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10EE44

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Field Theory

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Missing data, if any, may be suitably assumed.

PART – A

1 a. State and explain Coulomb's law for electrostatic force between two point charges. Represent force in vector form. **(05 Marks)**

b. Find electric flux density in Cartesian co-ordinate system at a point (6, 8, –10) due to :
i) A point charge of 60mc at the origin
ii) A uniform surface charge of density $\rho_S = 100\ \mu c/mt^2$ on the plane x = 12mt. **(08 Marks)**

c. Given the electric flux density $\vec{D} = 5\sin\theta\,\hat{a}_\theta + 5\sin\phi\,\hat{a}_\phi$, find the charge density of (0.7m, $\pi/2$, 2π) (spherical – coordinates). **(07 Marks)**

2 a. Obtain the boundary conditions between two perfect dielectrics. **(07 Marks)**

b. An electrostatic field is given by $\vec{E} = -12xy\,\hat{a}_x - 6x^2\,\hat{a}_y + \hat{a}_z$ V/m . The charge of 6c is to be moved from B(1, 8, 5) to A(2, 18, 6). Find the work done in each of the following cases :
i) The path selected is $y = 3x^2 + z$; $z = x + 4$
ii) The straight line from B to A
Show that the work done remains same and is independent of the path selected. **(08 Marks)**

c. Find the work done in assembling four equal point charges of 2 μc each on x and y axis at ±3m and ±4m respectively. **(05 Marks)**

3 a. Obtain Poisson's and Laplace's equations form Maxwell's first equation. **(06 Marks)**

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

c. Determine whether or not the following potential fields satisfy the Laplace's equation :
i) $V = x^2 - y^2 + z^2$
ii) $V = r\cos\phi + t$
iii) $V = r\cos\theta + \phi$. **(06 Marks)**

4 a. Obtain on expression for magnetic field intensity of a point due to infinite conductor using Biot – Savart's law.. **(08 Marks)**

b. State and prove Ampere's circuital law as applied to magnetic field. **(05 Marks)**

c. Evaluate both sides of the Stoke's theorem for the field. $\vec{H} = 6xy\,\hat{a}_x - 3y^2\,\hat{a}_y$ A/m and the rectangular path around the region, $2 \le x \le 5$; $-1 \le y \le 1$; $z = 0$. Let the positive direction of $\vec{ds}$ be $\hat{a}_z$. **(07 Marks)**

PART – B

5 a. Discuss the magnetic boundary conditions to apply $\vec{B}$ and $\vec{H}$ at the interface between tw different magnetic materials. **(06 Marks**

b. Define self inductance. Derive an expression for self inductance of a co-axial cable. **(06 Marks**

c. A rectangular loop in z = 0 plane has corners at (0, 0, 0), (1, 0, 0), (1, 2, 0) and (0, 2, 0). Th loop carries a current of 5A in $\hat{a}_x$ direction. Find the total force produced by the magneti field, $\vec{B} = 2\hat{a}_x + 2\hat{a}_y - 4\hat{a}_z \text{ Wh/mt}^2$. **(08 Marks**

6 a. Explain the interpretation of Faraday's law applicable to time varying magnetic field an derive an expressions for 'transformer e.m.f' and motional e.m.f. **(06 Marks**

b. Derive the equation giving relation between $\vec{A}$ and V (Lorent'z condition for potentials fron retarded potentials) **(07 Marks**

c. A parallel plate capacitor with plate area of 5cm^2 and plate separation of 3mm has a voltag of 50 sin $(10^3 t)$ volts applied to its plates. Calculate the displacement current assumin $\epsilon = 2\epsilon_0$. **(07 Marks**

7 a. Obtain the solution of wave equations for uniform plane wave propagating in free space. **(10 Marks**

b. Wet marshy soil is characterized by $\sigma = 10^{-2}$ s/m, $\epsilon_r = 15$ and $\mu_r = 1$. At frequencies 60Hz 1mHz, 100mHz and 10 GHz. Indicate whether soil be considered as a conductor or a dielectric. **(10 Marks**

8 a. With necessary expression. explain (SWR) standing wave ratio. **(10 Marks**

b. Derive the expressions for transmission co-efficient and reflection co-efficient. **(10 Marks**

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