

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VI • EXAMINATION – WINTER • 2014****Subject Code: 160906****Date: 08-12-2014****Subject Name: Theory of 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)** Explain spherical coordinate system. Explain conversion from cylindrical to spherical system. **07**

**(b)** The two vectors are  $\mathbf{F} = 10 \mathbf{a}_x - 6 \mathbf{a}_y + 5 \mathbf{a}_z$  and  $\mathbf{G} = 0.1 \mathbf{a}_x + 0.2 \mathbf{a}_y + 0.3 \mathbf{a}_z$  **07**  
 (i) Find the vector component of  $\mathbf{F}$  that is parallel to  $\mathbf{G}$  (ii) Find the vector component of  $\mathbf{F}$  that is perpendicular to  $\mathbf{G}$  (iii) Find the vector component of  $\mathbf{G}$  that is perpendicular to  $\mathbf{F}$ .

**Q.2 (a)** Find  $\mathbf{E}$  at  $\mathbf{P}(1,5,2)$  in free space if a point charge of  $6 \mu\text{C}$  is located at  $\mathbf{Q}(0,0,1)$ , a uniform line charge of  $180 \text{ nC/m}$  lies along the  $x$  axis and a uniform sheet of charge equal to  $25 \text{ nC/m}^2$  lies in the plane  $z = -1$ . **07**

**(b)** A point charge  $\mathbf{Q}_1 = 10 \mu\text{C}$ , is located at  $\mathbf{P}_1(1, 2, 3)$  in free space, while  $\mathbf{Q}_2 = -5 \mu\text{C}$  is at  $\mathbf{P}_1(1, 2, 10)$ . Find (a) the vector force exerted on  $\mathbf{Q}_2$  by  $\mathbf{Q}_1$ . (b) The coordinates of  $\mathbf{P}_3$  at which point charge  $\mathbf{Q}_3$  experience no force. **07**

**OR**

**(b)** Obtain expression for an electric field due to infinite line charge having density  $\rho_L \text{ C/m}$  placed along  $z$  – axis at a Point  $\mathbf{P}$  on  $y$  axis at a distance  $d$  from  $z$  axis. **07**

**Q.3 (a)** State and Explain Gauss Law. Explain Divergence Theorem **07**

**(b)** If  $\mathbf{G} = 5 r \sin^2 \theta \cos^2 \Phi \mathbf{a}_r$  evaluate both sides of Divergence theorem for the region  $r \leq 2$ . **07**

**OR**

**Q.3 (a)** Explain concept of potential gradient and prove that  $\mathbf{E} = - \nabla V$  **07**

**(b)** Find spherical coordinates of  $10 \mathbf{a}_x$  at the point  $\mathbf{P}(-3, 2, 4)$ . **07**

**Q.4 (a)** Explain boundary conditions between two perfect Dielectric material **07**

**(b)** The magnetic Field intensity is given in certain region of space as :  $\mathbf{H} = [(x + 2y) / z^2] \mathbf{a}_y + (2/z) \mathbf{a}_y \text{ A/m}$ . Find: (i)  $\nabla \times \mathbf{H}$  (ii)  $\mathbf{J}$  (iii) Use  $\mathbf{J}$  to find the total current passing through the surface  $z=4$ ,  $1 \leq x \leq 2$ ,  $3 \leq y \leq 5$  in  $\mathbf{a}_z$  direction. **07**

**OR**

**Q.4 (a)** State and Explain Biot Savart Law **07**

**(b)** Three identical point charges of  $4 \text{ PC}$  each are located at the corners of an equilateral triangle  $0.5 \text{ mm}$  on a side in free space. How much work must be done to move one charge to a point equidistant from the other two and on the line joining them? **07**

**Q.5 (a)** Discuss Poisson's and Laplace equation **07**

**(b)**  $\mathbf{F} = x^2 y \mathbf{a}_x - 2 z \mathbf{a}_y + (3z^2 + xy) \mathbf{a}_z$  Find  $\nabla \times [\nabla \cdot (\nabla \cdot \mathbf{F})]$  **07**

**OR**

**Q.5 (a)** Explain briefly the finite element method and write advantages and disadvantages of it. **07**

**(b)** State and Explain Lorentz force equation on charge particle and explain the concept of magnetic torque. **07**

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