USN | | | | | | | | | | |

10ES36

Third Semester B.E. Degree Examination, June/July 2015
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. State and prove Gauss law. **(04 Marks)**

b. Find the volume charge density at $(4m, 45^\circ, 60^\circ)$. If the electric flux density is given by, $\vec{D} = (r\hat{a}_r + \sin\theta\hat{a}_\theta + \sin\theta\cos\phi\hat{a}_\phi)$ C/m^2. **(06 Marks)**

c. Given $\vec{D} = \frac{10r^3}{4}\hat{a}_r$ in cylindrical co-ordinates, evaluate both sides of the divergence theorem for the volume enclosed by the cylinder with r = 2 m, z = 0 to 10 m. **(10 Marks)**

2 a. With usual notations, prove point form of continuity equation, $\nabla.J = \frac{\partial \rho_v}{\partial t}$. **(05 Marks)**

b. Find the amount of energy required to move a 6 coulomb of point charge from the origin to P(3, 1, -1) m in the field $\vec{E} = (2x\hat{a}_x - 3y^2\hat{a}_y + 4\hat{a}_z)$ V/m along the straight line path, x = -3z, y = x+ 2z **(05 Marks)**

c. A parallel plate capacitor is filled with a dielectric of 0.03 power factor and $\varepsilon_r = 10$. The plates have an area of 250 mm^2 and the distance between them is 10 mm. If 5000 V (rms) at 1 MHz is applied to the capacitor find the power dissipated as heat. **(10 Marks)**

3 a. Find V and the volume charge density in free space, if $V = \frac{2\cos\phi}{r^2}$ at P(0.5, 45°, 60°). **(07 Marks)**

b. Find the electric field at P(3, 1, 2) for the field of two radial conducting planes V= 50 V at ϕ = 10° and V = 20 V at ϕ = 30° **(08 Marks)**

c. State and prove uniqueness theorem. **(05 Marks)**

4 a. State and prove Ampere's law. **(04 Marks)**

b. Calculate the magnetic field intensity at point P due to 10 A current flowing in the anticlockwise direction in the metallic block shown in Fig. Q4 (b). **(06 Marks)**

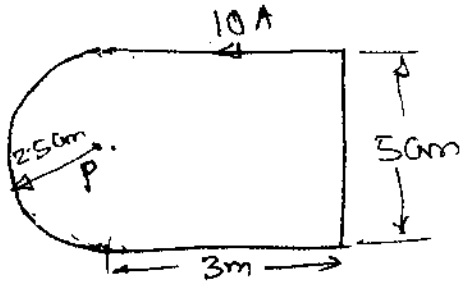

Fig. Q4 (b)

c. Verify stokes theorem for a field having $\vec{H} = 2\rho^2(\tau+1)\sin\phi\hat{a}_\phi$ for the portion of a cylindrical surface defined by $\rho = 2$, $\frac{\pi}{4} \le \phi \le \frac{\pi}{2}$, $1 \le \tau \le 1.5$ and for its perimeter. **(10 Marks)**

PART – B

5 a. What is Lorentz force equation? **(02 Marks)**

b. A square loop carrying 2 mA current is placed in the field of an infinite element carrying current of 15 A as shown in Fig. Q5 (b). Find the force exerted on the loop. **(08 Marks)**

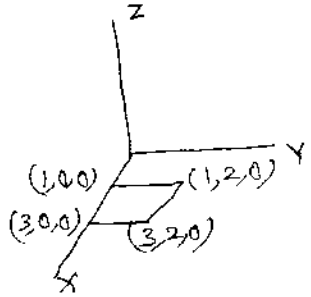

Fig. Q5 (b)

c. Two homogeneous, linear, isotropic material have interface at X = 0, in which there is a surface current $K = 200\hat{a}_z$ A/m. In region 2 for X > 0, find i) H_2 ii) $|B_1|$ iii) $|B_2|$ iv) α_1 v) α_2. If $H_1 = (150\hat{a}_x - 400\hat{a}_y + 250\hat{a}_z)$A/m. **(10 Marks)**

6 a. State Maxwell's equations for a good conductor and for perfect dielectrics. **(08 Marks)**

b. Define phase velocity, wavelength and propagation constant. **(06 Marks)**

c. A uniform plane wave traveling in +z direction in air has $H = 20\hat{a}_y$ A/m the frequency of the signal is $\frac{1}{\pi} \times 10^9$ Hz. Find λ, T and E. **(06 Marks)**

7 a. Derive the expression for α, β, γ and V for low loss dielectric. **(06 Marks)**

b. For a uniform plane wave, $E_y = 10.4e^{(-j\beta x + 2\pi \times 10^9 t)}$ V/m. Find

i) The direction of propagation.

ii) Phase constant β

iii) Expression for H. **(05 Marks)**

c. A material is characterized by $\varepsilon_r = 2.5$, $\mu_r = 1$ and $\sigma = 4 \times 10^{-5}$ ℧/m at f = 1 MHz. Determine the value of the loss tangent, attenuation constant and phase constant. **(09 Marks)**

8 Write an explanatory notes on:

a. Standing wave ratio. **(08 Marks)**

b. Poynting vector. **(12 Marks)**

* * * * *