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06ES36

Third Semester B.E. Degree Examination, June/July 2014
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. Define 'electric field intensity' and derive the expression for field due to an infinite line of charge. **(12 Marks)**

b. Sheet of charge with $\rho_s = -40\ \mu c/m^2$ located at z = -0.5m, line of charge with $\rho_L = -6\mu c/m$ line along y-axis, what is the net flux crosses the surface of a cube of 2m on an edge of centered at origin. **(04 Marks)**

c. Calculate $\vec{D}$ in rectangular co-ordinates at P(2, -3, 6) produced by a point charge Q = 55mc located at (-2, 3, 6). **(04 Marks)**

2 a. Show that $\vec{E}$ is a negative potential gradient of the potential V. **(05 Marks)**

b. Given potential field $V = 2x^2y - 5z$ and at a point P(-4, 3, 6), obtain

i) V, ii) $\vec{E}$, iii) Direction of $\vec{E}$. **(05 Marks)**

c. Find the capacitance of coaxial cable of inner radius 'a' and outer radius 'b'. **(05 Marks)**

d. A special capacitor of 54pF of two concentric sphere differing in radii 4cm with air as dielectric medium, find their radii and also find energy stored in the capacitor for V = 100V. **(05 Marks)**

3 a. Derive Poisson's and Laplace's equations and write Laplace's equation in cylindrical and polar coordinates. **(06 Marks)**

b. Determine whether the following potential fields satisfies Laplace's equation or not:
i) $V = x^2 + y^2 + z^2$; ii) $V = \rho\cos\phi + z$. **(06 Marks)**

c. Using Laplace's equation, find capacitance of metallic parallel plates. **(08 Marks)**

4 a. Derive an expression for H at a point in the axis of solenoid. **(06 Marks)**

b. A circuit carrying current 5A, from rectangular hexagon inscribed in a circle of radius 1m, calculate B at the centre of hexagon. **(04 Marks)**

c. Show that $\int H.dl = \int_S \nabla X H dS = I$, with definition of the same. **(10 Marks)**

PART – B

5 a. Obtain the expression for magnetic force on moving point charge and magnetic force on differential current element. **(10 Marks)**

b. Obtain the expression for inductance of coaxial cable. **(06 Marks)**

c. Calculate the inductance of solenoid of 200 turns, wound tightly on a cylindrical tube of 6cm dia, length of cable (solenoid) is 60cm in air for $\rho = 3 \times 10^{-2}$m. **(04 Marks)**

6 a. Explain Faraday's law and Lenz's law. **(06 Marks)**

b. Write Maxwell's equations in differential form and integral form. **(08 Marks)**

c. A circular cross section conductor of radius 1.5mm carries a current $i = 5.5\sin(4 \times 10^{10}t)\mu A$. Find amplitude of the displacement current density if $\sigma = 35\mho/m$, $\epsilon_r = 10$. **(06 Marks)**

7 a. Derive an equation for wave propagation in free-space. **(10 Marks)**

b. State and prove Poyntings theorem. **(06 Marks)**

c. A plane wave traveling in positive x-direction in a lossless unbounded medium having permeability 4.5 times that of free space and a permittivity twice that of the wave,

i) Find phase velocity of the wave.

ii) If E has only y-component with a amplitude 20 V/m, find the amplitude and direction of H. **(04 Marks)**

8 a. Derive the expression for transmission coefficient and reflection coefficient. **(08 Marks)**

b. Show that $SWR = \frac{1+\Gamma}{1-\Gamma}$. **(06 Marks)**

c. Given, $\Gamma = 0.5$, $\eta_1 = 300\Omega$, $\eta_2 = 300\Omega$, E_xi, = 100 v/m. Calculate incident, reflected and transmitted waves also find average power is conserved. **(06 Marks)**

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