Seat No.: ________ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI(OLD) – EXAMINATION – SUMMER 2019

Subject Code:160906 **Date:16/05/2019**

Subject Name: Theory Of Electromagnetics

Time:10:30 AM TO 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.**

Q.1 **(a)** What is dot product and cross product? Explain its significance and applications. **07**

(b) A perpendicular vector field $\bar{F} = r^2 cos^2\emptyset\, \overline{a_r} + zsin\emptyset\, \overline{a_\emptyset}$ is in cylindrical system. Find the flux emanating due to this field from the closed surface of the cylinder 0 ≤ z ≤ 1, r = 4, verify the divergence theorem. **07**

Q.2 **(a)** Define surface charge density. Drive an expression for electric field intensity due to a sheet of charge with uniform surface charge density $\rho_s\ c/m^2$ on an infinite plane. **07**

(b) Show that the divergence of flux density due to point charge and uniform line charge is zero. **07**

OR

(b) If a sphere of radius 'a' has a charge density $\rho_v = kr^3$ then find $\bar{D}$ and $\nabla.\bar{D}$ as a function of radius r and sketch the result. Assume k constant. **07**

Q.3 **(a)** Establish relation between $\bar{E}$ and $\bar{V}$. Proof that gradient of a scalar is a vector. **07**

(b) If $V = x - y + xy + 2z$ V, find $\bar{E}$ at (1, 2, 3) and the energy stored in a cube of side 2m centered at the origin. **07**

OR

Q.3 **(a)** What is the principle of Continuity equation? Drive an expression for integral and differential form of Continuity equation of current. **07**

(b) Write a short note on "Electrostatic boundary conditions between two perfect dielectrics". **07**

Q.4 **(a)** The region between two concentric right circular cylinders contains a uniform charge density ρ. Solve the Poisson's equation for the potential in the region. **07**

(b) It is known that $V = XY$ is a solution of Laplace's equation where X is function of x and Y is function of y alone. Determine which function of the following function are also solutions of Laplace's equation. **07**

(i) $V = 100\ XY$ (ii) $V = 100XY + 2x$ (iii) $V = X + 3Y$

(iv) $V = 2XY + Y^2 - X^2$ (v) $V = (XY)^2$.

OR

Q.4 **(a)** State and Explain Biot Savart law. How Biot-Savart law can be applied to the distributed sources. **07**

(b) If a perpendicular field is given by **07**

$\bar{F} = (x + 2y + az)\overline{a_x} + (bx - 3y - z)\overline{a_y} + (4x + cy + 2z)\overline{a_z}$ then find the constant a, b and c such that the field is irrotational.

Q.5 **(a)** Drive an expression for the inductance of **07**

Solenoid (ii) Toroid (iii) Co-axial Cable.

(b) A charge of $Q = 5 \times 10^{-18}\ c$ is moving, through the uniform magnetic field $\bar{B} = -0.4\overline{a_x} + 0.2\overline{a_y} - 0.1\overline{a_z}$. T with a velocity **07**

V= $\left(2\overline{a_x} - 3\overline{a_y} + 6\overline{a_z}\right)10^5 m/s$ at $t = 0$.

1. What electric field is present at $t = 0$, if the net force on the electron is zero?

2. If the electric field intensity in entirely in $\overline{a_x}$ direction and $|E_{net}| = 2pN$ at $t = 0$ find E_x.

OR

Q.5 **(a)** State Maxwell's equations for static field. Write the expression for integrated and derivative form of Maxwell's equation derived from faraday's law and Ampere's circuit law for static field. **07**

(b) A point charge of 25 nC located in free space at P (2, -3, 5) and a perfectly conducting plane at z = 2. **07**

Find (i) V at (3, 2, 4) (ii) $\bar{E}$ at (3, 2, 4) (iii) ρ_s at (3, 2, 2) use method of image.

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