Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV EXAMINATION – SUMMER 2025

Subject Code:3141009 Date:19-05-2025

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
Q.1	**(a)**	Explain Lorentz Force Equation.	**03**
	(b)	Compare Cartesian and Cylindrical coordinate system	**04**
	(c)	Derive the expression for the electric flux density due to infinite line charge placed on the z-axis.	**07**
Q.2	**(a)**	Explain the concept of retarded potential.	**03**
	(b)	Explain properties of Smith Chart.	**04**
	(c)	Draw the equivalent circuit of the transmission line and derive its voltage and current equations.	**07**
		OR	
	(c)	State and prove Ampere's Circuital Law.	**07**
Q.3	**(a)**	State Stoke's theorem and Divergence theorem.	**03**
	(b)	Derive continuity equation.	**04**
	(c)	Write short note on wave propagation in good conductor.	**07**
		OR	
Q.3	**(a)**	Write Maxwell's equation in integral form for static electric and magnetic fields	**03**
	(b)	Explain VSWR and Reflection coefficient.	**04**
	(c)	Given three charge distributions in free space: 0.25nC/m on the line x=3,y=2; -0.2nC/m on the line z=1,y=3 and a point charge of 0.5nC at origin. Find electric field intensity at point (2,3,4).	**07**
Q.4	**(a)**	State and explain Biot-Savart's law.	**03**
	(b)	Explain spherical coordinate system.	**04**
	(c)	Using Biot-Savart law, find the vector magnetic field intensity in Cartesian coordinate at P(1.5,2,3) caused by a current filament of 24A in the a_z direction on z-axis and extending from z=0 to z=6.	**07**
		OR	
Q.4	**(a)**	Explain concept of conduction and convection current.	**03**
	(b)	Prove that curl of gradient of any scalar is zero.	**04**
	(c)	Obtain the expression of impedance for a loseless transmission line terminated in short circuit.	**07**
Q.5	**(a)**	Define and explain characteristic impedance.	**03**
	(b)	State Gauss's law and give its mathematical expression	**04**
	(c)	Write a note on Wave Reflection from Multiple Interfaces.	**07**
		OR	
Q.5	**(a)**	Write Maxwell's equation in differential form for static electric	**03**

and magnetic fields

(b) Prove that divergence of curl of any vector is zero. **04**

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

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2024

Subject Code:3141009 Date:03-07-2024

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; Field, DOT and CROSS product.	**3**
	(b)	Transform the following vectors to spherical coordinates at the points given: (a) $10\mathbf{a_x}$ at P(x = -3, y = 2, z = 4) (b) $10\mathbf{a_z}$ at M(r = 4, $\Theta = 110^o$, $\phi = 120^o$).	**4**
	(c)	Explain gradient of a scalar. Write fundamental properties of the gradient of a scalar field.	**7**
Q-2	**(a)**	State and explain Coulombs law.	**3**
	(b)	Explain Electric field intensity with necessary equations.	**4**
	(c)	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 points; (a) P_A(2, 5, -5); (b) P_B(4, 2, -3); (c) P_C(-1, -5, 2); (d) P_D(-2, 4, 5).	**7**
		OR	
	(c)	Derive expression of Electric field intensity due to line charge along z-axis.	**7**
Q-3	**(a)**	Define potential and potential difference.	**3**
	(b)	An Electric field is expressed in rectangular coordinates by $\mathbf{E}=6x^2\mathbf{a_x}+6y\mathbf{a_y}+4\mathbf{a_z}$ V/m. Find: (a) V_{MN} if points M and N are specified by M(2, 6, -1) and N(-3, -3, 2); (b) V_M if V = 0 at Q(4, -2, -35).	**4**
	(c)	State and prove gauss's law.	**7**
		OR	
Q-3	**(a)**	What is equipotential surface?	**3**
	(b)	If 15 nC point charge is at the origin in free space. Calculate V_1 if point p_1 is located at P_1(-2, 3, -1) and : (a) V = 0 at (6, 5, 4); (b) V = 0 at infinity.	**4**
	(c)	State and prove divergence theorem.	**7**
Q-4	**(a)**	A uniform plane wave in air is normally incident onto a lossless dielectric plate of thickness $\lambda/8$ and of intrinsic impedance $\eta = 260\ \Omega$. Determine standing wave ratio of in front of the plate.	**3**
	(b)	Write Maxwell's equations in point and integral form.	**4**
	(c)	State and explain Faraday's law.	**7**
		OR	
Q-4	**(a)**	The electric field amplitude of a uniform plane wave propagating in the a_z direction is 250 V/m. If $\mathbf{E} = E_x\mathbf{a_x}$ and ω = 1.00 Mrad/s, find: (a) The frequency; (b) The wavelength; (c) The period.	**3**
	(b)	State Ampere's Circuital Law.	**4**
	(c)	Write short note on plane wave propagation in general dielectrics.	**7**

Q-5	**(a)**	Write applications of transmission lines.	**3**
	(b)	What do you mean by impedance matching? Explain.	**4**
	(c)	Explain voltage standing wave ratio (VSWR) with necessary equations.	**7**

OR

Q-5	**(a)**	What is skin effect?	**3**
	(b)	Write transmission line equations and their solutions in phasor form.	**4**
	(c)	Write short note on lossless and low-less propagation.	**7**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2023

Subject Code:3141009 Date:19-07-2023

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
Q.1	**(a)**	Explain the difference between vector and vector field with example.	**03**
	(b)	Write the various applications of Dot Product and Vector Product.	**04**
	(c)	What is electric field intensity? Write the expression of electric filed intensity due to infinite line charge and explain its significance.	**07**
Q.2	**(a)**	Transform the vector A = 20 a_z into spherical coordinate system at point P (4, 110^0, 120^0)	**03**
	(b)	Derive mathematical equation of electric field intensity due to a continuous volume charge distribution and explain the dependency of field on various parameters of the field.	**04**
	(c)	Find the volume charge density that is associated with $D= \rho z^2 \sin^2\varphi\, a_\rho + \rho z^2 \sin\varphi \cos\varphi\, a_\varphi + \rho^2 z \sin^2\varphi\, a_z$ C/m^2	**07**
		OR	
	(c)	Given the field $D = 6\rho\sin(\varphi/2)\, a_\rho + 15\rho\cos(\varphi/2)\, a_\varphi$ c/m^2, evaluate both sides of the divergence theorem for the region defined $\rho = 2$, $0<\varphi<180^0$, $0<z<5$.	**07**
Q.3	**(a)**	What is the use of coordinate system? Write the expressions of unit surfaces and unit volume of cylindrical coordinate system.	**03**
	(b)	State and explain divergence.	**04**
	(c)	Find E at P(1,5,2) m in free space if a point charge of 3 μC is located at (0,0,1), the uniform line charge density is 90 nC/m along x-axis and uniform sheet of charge density 50 nC/m^2 over the plane z = -1.	**07**
		OR	
Q.3	**(a)**	State and explain Gauss's Law in brief.	**03**
	(b)	Explain the potential gradient and the conservative field.	**04**
	(c)	Given the potential field in cylindrical coordinate V = 500 φ +25 V. Calculate the value at P (5, 30^0, 1) in air (i) E (ii) D and (iii) ρ_v	**07**
Q.4	**(a)**	Write and explain Lorentz Force equation.	**03**
	(b)	Explain the reflection of uniform plane wave at normal incidence.	**04**
	(c)	A filamentary current of 20A is directed in from infinity to the origin on the positive x axis, and then back out to infinity along the positive y axis. Use the Biot-Savart law to find H at P (0,0,1)	**07**
		OR	
Q.4	**(a)**	Compare magnetic scalar and vector potential.	**03**
	(b)	Explain the curl.	**04**
	(c)	A surface current density, K = 10 a_x A/m, flows in the y = 0 plane throughout the region, $-5<z<5$, $-\infty<z<\infty$, Find H at P (0,10,0) in free space.	**07**
Q.5	**(a)**	Write and explain the Maxwell's equations in point form.	**03**

	(b)	Explain double stub lines impedance matching method of transmission line.	**04**
	(c)	Write short note on electromagnetic waves in perfect dielectric.	**07**

OR

Q.5	**(a)**	Explain skin effect.	**03**
	(b)	Define and explain wave polarizations.	**04**
	(c)	What are the applications of transmission line? Write the equations of transmission lines and their solutions in phasor form.	**07**

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2022

Subject Code:3141009 Date:04-07-2022

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
Q.1	**(a)**	'The divergence of curl of vector magnetic potential is zero'-Justify the statement.	**03**
	(b)	Find the rectangular coordinates of the point A ($\rho = 4.4$, $\varphi = -115^0$ $z=2$).	**04**
	(c)	What is divergence? Explain the physical significance of divergence with two examples.	**07**
Q.2	**(a)**	Find the a_x dot a_ϕ and a_z dot a_θ	**03**
	(b)	What is electric field intensity? Derive mathematical equation of electric field intensity due to a continuous volume charge distribution.	**04**
	(c)	A uniform line charge density of 5 nC /m is at y = 0, z = 2 m in free space, while -5 nC/m is located at y = 0, z = - 2 m. A uniform surface charge density of 0.3 nC/m^2 is at y = 0.2 m and -0.3 nc /m^2 is at y = -0.2m. Find E at the origin.	**07**
		OR	
	(c)	Given the flux density D = $(\cos\theta/r^3)\, a_r + (5\sin\theta/r^3)\, a_\theta$ c/m^2, evaluate both sides of the divergence theorem for the region defined by $1< r < 2$, $0 < \theta < \pi/2$, $0< \phi< \pi$	**07**
Q.3	**(a)**	What is the use of coordinate system? Explain the Cartesian coordinate system in brief.	**03**
	(b)	State and explain Gauss's Law.	**04**
	(c)	Write Maxwell's equations in integral form and explain physical significance of equations.	**07**
		OR	
Q.3	**(a)**	State and explain Ampere's circuital Law in brief.	**03**
	(b)	Derived the desired distance field for the dipole.	**04**
	(c)	Write Maxwell's equations in point form and explain their physical significance.	**07**
Q.4	**(a)**	Explain Skin effect.	**03**
	(b)	Explain the reflection of uniform plane wave at normal incidence.	**04**
	(c)	Current filaments of 2 a_x A lies along x axis. Find H components at B (-1, 3, 2).	**07**
		OR	
Q.4	**(a)**	Compare spherical and Cylindrical coordinate systems.	**03**
	(b)	State and explain Stoke's theorem.	**04**
	(c)	For magnetic vector potential A = $- r^2/2\, a_z$ Wb/m calculate the total flux crossing the surface $\varphi = \pi/2$, $2\leq r \leq 4$ m, $0\leq z \leq 4$ m.	**07**

Q.5	**(a)**	What is smith chart? What are its uses?	**03**
	(b)	Explain one of the impedance matching methods of transmission line.	**04**
	(c)	Write short note on plane wave reflection at oblique incidences angles.	**07**

OR

Q.5	**(a)**	Define and explain voltage standing wave ratio.	**03**
	(b)	Define and explain hall effect.	**04**
	(c)	What are the applications of transmission line? Write the equations of transmission lines and their solutions in phasor form.	**07**

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