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10EE44

Fourth Semester B.E. Degree Examination, June/July 2017
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 Coulomb's law in vector form. **(06 Marks)**

b. Four point charges, each of 25 nC are kept at the corners of a square of 5m. Find out the value of the charge that should be kept at the centre of the square to keep all the above charges stable at the corners of the square. **(08 Marks)**

c. State and explain Gauss law. Find out electric field intensity at a distance 'r' from an infinite line charge using Gauss law. **(06 Marks)**

2 a. Prove $E = -\nabla V$ by considering $E.\Delta l$. **(06 Marks)**

b. Find the capacitance per unit length of a cable having inner radius 'a' and outer radius 'b' by finding $\vec{E}$ and V of the cable. Use Gauss law for finding 'E' of the cable. **(06 Marks)**

c. The lines of electric field make an angle of 45° in air at the boundary between Glass ($\in_r = 5$) and air ($\in_r = 1$). If the electrical flux density in air (Dr) is 0.5 $\mu C/m^2$, determine the orientation and magnitude of D_g in glass. **(08 Marks)**

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

b. Determine voltage at any given point of the region between two concentric spheres of radius 'a' (inner sphere) and radius 'b' (outer sphere) using Laplace equation. Assume that inner sphere is having a potential of 100 volts and outer sphere is earthed. **(08 Marks)**

c. Find out whether $V = 2x^2 - 3y^2 + z^2$ satisfies Laplace equation or not. **(06 Marks)**

4 a. Derive Stokes theorem $\int_S (\nabla \times H) \cdot \Delta S = \oint_\ell H \cdot d\ell$ after determining $\nabla \times H = J$ by considering elemental rectangular loop in xy plane and generalizing for other. **(08 Marks)**

b. Determine magnetic field intensity and magnetic flux density of a coaxial cylinder by ampere circuital law. Radius of inner conductor is 'a' and carries a current 'I'. Outer conductor of radius 'b' is earthed. Assume that the thickness of the outer cylinder is negligible. **(06 Marks)**

c. Determine the magnetic field intensity at the centre of a square loop of 2m length carrying a current of 10A. **(06 Marks)**

PART – B

5 a. Derive an expression for the force between the current loops. **(06 Marks)**

b. A conductor length of 2.5 m located at z = 0, x = 4m carries a current of 12A in $-\hat{a}y$ direction. Find the uniform 'B' in the region if the force on the conductor is 1.2×10^{-2} N in the direction $\frac{-\hat{a}x + \hat{a}z}{\sqrt{2}}$. **(08 Marks)**

c. An aircored torroid has a c/s of 10 cm^2, a mean radius of 15 cm and is wound with 500 turns carries a current of 5A. Find the magnetic field intensity at the mean radius. **(06 Marks)**

6 a. Write the Maxwell's equation in both point and integral form. **(06 Marks)**

b. Derive an expression for open circuit voltage of a faraday disc generator. The disc has a radius 'a' and rotate at a constant angular velocity 'w' rad/sec in a magnetic field of 'B' âz wb/m^2. The brushes are placed at the axis and rim of the disc. **(06 Marks)**

c. Explain what is meant by displacement current. What is meant by retarded potential? **(08 Marks)**

7 a. State and prove Poynting theorem. **(06 Marks)**

b. If the electric field strength is equal to 50 cos(wt – βy) âz V/m determine the displacement current density. If the same field exists in a medium whose conductivity is given by 2×10^3 ℧/cm, find the conduction current density **(08 Marks)**

c. Derive the equation $\nabla^2\vec{E} - \mu \in \frac{\partial^2 E}{\partial t^2} = \mu\frac{\partial \vec{J}}{\partial t} + \nabla\left(\frac{\rho V}{t}\right)$ from Maxwell's equations. **(06 Marks)**

8 a. Explain skin effect and its significance. **(06 Marks)**

b. With necessary expression explain standing wave ratio (SWR). **(06 Marks)**

c. Discuss wave propagation in lossy dielectric. **(08 Marks)**

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