. **(05 Marks)**

3 a. Derive Poisson's and Laplace's equation. **(06 Marks)**

b. State and prove uniqueness theorem. **(08 Marks)**

c. Find the capacitance of a co-axial cable with inner radius a and outer radius b where $b > a$, using Laplace equation. **(06 Marks)**

4 a. State and explain Biot-Savart law. **(05 Marks)**

b. Calculate vector current density at a given point P(2, 3, 4) if $\vec{H} = x^2z\vec{a}_y - y^2x\vec{a}_z$. **(05 Marks)**

c. State Ampere's circuital law. Apply it to a co-axial cable with inner conductor of radius 'a' carrying current I. The outer conductor carries return current –I. The inner radius of outer conductor is 'b' and its outer radius is 'c'. Evaluate magnetic field intensity. **(10 Marks)**

PART – B

5 a. Derive the equation for force between two differential current carrying elements. **(06 Marks)**

b. Explain the terms magnetization and permeability. **(06 Marks)**

c. Derive the boundary condition between two isotropic homogeneous materials with permeability μ_1 and μ_2. **(08 Marks)**

6 a. State and explain Faraday's law. **(06 Marks)**

b. Write Maxwell's equation in integral and point form for time varying fields. **(08 Marks)**

c. Derive the concept of displacement current density. **(06 Marks)**

7 a. Derive the wave equation for uniform plane wave propagation in perfect dielectric and explain the concept of loss tangent. **(10 Marks)**

b. Derive the wave equation for uniform plane wave propagation in perfect conductor and explain the concept of skin effect. **(10 Marks)**

8 a. Derive reflection coefficient and transmission coefficient equations for a uniform plane wave incident normally at the boundary. **(10 Marks)**

b. Two media are characterized by intrinsic impedances $\eta_1 = 100\Omega$ and $\eta_2 = 300\Omega$ respectively. For a incident electric field of magnitude 100 v/m calculate reflected and transmitted wave magnitude. Calculate the value of standing wave ratio. **(10 Marks)**

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