Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- Vth SEMESTER–EXAMINATION – MAY/JUNE - 2012

Subject code: 151002 **Date: 04/06/2012**

Subject Name: Engineering Electromagnetics

Time: 02:30 pm – 05:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Given points are E (2, 5, 1), F (-1, 4, -2) and G (3, -2, 4). **07**
Find: (i) A unit vector directed from E towards F.
(ii) The angle between R_{EF} and R_{EG}.
(iii) The scalar projection R_{EF} and R_{EG}.

(b) (i) Find the volume defined by $4 < \rho < 6$, $30° < \varphi < 60°$, $2 < z < 5$. (ii) What is the length of the longest straight line that lies entirely within the volume? (iii) Find the total area of the surface. **07**

Q.2 **(a)** Find Electric field intensity due to infinite line with uniform line charge density ρ_L on z-axis **07**

(b) Find E at P (1, 5, 2) in free space if a point charge of 6 μC is located at Q(0, 0, 1), a uniform line charge ρ_L=180 nC/m lies along the z axis and a uniform sheet charge 25 nC/m^2 lies in the plane z = -1 **07**

OR

(b) Given the field $\bar{D} = 6\rho \sin(\varphi/2)\, \bar{a}_\rho + 1.5\rho \cos(\varphi/2)\, \bar{a}_\varphi$ C/m^2. Evaluate both sides of the divergence theorem for the region bounded by $\rho = 2$, $0 < \varphi < 180°$, $0 < z < 5$. **07**

Q.3 **(a)** Derive equation to find Energy stored in the field of a system of charges **07**

(b) The region y < 0 contains a dielectric material for which ε_{R1}=2.5, while the region y > 0 is characterized by ε_{R2}= 4. Let $\bar{E}_1 = -30\, \bar{a}_x + 50\, \bar{a}_y + 70\, \bar{a}_z$ V/m Find (i) D_{N2} (ii) D_{t2} (iii) $\bar{D}_2$ (iv) θ_2 **07**

OR

Q.3 **(a)** Find Capacitance between two concentric spheres using Laplace Equation. **07**

(b) Given a point of $200\pi\varepsilon_0$ C at (3, -1, 2), a line charge of $40\pi\varepsilon_0$ C/m on the x-axis and a surface charge of $8\varepsilon_0$ C / m^2 on the plane x = -3, all in free space. Find the potential at P (5, 6, 7) if V = 0 at Q (0, 0, 1). **07**

Q.4 **(a)** Define the term "curl". Also explain the point form of "Ampere's circuital law". **07**

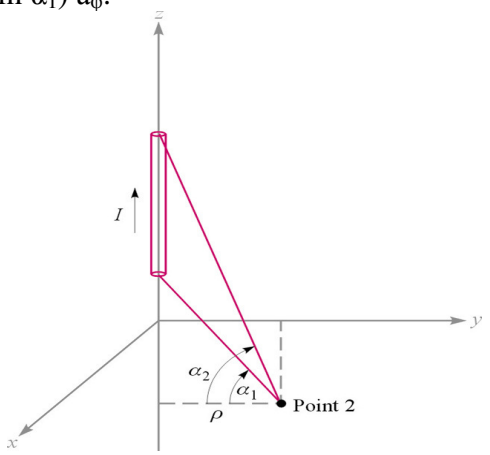
(b) Write the statement of Stoke's theorem. **07**

Evaluate both sides of Stoke's theorem for the field $\bar{H} = 6xy\ \bar{a}_x - 3y^2\ \bar{a}_y$ 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 dS be $\bar{a}_z$.

OR

Q.4 **(a)** Prove that for a differential current loop which carries current I in a given magnetic field, the torque on that loop is given by $d\bar{T} = d\bar{m} \times \bar{B}$. **07**

(b) As shown in the figure below, the finite length current element is on the z – axis. Using Bio–savart law show that $\bar{H} = I / 4\pi\rho\ (\sin\alpha_2 - \sin\alpha_1)\ \bar{a}_\varphi$. **07**



Q.5 **(a)** Derive Maxwell's four equations in point form. **07**

(b) Explain Skin effect in detail. A steel pipe is constructed of a material for which $\mu_r = 200$ and $\sigma = 5 \times 10^6$ mho/m. The outer and inner radii 8 and 6 mm respectively and the length is 80 m. If the total current carried by the pipe is $2\cos 10^4\pi t$ A, find (i) the skin depth (ii) the effective resistance **07**

OR

Q.5 **(a)** Derive Maxwell's four equations in integral form. **07**

(b) A lossy dielectric is characterized by $\varepsilon_r = 2.5$, $\mu_r = 4$, and $\sigma = 10^{-3}$ mho/m at 10MHz. Let $\bar{E}_s = 20\ e^{-yz}\ \bar{a}_x$ V/m and find (i) α (ii) η (iii) $\bar{H}_s$ **07**

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