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10EE44

Fourth Semester B.E. Degree Examination, Dec. 2013/Jan. 2014
Field Theory

Time: 3 hrs. Max. Marks: 100

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

PART – A

1 a. State and explain Gauss's law. **(06 Marks)**

b. Find electric field intensity E at (0, 0, 5)m due to charge Q_1 at (0, 4, 0)m and charge Q_2 at (3, 0, 0)m. The charges are $Q_1 = 0.35$ micro coulombs and $Q_2 = -0.55$ micro coulombs respectively. Hence find magnitude and direction of E. **(08 Marks)**

c. Find the total charge in a volume defined by six planes for which $1 \le x \le 2$; $2 \le y \le 3$; and $3 \le z \le 4$ if $D = (4xa_x^{\wedge} + 3y^2a_y^{\wedge} + 2z^3a_z^{\wedge})$ c/m^2. **(06 Marks)**

2 a. Find the work done in moving a charge Q = −20 micro-coulombs in the electric field given by

$E = \left(\frac{x}{2} + 2y\right)a_x^{\wedge} + 2xa_y^{\wedge}$ v/m from

i) (0, 0, 0)m to (4, 0, 0)m

ii) (4, 0, 0)m to (4, 2, 0)m. **(06 Marks)**

b. Obtain the boundary conditions between conductor and free space. **(08 Marks)**

c. Derive an expression for capacitance of two concentric spherical shells. **(06 Marks)**

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

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

c. Let $V = \frac{\cos 2\phi}{\rho}$ in free space. Find the volume charge density at point A($\rho = 0.5$, $\phi = 60°$, $z = 1$). **(06 Marks)**

4 a. Show that curl H = J ion a steady magnetic filed. **(08 Marks)**

b. Find the magnetic field intensity and flux density at a point P for the current circuit shown in Fig. Q4(b). **(08 Marks)**

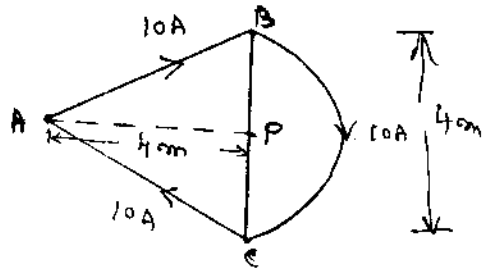

Fig. Q4(b)

c. State and explain Stoke's theorem. **(04 Marks)**

PART – B

5 a. Find an expression for the force on a differential current carrying element. **(08 Marks)**

b. Obtain the relationship between α_1 and α_2 interms of relative permeabilitie's of the two media μ_{r1} and μ_{r2}. **(06 Marks)**

c. Derive an expression for the inductance of a co-axial cable. **(06 Marks)**

6 a. State Faraday's law and obtain point and integral form of electromagnetic induction. **(06 Marks)**

b. If the electric field intensity in free space is given by $E = E_m \sin(\alpha x) \sin(\omega t - \beta z)\ a_y^{\wedge}$ v/m, find the magnetic field intensity using faraday's law. **(08 Marks)**

c. Write Maxwell's equation in point form and in integral form for time varying fields. **(06 Marks)**

7 a. Starting from Maxwell's equation, derive the wave equation for a uniform plane wave traveling in free space. **(10 Marks)**

b. State and prove Poynting's theorem and show that P = EXH. **(10 Marks)**

8 a. Show that at any instant "t", the magnetic and electric field in a reflected wave are out of phase by 90°. **(10 Marks)**

b. With necessary expression, explain standing wave ratio (SWR). **(10 Marks)**

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