2002 SCHEME

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EC44

Fourth Semester B.E. Degree Examination, December 2010
Field Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. State and explain Coulomb's law. Clearly indicate the unit of quantities used in the force equation. **(06 Marks)**

b. State and prove the Gauss theorem. **(08 Marks)**

c. Find E at P(1, 2, 3) due to $Q_1 = 5\mu C$ at (-1, -2, -3) and $Q_2 = 10\mu C$ at (3, 5, -1). **(06 Marks)**

2 a. Obtain an equation for the electric scalar potential. **(06 Marks)**

b. Show that the electric field intensity is a negative of the gradient of the electric scalar potential. **(05 Marks)**

c. Check whether the following potential equations are satisfying Laplace's equation or not

i) $V = 20x^2yz + 10xy^2z^2$

ii) $V = 15x^2 + 10y^2 - 25z^2$ **(05 Marks)**

d. Define : i) Electric field intensity ii) Displacement flux density. **(04 Marks)**

3 a. Derive Poisson's and Laplace's equations. **(04 Marks)**

b. Derive equations of energy stored and energy density in an electrostatic field. **(06 Marks)**

c. Discuss the boundary conditions between two different dielectrics. **(10 Marks)**

4 a. Obtain the differential form of Ampere's work law, in a steady magnetic field. **(08 Marks)**

b. By using Biot-Savart's law, obtain the equations of magnetic field intensity and magnetic flux density at any point on the axis of a coil. **(06 Marks)**

c. Find the magnetic field intensity and the magnetic flux density at P, as shown in the figure Q4 (c). **(06 Marks)**

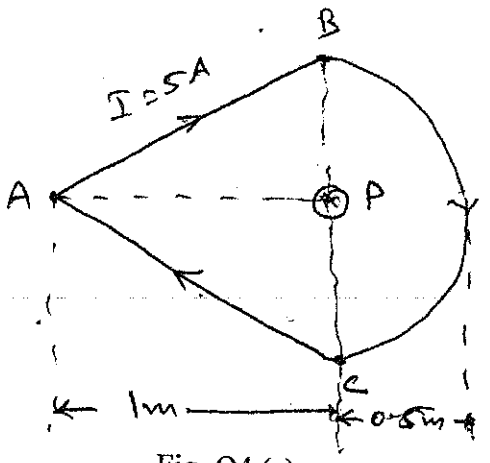

Fig. Q4 (c)

5 a. Prove that $\nabla \times \vec{E} = \frac{-\delta \vec{B}}{\delta t}$. **(06 Marks)**

b. For a time varying field, having a capacitor, show that, the conduction current is equal to the displacement current. **(04 Marks)**

c. Find the depth of penetration, when a 20 MHz signal is propagating the free space and penetrating into a conductor of conductivity $\sigma = 5 \times 10^7$ Ʊ/m. **(02 Marks)**

d. Write Maxwell's equation in,
i) Steady magnetic field.
ii) Time varying field. **(08 Marks)**

6 a. State and prove the pointing vector theorem. **(08 Marks)**

b. Derive the wave equation of E & H. **(08 Marks)**

c. The electric field intensity at 10 km in free space from a radio station was found to be 2.2 mv/m. Calculate : i) The power density ii) The total power radiated from the station. Assume the radiation to be spherically symmetric. **(04 Marks)**

7 a. Show that the uniform plane wave is transverse in nature. **(04 Marks)**

b. Discuss the wave propagation in a good dielectric (absorption medium). **(12 Marks)**

c. A 10 MHz signal with Ex = 100 mV/m is propagating in a nature of medium with $\epsilon_r = 1.5$ and $\mu_r = 3.5$. Find, i) Velocity ii) Phase constant iii) Wavelength iv) Intrinsic impedance and v) Hz. **(04 Marks)**

8 a. Derive an equation for the force acting as a current element. **(06 Marks)**

b. Derive an equation for the torque as a closed circuit. **(06 Marks)**

c. Explain : i) Scalar magnetic potential ii) Vector magnetic potential. **(04 Marks)**

d. Derive an equation for the inductance of a solenoid. **(04 Marks)**

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