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2002 SCHEME

EC44

Fourth Semester B.E. Degree Examination, June-July 2009
Field Theory

Time: 3 hrs. Max. Marks:100

Note:1. ***Answer any FIVE full questions.***
2. Missing data may suitably be assumed.

1 a. Define electric field intensity and electric potential in an electrostatic field. Also derive a relation between them. **(08 Marks)**

b. Obtain an expression for the electric field at some point due to an infinite sheet of charges. **(07 Marks)**

c. Find the electric field strength at a point (1, 2, -1) where the electric potential is given by, $V=3x^2y+2yz^2+3xyz$. **(05 Marks)**

2 a. State and prove Gauss law applied to an electric field. **(06 Marks)**

b. Using Maxwell's first equation, derive Poisson's and Laplace equation. **(06 Marks)**

c. Derive the boundary conditions between the two dielectrics placed in an electric field. **(08 Marks)**

3 a. Show that the energy density in an electrostatic field is given by $\frac{1}{2}\in E^2$. **(08 Marks)**

b. State Biot-Savart's law. Obtain an expression for the magnetic field intensity at a point due to a current in a straight conductor. **(07 Marks)**

c. Find the magnetic field intensity at the center of a square of sides 5 m and carrying a current of 10 ampere. **(05 Marks)**

4 a. State and prove Ampere's circuital law as applied to a magnetic field. **(06 Marks)**

b. Explain the concept of scalar magnetic potential. Obtain an expression for the vector magnetic potential. **(09 Marks)**

c. A solenoid with air core has 2000 turns and length of 50 cm. The core radius is 4 cm. Find its inductance. **(05 Marks)**

5 a. Explain i) Motional e.m.f. ii) Transformer e.m.f. **(08 Marks)**

b. Derive an expression for the force between two current carrying conductors. **(06 Marks)**

c. If the magnetic field intensity in a region is $\vec{H}=x^2\hat{a}_x+2yz\hat{a}_y+(-x^2)a_z^2$; find the current density at the origin. **(06 Marks)**

6 a. Show that a uniform plane electromagnetic wave is transverse in nature. **(08 Marks)**

b. Obtain the relation $\frac{E}{H}=\sqrt{\frac{\mu}{\epsilon}}$ for an electromagnetic wave. **(08 Marks)**

c. A plane wave is traveling in positive x-direction in a lossless unbounded medium having permeability 4.5 times that of free space and permittivity twice that of free space. Find the phase velocity of the wave. **(04 Marks)**

7 a. Derive an expression for the intrinsic impedance of a perfect dielectric medium when an EM wave travels in it. **(08 Marks)**

b. State poynting theorem and prove that the power flow per unit area is given by, $\vec{P}=\vec{E}\times\vec{H}$. **(08 Marks)**

c. The depth of penetration of an EM wave in a conducting medium is 0.1 m. The frequency of the wave is one MHz. Find the conductivity of the medium. **(04 Marks)**

8 Derive expressions for:

a. Equation of continuity.

b. Skin effect.

c. Energy stored in a parallel plate capacitor.

d. Capacity of two concentric spherical shells. **(20 Marks)**