## **GUJARAT TECHNOLOGICAL UNIVERSITY B. E. - SEMESTER – VI • EXAMINATION – WINTER 2012**

# Subject code: 160906 **Subject Name: Theory of Electromagnetics** Time: 02.30 pm - 05.00 pm **Instructions:**

**Total Marks: 70** 

04

Date: 08/01/2013

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.
- 0.1 (a) Define electric field intensity. Obtain the expression for the electric field intensity at a 07 point which is at a distance of R from a point charge Q. 03
  - Explain dot product and cross product of two vectors. **(b)**
  - (c) Explain unit vectors of Cartesian, Cylindrical and Spherical co-ordinate systems.
- (a) Derive expression of electric field intensity due to a uniform line charge over z-axis Q.2 07 having a charge density of  $\rho_L C/m$ .
  - Consider a cylindrical electron beam having length of 2 cm and radius 1 cm. The uniform **(b)** 07 charge density  $\rho_{\nu}$  within the cylinder is  $-5 \times 10^{-6} e^{(-10^{4}\rho z)}$  C/m<sup>3</sup>. Calculate the total charge enclosed in this cylinder. Use volume integral for this calculation. p 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.

#### OR

(b) (i) Consider a vector field  $\mathbf{G} = y\mathbf{a}_x - 2.5x\mathbf{a}_y + 3\mathbf{a}_z$  and the point Q(4, 5, 2). Find (1) **G** 04 at Q, (2) the scalar component of G at Q in the direction of  $\mathbf{a}_{N} = 1/3 (2a_{x} + a_{y} - 2a_{z})$ , (3) the vector component of **G** at Q in the direction of  $\mathbf{a}_N$  and (4) the angle  $\theta_{ca}$  between  $\mathbf{G}(\mathbf{r}_{0})$  and  $\mathbf{a}_{N}$ . 03

(ii) Describe vector fields.

- 0.3 (a) State and explain gauss's law. Obtain expression of electric field intensity of line charge 07 using gauss's law.
  - Given the potential field,  $V = 2x^2y 5z$ , and a point P(-4, 3, 6), find following at point 07 **(b)** 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  $\rho_{u}$ .

#### OR

- (a) Derive Maxwell's first equation as applied to the electrostatics, using Gauss's law. Also **Q.3** 07 state the Divergence theorem.
  - State and Explain Lorentz force equation on charge particle. Also explain concept of 07 **(b)** magnetic torque.
- Explain an electric dipole. Also derive expression of **E** due to an electric dipole. 07 **Q.4** (a) 07
  - State and explain Ampere circuital law. **(b)**

### OR

- (a) Write short note: Electrostatic boundary conditions between perfect dielectrics. Q.4
- **Q.4** Derive Poisson's and Laplace's equation. **(b)**
- State and Explain Biot-Savart's law for magnetic field. Using this law derive expression 0.5 07 (a) 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.

### OR

(a) Write a short note on advantages and applications of numerical techniques in engineering. 07 Q.5 (b) Explain briefly finite element method. Also state the advantages and disadvantages of 07 finite element method.

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