

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

B E Sem-VI Examination May 2011

Subject code: 160906

Subject Name: Theory of Electromagnetics

Date: 24/05/2011

Time: 10.30 am – 01.00 pm

Total Marks: 70

Instructions:

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

Q.1 (a) Let each of the vectors $\mathbf{A} = 5\mathbf{a}_x - \mathbf{a}_y + 3\mathbf{a}_z$, $\mathbf{B} = -2\mathbf{a}_x + 2\mathbf{a}_y + 4\mathbf{a}_z$ and $\mathbf{C} = 3\mathbf{a}_y - 4\mathbf{a}_z$ extend outward from the origin of a Cartesian coordinate system to points A, B and C respectively. Find a unit vector directed from point A toward: (a) to the origin; (b) point B; (c) point equidistance from B and C on the line BC; (d) Find the length of the perimeter of the triangle ABC. **07**

(b) Given points A($x = 2$, $y = 3$, $z = -1$) and B($\rho = 4$, $\Phi = -50^\circ$, $z = 2$), find a unit vector in cylindrical coordinates at point B directed towards point A. **07**

Q.2 (a) Define electric field intensity. Obtain an expression for the electric field intensity at a point which is at a distance of R from a point charge Q. **07**

(b) Find the total charge inside a volume having volume charge density as $10z^2 e^{-0.1x} \sin \pi y \text{ C/m}^3$. The volume is defined between $-2 \leq x \leq 2$, $0 \leq y \leq 1$ and $3 \leq z \leq 4$. **07**

OR

(b) A uniform line charge, infinite in extent with $\rho_L = 20 \text{ nC/m}$ lies along the z axis. Find the $\mathbf{E}$ at (6,8,3) m. **07**

Q.3 (a) State and prove the Gauss's law. Also state the conditions to be satisfied by the special Gaussian surfaces. **07**

(b) Derive Maxwell's first equation as applied to the electrostatics, using Gauss's law. Also state the Divergence theorem. **07**

OR

Q.3 (a) Explain an electric dipole. Also derive expression of $\mathbf{E}$ due to an electric dipole. **07**

(b) An electric potential is given by, $V = 60 \sin \theta / r^2 \text{ volt}$. Find V and $\mathbf{E}$ at P(3, 60° , 25°). **07**

Q.4 (a) Write short note: Electrostatic boundary conditions between perfect dielectrics. **07**

(b) Derive Poisson's and Laplace's equation. **07**

OR

Q.4 (a) State and explain Biot-Savart's law. **07**

(b) Write short note on Stoke's theorem. **07**

- Q.5 (a)** Derive Lorentz force equation. **07**
(b) Write a note on ferrite core. Also list out various properties of ferrites. **07**
- OR**
- Q.5 (a)** State Maxwell's equations in point form and explain physical significance of the equations. **07**
(b) Explain briefly finite element method. Also state the advantages and disadvantages of finite element method. **07**
