

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2024****Subject Code:2140909****Date:03-07-2024****Subject Name:Field 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) Explain cylindrical coordinate system. **03**
- (b) Explain unit vectors of Cartesian, cylindrical and spherical coordinate systems. **04**
- (c) A triangle is defined by three points A(2,-5,1), B(-3,2,4) and C(0,3,1). **07**
Find (a) $\vec{R}_{BC} \times \vec{R}_{BA}$ (b) The area of triangle.
- Q.2**
- (a) Explain Coulom's law in vector form. **03**
- (b) Obtain an expression for electric field intensity at a point which is at a distance of R from a point charge Q. **04**
- (c) An infinite uniform line charge having line charge density of $\rho_L = 30 \text{ nC/m}$ placed at $y = 3, z = 5$. Find the total electric field intensity at (5,6,1). **07**
- OR**
- (c) The surface charge density of $0.1 \times 10^{-9} \text{ C/m}^2$ exist on the plane $z = -3$. Find **E** at (I) P1 (0,1,4) (II) P2 (1,4,-5). **07**
- Q.3**
- (a) Define divergence and its physical significance. **03**
- (b) Derive relationship between Electrical field intensity and Electrical flux density. **04**
- (c) Derive an expression for static potential due to electrical dipole. **07**
- OR**
- Q.3**
- (a) Write Maxwell's equations for Static Electromagnetic field in point form and integral form. **03**
- (b) Derive the point form of continuity equation **04**
- (c) Derive the expression for electric field intensity due to line charge. **07**
- Q.4**
- (a) Derive Poisson's and Laplace's equation. **03**
- (b) Explain electric dipole. Derive the expression for **E** at any distant point from dipole. **04**
- (c) If $V = 60 \sin \theta / r^2 \text{ V}$ in free space and point P is located at $r = 3 \text{ m}, \theta = 60^\circ, \Phi = 25^\circ$, find (a) V_p (b) E_p (c) dV/dN at P (d) $\vec{a}_n$ at P. **07**
- OR**
- Q.4**
- (a) Explain concept of electric potential difference. **03**
- (b) State and explain Ampere's circuital law. **04**
- (c) Write a short note on sources of EMI. **07**
- Q.5**
- (a) State and explain Biot Savart's law. **03**
- (b) Explain the physical significance of the term: Curl of a vector. **04**
- (c) Evaluate the closed line integral of **H** about the rectangular path P1(2, 3, 4) to P2(4, 3, 4) to P3(4, 3, 1) to P4(2, 3, 1) to P1, given $\vec{H} = 3z \vec{a}_x - 2x^3 \vec{a}_z \text{ A/m}$ **07**

OR

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| Q.5 | (a) | Derive equation of energy stored in magnetic fields | 03 |
| | (b) | Derive Lorentz force equation on charge particle. | 04 |
| | (c) | Explain Stoke's theorem with its mathematics expression. | 07 |
