Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER– V • EXAMINATION – WINTER 2016

Subject Code: 151002 **Date: 19/11/2016**
Subject Name: Engineering Electromagnetics
Time: 10:30AM – 01:00PM **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 two points , M(2,5,-3) and N(-3,1,4): (i) Find their separation (ii) find the distance from the origin to the midpoint of the line MN (iii) Find a unit vector in the direction of $\mathbf{R_{MN}}$. **07**

(b) (i) Find $\mathbf{a_x}$ in spherical components at P (3,-4, 5). (ii) Find $\mathbf{a_\theta}$ in Cartesian components at P(3,-4,5). **07**

Q.2 **(a)** Evaluate both sides of the divergence theorem for the field $\mathbf{D} = 2xy\,\mathbf{a_x} + x^2\,\mathbf{a_y}$ C/m^2 and the rectangular parallelepiped formed by the planes x= 0 and 1, y= 0 and 2, and z= 0 and 3. **07**

(b) Using Gauss's law, explain the concept of divergence. Prove Divergence Theorem and obtain Maxwell's first equation **07**

OR

(b) Derive the expression for the electric field E due to infinite sheet of charge having a uniform density of ρ_S C/m^2. **07**

Q.3 **(a)** Write Maxwell's equations in point form and explain physical significance of equations. **07**

(b) Assuming the potential function V varies as a function of ρ in cylindrical coordinates systems, obtain the solution of Laplace equation and deduce the value of capacitance of a coaxial capacitor. **07**

OR

Q.3 **(a)** Explain uniqueness theorem in brief. Also derive the expression of E if boundary conditions for two radial planes are given by V = 0 at Φ = 0 and V = V_0 at Φ = α. **07**

(b) Write a detailed note on potential gradient. **07**

Q.4 **(a)** An infinitely long coaxial cable is carrying current I by the inner conductor of radius 'a' and –I by the outer conductor of radii 'b' and 'c'. Where c>b. Deduce the expressions for H at (i) ρ < a (ii) a <ρ < b (iii) b < ρ < c (iv) ρ > c. **07**

(b) Define magnetic flux & magnetic field intensity. Also explain Magnetic boundary conditions in brief. **07**

OR

Q.4 **(a)** Let $\mu=\mu_1 = 4$ μH/m in region 1 where z>0, while $\mu_2 = 7$ μH/m wherever z<0. Moreover, let $\mathbf{K}$=80 $\mathbf{a_x}$ A/m on the surface z=0. In region 1, the magnetic flux density is $\mathbf{B_1} = 2\,\mathbf{a_x} - 3\,\mathbf{a_y} + \mathbf{a_Z}$ mT. Find $\mathbf{B_2}$ **07**

(b) State and prove Poynting theorem relating to the flow of energy at a point in space in an electromagnetic field. **07**

Q.5 **(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 $\mathbf{dT} = \mathbf{dm} \times \mathbf{B}$ **07**

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

OR

Q.5 **(a)** Write Short note on the followings. **07**
1) Skin effect
2) The retarded potentials

(b) An E field in free space is given as $\mathbf{E} = 800\cos(10^8 t - \beta y)\,\mathbf{a_z}$ V/m. find (i)β (ii)λ (iii) H at P(0.1, 1.5, 0.4) at t = 8 ns. **07**

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