

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE- SEMESTER-IV EXAMINATION – WINTER 2025****Subject Code:3141009****Date:24-11-2025****Subject Name:Electromagnetic Theory****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.
4. Simple and non-programmable scientific calculators are allowed.

		Marks
<b>Q.1</b>	(a) Define 1) Divergence, 2) Gradient and 3) Curl	<b>03</b>
	(b) Prove that the divergence of curl of any vector field is zero.	<b>04</b>
	(c) Derive an equation of electric field due to surface charge distribution.	<b>07</b>
<b>Q.2</b>	(a) Given vectors $A = 3a_x + 4a_y + a_z$ and $B = 2a_y - 5a_z$ , find angle between vector A and B.	<b>03</b>
	(b) State and explain Gauss's Law.	<b>04</b>
	(c) What is the application of Poynting's Theorem? Derive its equation for total power leaving the volume.	<b>07</b>
	<b>OR</b>	
	(c) Derive and sketch the standing wave pattern when the intrinsic impedance of medium 1 is less than medium 2 ( $\eta_1 < \eta_2$ ).	<b>07</b>
<b>Q.3</b>	(a) Explain Electric Field Intensity.	<b>03</b>
	(b) Briefly describe magnetic boundary condition between two different media.	<b>04</b>
	(c) Draw the equivalent circuit of the transmission line and derive its voltage and current equations.	<b>07</b>
	<b>OR</b>	
<b>Q.3</b>	(a) Write Maxwell's equation in differential form and integral form for static electric and magnetic fields.	<b>03</b>
	(b) State and prove Stokes's Theorem.	<b>04</b>
	(c) Write short note on wave propagation in good conductor.	<b>07</b>
<b>Q.4</b>	(a) Compare Cartesian and Cylindrical coordinate systems.	<b>03</b>
	(b) Obtain the expression of impedance for a lossless transmission line terminated in short circuit.	<b>04</b>
	(c) Explain the boundary condition between two dielectric material having permittivity $\epsilon_1$ and $\epsilon_2$ .	<b>07</b>
	<b>OR</b>	
<b>Q.4</b>	(a) Define following terms: 1. Standing wave ratio 2. Reflection coefficient 3. Characteristic impedance	<b>03</b>
	(b) State and explain Faraday's Law.	<b>04</b>
	(c) Explain Pulse Broadening in Dispersive Media.	<b>07</b>
<b>Q.5</b>	(a) Explain Lorentz Force equation.	<b>03</b>
	(b) How electric dipole is formed? Derived an equation of electric field due to electric dipole.	<b>04</b>

(c) Write short note on loss less and distortion less transmission line. **07**

**OR**

**Q.5** (a) Derive an equation for variation in flux by moving loop in static magnetic field. **03**

(b) State and derived the Biot-Savart Law. **04**

(c) Write a short note on Smith Chart **07**

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**GUJARAT TECHNOLOGICAL UNIVERSITY****BE- SEMESTER-IV (NEW) EXAMINATION – WINTER 2024****Subject Code:3141009****Date:27-11-2024****Subject Name: Electromagnetic Theory****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.
4. Simple and non-programmable scientific calculators are allowed.

		Marks
<b>Q.1</b>	(a) Explain the difference between scalar and scalar field with example.	<b>03</b>
	(b) Explain the position vector and distance vector with example.	<b>04</b>
	(c) Explain the various types of charge distributions and its charge density.	<b>07</b>
<b>Q.2</b>	(a) Calculate the volume of the sphere of radius R using integration.	<b>03</b>
	(b) State and derive the Gauss' law in point form.	<b>04</b>
	(c) A charge distribution with spherical symmetry has density $\rho_v = \rho_0(r/R)$ , at $0 \leq r \leq R$ and 0 for $r > R$ , Determine E everywhere.	<b>07</b>
	<b>OR</b>	
	(c) The flux density $D = r/3 \text{ a}_r \text{ nC/m}^2$ is in free space:	<b>07</b>
	1. Find E at 0.4 m	
	2. Find the total electric flux leaving the sphere of $r=0.4\text{m}$	
	3. Find the total charge within the sphere of $r = 0.5 \text{ m}$	
<b>Q.3</b>	(a) Define the Gaussian surface, Discuss satisfying conditions for Gaussian surface.	<b>03</b>
	(b) What is streamlines? Explain the equations of streamlines in various coordinate systems.	<b>04</b>
	(c) Two uniform line charges of density $\rho_l = 2 \text{ nC/m}$ lie in the $x = 0$ plane at $y = \pm 4 \text{ m}$ . Find E at (4, 0, 12) m.	<b>07</b>
	<b>OR</b>	
<b>Q.3</b>	(a) Why the divergence of curl of any vector is zero? Explain.	<b>03</b>
	(b) State and prove divergence theorem.	<b>04</b>
	(c) What is the potential at the center of a square with aside $a = 4 \text{ m}$ ? While charges $2 \mu\text{C}$ , $-2 \mu\text{C}$ , $4 \mu\text{C}$ and $-2 \mu\text{C}$ are located at its corner.	<b>07</b>
<b>Q.4</b>	(a) State and explain Ampere's circuital law.	<b>03</b>
	(b) Explain the reflection of uniform plane wave at normal incidence.	<b>04</b>
	(c) A current filament carrying 20 A in the $a_z$ direction lies along the entire z axis. Find H in rectangular coordinates at P (10,0,4).	<b>07</b>
	<b>OR</b>	
<b>Q.4</b>	(a) Write and explain the properties of Curl.	<b>03</b>
	(b) State and explain Biot-Savart Law.	<b>04</b>
	(c) Given the vector magnetic $A = -r^2/4 \text{ a}_z \text{ Wb/m}$ . Calculate the total magnetic flux crossing the surface $\phi = \pi/2$ , $1 \leq r \leq 2\text{m}$ ; $0 \leq z \leq 5\text{m}$ .	<b>07</b>
<b>Q.5</b>	(a) Write and explain the Maxwell's equations in integral form.	<b>03</b>
	(b) Explain the propagation constant and characteristic impedance of transmission line.	<b>04</b>
	(c) Write short note on electromagnetic waves in good conductor.	<b>07</b>
	<b>OR</b>	
<b>Q.5</b>	(a) Explain poynting vector.	<b>03</b>
	(b) Define and explain wave polarizations.	<b>04</b>
	(c) What are the applications of transmission line? Write the equations of transmission lines and their solutions in phasor form.	<b>07</b>

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**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  $\rho_L$  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;  $3 \text{ nC/m}^2$  at  $z = -4$ ,  $6 \text{ nC/m}^2$  at  $z = 1$ , and  $-8 \text{ nC/m}^2$  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)  $12 \text{ nC/m}$  on the line  $\rho = 2.5 \text{ m}$ ,  $z = 0$ ; (b) point charge of  $18 \text{ nC}$  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**

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**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-IV(NEW) EXAMINATION – WINTER 2022****Subject Code:3141009****Date:17-12-2022****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.

		MARKS
<b>Q.1</b>	(a) State Gauss's law and give its mathematical expression.	<b>03</b>
	(b) Explain the phenomena of skin depth.	<b>04</b>
	(c) State and prove Ampere's Circuital Law.	<b>07</b>
<b>Q.2</b>	(a) State Biot-Savart's law and give its mathematical expression.	<b>03</b>
	(b) Explain properties of Smith Chart.	<b>04</b>
	(c) Find total Electric field intensity at origin if the following charge distributions are present in free space. Point charge 12nC at (2,0,6), line charge 3nC/m at x=-2,y=3 and surface charge density 0.2nC/m <sup>2</sup> at x=2.	<b>07</b>
	<b>OR</b>	
	(c) State Electric field intensity and obtain the derivation of it due to infinite line charge.	<b>07</b>
<b>Q.3</b>	(a) State and explain Faraday's law.	<b>03</b>
	(b) Write Maxwell's equation in differential form and integral form for static electric and magnetic fields.	<b>04</b>
	(c) Give statement & mathematical expression of Poynting Theorem.	<b>07</b>
	<b>OR</b>	
<b>Q.3</b>	(a) Define VSWR and reflection coefficient.	<b>03</b>
	(b) Derive continuity equation.	<b>04</b>
	(c) Draw the equivalent circuit of the transmission line and derive its voltage and current equations.	<b>07</b>
<b>Q.4</b>	(a) State Stoke's theorem and Divergence theorem	<b>03</b>
	(b) Prove that curl of gradient of any scalar is zero.	<b>04</b>
	(c) Explain the concept of potential gradient and obtain the relation between electric field (E) and potential (V)	<b>07</b>
	<b>OR</b>	
<b>Q.4</b>	(a) State Lorentz Force Equation.	<b>03</b>
	(b) Prove that divergence of curl of any vector is zero.	<b>04</b>
	(c) Write a short note on wave propagation in good conductor.	<b>07</b>
<b>Q.5</b>	(a) Explain spherical co-ordinate system.	<b>03</b>
	(b) Explain Retarded Vector Potential.	<b>04</b>
	(c) Write a short note on Wave Reflection from Multiple Interfaces.	<b>07</b>
	<b>OR</b>	
<b>Q.5</b>	(a) Explain cylindrical co-ordinate system.	<b>03</b>
	(b) Transform the given vector $\mathbf{A}=10\mathbf{a}_z$ into spherical co-ordinates at the point P(4,110°,120°)	<b>04</b>

(c) Write a short note on Plane Wave Reflection at Oblique Incidence Angle. **07**

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