Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. - SEMESTER – VI • EXAMINATION – WINTER 2012

Subject code: 160906 **Date: 08/01/2013**

Subject Name: Theory of Electromagnetics

Time: 02.30 pm - 05.00 pm **Total Marks: 70**

Instructions:

1. **Attempt any five questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Bold letter indicates vector quantity.**

Q.1	**(a)**	Define electric field intensity. Obtain the expression for the electric field intensity at a point which is at a distance of R from a point charge Q.	**07**
	(b)	Explain dot product and cross product of two vectors.	**03**
	(c)	Explain unit vectors of Cartesian, Cylindrical and Spherical co-ordinate systems.	**04**
Q.2	**(a)**	Derive expression of electric field intensity due to a uniform line charge over z-axis having a charge density of ρ_L C/m.	**07**
	(b)	Consider a cylindrical electron beam having length of 2 cm and radius 1 cm. The uniform charge density ρ_v within the cylinder is $-5 \times 10^{-6} e^{(-10^8 \rho z)}$ C/m^3. Calculate the total charge enclosed in this cylinder. Use volume integral for this calculation. ρ is the shortest distance of the point from the axis of cylinder (the z- axis). For the calculation consider the electron beam between $z = 2$ cm and $z = 4$ cm.	**07**
		OR	
	(b)	(i) Consider a vector field $\boldsymbol{G} = y\boldsymbol{a}_x - 2.5x\boldsymbol{a}_y + 3\boldsymbol{a}_z$ and the point Q(4, 5, 2). Find (1) **G** at Q, (2) the scalar component of **G** at Q in the direction of $\mathbf{a}_N$ = 1/3 ($2\boldsymbol{a}_x + \boldsymbol{a}_y - 2\boldsymbol{a}_z$), (3) the vector component of **G** at Q in the direction of $\mathbf{a}_N$ and (4) the angle θ_{Gn} between $\mathbf{G}(\mathbf{r}_Q)$ and $\mathbf{a}_N$.	**04**
		(ii) Describe vector fields.	**03**
Q.3	**(a)**	State and explain gauss's law. Obtain expression of electric field intensity of line charge using gauss's law.	**07**
	(b)	Given the potential field, $V = 2x^2y - 5z$, and a point P(-4, 3, 6), find following at point P: (1) the potential V, (2) the electric field intensity **E,** (3) the direction of **E,** (4) the electric flux density **D,** and (5) the volume charge density ρ_v.	**07**
		OR	
Q.3	**(a)**	Derive Maxwell's first equation as applied to the electrostatics, using Gauss's law. Also state the Divergence theorem.	**07**
	(b)	State and Explain Lorentz force equation on charge particle. Also explain concept of magnetic torque.	**07**
Q.4	**(a)**	Explain an electric dipole. Also derive expression of **E** due to an electric dipole.	**07**
	(b)	State and explain Ampere circuital law.	**07**
		OR	
Q.4	**(a)**	Write short note: Electrostatic boundary conditions between perfect dielectrics.	**07**
Q.4	**(b)**	Derive Poisson's and Laplace's equation.	**07**
Q.5	**(a)**	State and Explain Biot-Savart's law for magnetic field. Using this law derive expression for magnetic field intensity at a point due to a finite length current element carrying current 'I' lying on z-axis in cylindrical co-ordinates.	**07**
	(b)	State and explain Stoke's theorem.	**07**
		OR	
Q.5	**(a)**	Write a short note on advantages and applications of numerical techniques in engineering.	**07**
	(b)	Explain briefly finite element method. Also state the advantages and disadvantages of finite element method.	**07**

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