Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (OLD) - EXAMINATION – SUMMER 2017

Subject Code: 151002 **Date: 01/05/2017**

Subject Name: Engineering Electromagnetics

Time: 02:30 PM to 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) (i) Transform the vector $\mathbf{B} = y\mathbf{a}_x - x\mathbf{a}_y + z\mathbf{a}_z$ into cylindrical coordinates. **07**

(ii) Transform vector field $\mathbf{G} = (xz/y)\mathbf{a}_x$ into spherical components and variables.

(b) Derive the expression for the electric field **E** due to infinitely long line charge distribution using Coulomb's law. **07**

Q.2 (a) State Gauss's law. Also derive mathematical formulation for the same. **07**

(b) Three infinite uniform sheets of charges are located in the free space as follows: 3 nC/m^2 at z = - 4, 6 nC/m^2 at z = 1, and - 8 nC/m^2 at z = 4. Determine the **E** at the point $P(2, 5, -5)$ & $Q(4, 2, -3)$. **07**

OR

(b) State & derive following: **07**

(1) Maxwell's first equation for electrostatics, (2) Divergence theorem.

Q.3 (a) What are the characteristics of a good conductor? Determine boundary conditions at a boundary between a conductor and free space. **07**

(b) What is an electric dipole? Derive the expression for the potential and electric field intensity due to a dipole at distances very large from the origin compared to the spacing between the charges of the dipole. **07**

OR

Q.3 (a) Derive the boundary conditions at the interface between two dielectric materials with permittivities ε_1 and ε_2. **07**

(b) Given the potential field $V = 2x^2y - 5z$, and a point $P(-4, 3, 6)$, find following at point P : the potential V, the electric field intensity **E**, the direction of **E**, the electric flux density **D**, and the volume charge density ρ_v. **07**

Q.4 (a) Using necessary diagrams, discuss magnetic boundary conditions. **07**

(b) 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. Derive the expressions for **H** at (i) $\rho < a$, (ii) $a < \rho < b$, (iii) $b < \rho < c$, (iv) $\rho > c$. **07**

OR

Q.4 (a) State & discuss Biot-Savart law & Ampere's circuital law using necessary diagrams. **07**

(b) Write a detailed note on Magnetization and permeability. **07**

Q.5 (a) Derive the expression of capacitance for following capacitors: (a) Parallel plate capacitor, (b) Coaxial capacitor, (c) Spherical capacitor. **07**

(b) Mention all four Maxwell's equations for steady fields. Using the concept of Faraday's law and displacement current modify them for time varying fields. **07**

OR

Q.5 (a) Find the magnitude of current density in a sample of silver for which $\sigma = 6.17 \times 10^7$ S/m and $\mu_e = 0.0056$ m^2/V·s if: (i) the drift velocity is 1.5 μm/s; (ii) the electric field intensity is 1 mV/m; (iii) the sample is a cube 2.5 mm on a side having a voltage of 0.4 mV between opposite faces; (iv) the sample is a cube 2.5 mm on a side carrying a total current of 0.5 A. **07**

(b) Write a short note on skin effect & skin depth. **07**

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