

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER– IV EXAMINATION – SUMMER 2026****Subject Code:3140912****Date:21-05-2026****Subject Name: Electromagnetic Fields****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.

		MARKS
Q.1	(a) Explain cross product of vectors. What will be the direction of resultant vector when cross product is done?	03
	(b) Given vectors $A = 3a_x + 4a_y + a_z$ and $B = 2a_y - 5a_z$, find the angle between A and B using (i) dot product (ii) cross product	04
	(c) Explain cylindrical and spherical coordinate system	07
Q.2	(a) State and explain Coulomb's law and hence define electric field intensity 'E'. Explain how the principle of superposition can be applied to find 'E' due to multiple point charges?	03
	(b) Planes $x = 2$ and $y = -3$ respectively carry charge densities of 10 nC/m^2 and 15 nC/m^2 . If the line $x = 0, z = 2$ carries charge of $10\pi \text{ nC/m}$, calculate E at (1,1,-1) due to all the three charge distributions	04
	(c) Derive the expression for electric field intensity due to infinite sheet charge	07
	OR	
	(c) Two concentric circular cylinders having radius $\rho = 'a'$ and $\rho = 'b'$ ($a < b$) lie on the $z = 0$ plane. The inner cylinder has a charge distribution of ρ_s on the outer surface of the inner cylinder. Use Gauss' law to find D in all the regions	07
Q.3	(a) Define electric flux and electric flux density. What is the relationship between 'D' and 'E'?	03
	(b) Find volume charge density ρ_v if electric flux density 'D' is given by $D = e^{-x}\sin y a_x - e^{-x}\cos y a_y + 2z a_z$	04
	(c) What is potential gradient? Prove that electric field intensity is given by $E = -\text{grad } V$	07
	OR	
Q.3	(a) State the difference between conservative and non-conservative fields. Is $\oint E \cdot dL = 0$ in a non-conservative field? Comment	03
	(b) What is an electric dipole? Explain how electric and potential fields vary with distance 'r' from the dipole centre?	04
	(c) Derive continuity equation. Also state the point form of Ohm's law	07

- Q.4 (a)** An aluminium conductor is 1000 feet long has a circular cross section. If a d.c. voltage of 1.2 V is applied between the ends find 'E and 'J' (1 feet = 0.3048 metres, $\sigma = 3.82 \times 10^7$ mhos/m for aluminium) **03**
- (b)** Explain the phenomena of polarization in dielectrics **04**
- (c)** Derive Poisson's and Laplace's equation. Also state the expression for Laplace's equation in cylindrical and spherical coordinate system **07**
- OR**
- Q.4 (a)** Explain Stoke's theorem. Discuss how it gives the relationship between line integral and surface integral **03**
- (b)** Discuss Ampere's circuital law. Explain how one can find the value of magnetic field intensity at various locations in a co-axial cable **04**
- (c)** State and explain uniqueness theorem. **07**
- Q.5 (a)** State and explain Lorentz force equation **03**
- (b)** Explain magnetic boundary conditions for two magnetic materials having permeabilities μ_1 and μ_2 **04**
- (c)** What is curl? Prove that for a steady magnetic field $\nabla \times H = J$ **07**
- OR**
- Q.5 (a)** State the difference between ferromagnetic, paramagnetic and diamagnetic materials **03**
- (b)** Explain the meaning of displacement current I_d and displacement current density J_d ? **04**
- (c)** Discuss Maxwell's equations in integral form and point form **07**
