

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV (NEW) EXAMINATION – WINTER 2023****Subject Code:3141009****Date:24-01-2024****Subject Name:Electromagnetic Theory****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.
4. Simple and non-programmable scientific calculators are allowed.

- Q-1** (a) Define: Divergence, Gradient and Curl. **03**
 (b) Transform the following vectors to spherical co-ordinates at the points given: **04**
 (i) $10a_x$ at $P(x = -3, y = 2, z = 4)$; (ii) $10a_z$ at $M(r = 4, \theta = 110^\circ, \phi = 120^\circ)$.
 (c) Explain Cylindrical co-ordinate system in detail. **07**
- Q-2** (a) State and explain Coulombs law. **03**
 (b) Find the gradient of scalar fields, (i) $V = e^{-z} \sin 2x \cosh y$; (ii) $U = \rho^2 z \cos 2\phi$. **04**
 (c) 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**
- OR**
- (c) Derive expression of electric field intensity due to a surface charge. **07**
- Q-3** (a) Write Maxwell's equation in point and integral form. **03**
 (b) Three infinite uniform sheets of charge are located in free space as follows; 3 nC/m^2 at $z = -4$, 6 nC/m^2 at $z = 1$, and -8 nC/m^2 at $z = 4$. Find **E** at the point (a) $A(2, 5, -5)$, (b) $B(4, 2, -3)$, (c) $C(-1, -5, 2)$, (d) $D(-2, 4, 5)$. **04**
 (c) State and prove Gauss's Law. **07**
- OR**
- Q-3** (a) Define Gaussian surface. **03**
 (b) Calculate **D** in rectangular co-ordinates at point $P(2, -3, 6)$ produced by: (a) a point charge $Q_A = 55 \text{ mC}$ at $Q(-2, 3, -6)$; (b) a uniform line charge $\rho_{LB} = 20 \text{ mC/m}$ on the x-axis. **04**
 (c) State and explain Ampere's circuital law. **07**
- Q-4** (a) Briefly explain the wave polarization. **03**
 (b) If we take the zero reference for potential at infinity, find the potential at $(0, 0, 2)$ caused by this charge configuration in free space (a) 12 nC/m on the line $\rho = 2.5 \text{ m}$, $z = 0$; (b) point charge of 18 nC at $(1, 2, -1)$. **04**
 (c) State and explain Faraday's Law. **07**
- OR**
- Q-4** (a) Define: Electric potential. **03**
 (b) Derive the continuity equation from Maxwell's equation. **04**
 (c) Write short note on wave propagation in dielectrics. **07**
- Q-5** (a) Define displacement current. **03**
 (b) What is skin effect? **04**
 (c) Discuss, Plane Wave Propagation in General Directions. **07**
- OR**
- Q-5** (a) Define voltage standing wave ratio (VSWR). **03**
 (b) Discuss applications of transmission lines. **04**
 (c) Write short note on Lossless Propagation. **07**
