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10ES36

Third Semester B.E. Degree Examination, Dec.2015/Jan.2016

Field Theory

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define electric field intensity $(\vec{E})$. Find an expression for electric field intensity due to N different point charges. **(04 Marks)**

b. Derive Maxwell's first equation in electrostatics. **(04 Marks)**

c. Given $\vec{D} = z \operatorname{Sin}\phi\, \overrightarrow{ap} + P \operatorname{Sin}\phi\, \overrightarrow{az}$ c/m^2 compute the volume charge density at (1, 30° 2). **(04 Marks)**

d. Verify both sides of Gauss Divergence theorem if $\vec{D} = 2xy\,\overrightarrow{ax} + x^2\,\overrightarrow{ay}$ c/m^2 present in the region bounded by $0 \le x \le 1,\ 0 \le y \le 2,\ 0 \le z \le 3$ **(08 Marks)**

2 a. Derive an equation for potential due to infinite line charge. **(04 Marks)**

b. If $U = \dfrac{60 \sin\theta}{r^2}$ V find V and $\vec{E}$ at P (3,60,25) **(05 Marks)**

c. Derive an equitation for energy stored in terms of $\vec{E}$ and $\vec{D}$ **(05 Marks)**

d. Derive Boundary conditions for conductor and Dielectric interface. **(06 Marks)**

3 a. Expand ∇^2 operation in different co-ordinate system. **(03 Marks)**

b. Verify that the potential field given below satisfies the Laplace equation

$V = 2x^2 - 3y^2 + z^2$

$V = [Ar^4 + Br^{-4}] \operatorname{Sin} 4P$ **(08 Marks)**

c. Solve the Laplace equation for the potential field and find the capacitance in homogeneous region between two concentric conducting spheres with radii a and b such that b > a if V = 0 at r = b, V = Vo at r = a. **(09 Marks)**

4 a. Derive expression for $\vec{H}$ due to straight conductor of finite length. **(08 Marks)**

b. State and explain the following

i) Ampere circuit law

ii) Stokes theorem. **(08 Marks)**

c. Given the vector magnetic potential

$\vec{A} = x^2\,\overrightarrow{ax} + 2yz\,\overrightarrow{ay} + (-x^2)\,\overrightarrow{az}$

Find magnetic flux density. **(04 Marks)**

PART – B

5 a. Derive expression for force on a differential current element **(06 Marks)**

b. A current element $I_1\, \Delta L_1 = 10^{-5}\ \overrightarrow{az}$ A.m is located at $P_1(1, 0, 0)$ while second element $I_2\, \Delta L_2 = 10^{-5}\,(0.6\ -\overrightarrow{ax}\ \ 2\overrightarrow{ay} + 3\,\overrightarrow{az})$ A.m is at P_2 (-1, 0,0) both in free space find the vector force exerted on $I_2\, \Delta\, L_2$ by $I_1\, \Delta L_1$ **(08 Marks)**

c. Derive an equation of inductance of Toroid. **(06 Marks)**

6 a. Derive Maxwell's equations for time varying fields. **(08 Marks)**

b. $\vec{E} = E_m \sin(wt - Bz)\ \overrightarrow{a_y}$ in free space find $\vec{D}, \vec{B}, \vec{H}$ **(05 Marks)**

c. Define displacement current density. **(02 Marks)**

d. Derive continuity equation from Maxwell's equation. **(05 Marks)**

7 a. Derive General wave equation **(08 Marks)**

b. The uniform plane wave travelling in free space is given by

$E_y = 10.4\ e^{j(2\pi\times10^9 t - \beta x)}\ \mu v/m$

Find:

i) Direction of wave propagation.
ii) Phase velocity
iii) Phase constant
iv) Equation for magnetic field **(08 Marks)**

c. For $E = E_m e^{-\alpha z} \cos(wt - \beta z)\ \overrightarrow{a_x}$ find average power density. Assume free space. **(04 Marks)**

8 a. Derive expression for transmission co-efficient and Reflection co-efficient for uniform waves at normal incidence. **(08 Marks)**

b. For $n_1 = 100\Omega$, $n_2 = 100\Omega$ and $Ex_1 = 100v/m$ calculate amplitude of incident, reflected and transmitted waves. Also show that average power is conserved. **(10 Marks)**

c. Define SWR. **(02 Marks)**

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