Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–IV(NEW) EXAMINATION – WINTER 2022

Subject Code:3140912   **Date:14-12-2022**
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 how cross product of vectors can be obtained. Does cross product obey the commutative law? Comment	**03**
	(b)	A certain vector F is given by F = -5a_x –a_y(3x+2) + a_z. Find |F| and unit vector in the direction of F	**04**
	(c)	Discuss cylindrical and spherical co-ordinate system of vectors. Also explain how a vector in Cartesian co-ordinate system can be converted into cylindrical and spherical system.	**07**
Q.2	**(a)**	State Coulomb's law and hence define electric field intensity	**03**
	(b)	If $Q_1 = 3 \times 10^{-4}$ C is located at M (1,2,3) and $Q_2 = -10^{-4}$C is located at N(2,0,5) in vacuum, find the vector force on Q_2 by Q_1 using Coulomb's law	**04**
	(c)	Derive the equation for electric field intensity due to uniform sheet charge located at z = 0 plane at any point on the positive z-axis. What do you infer from the result obtained?	**07**
		OR	
	(c)	Determine the total charge (i) on cylinder ρ = 3, 0< z <4, if $\rho_s = \rho z^2$ nC/m^2. (ii) within the sphere if ρ_v = 10/rsinθ C/m^3	**07**
Q.3	**(a)**	State and explain Gauss' law.	**03**
	(b)	An infinite line charge on the z-axis passes through the centre of the cylinder (having radius ρ) which is lying on the z = 0 plane. Using Gauss' law, find the total charge enclosed	**04**
	(c)	Discuss the application of Gauss' law to differential volume element and hence explain divergence theorem	**07**
		OR	
Q.3	**(a)**	State the expression for work done in carrying a point charge from one place to another in an electric field. Hence, define potential difference.	**03**
	(b)	In the region of free space that includes the volume, 2<x,y,z<3 and D = $\frac{2}{z^2}$(yza_x + xza_y – 2xya_z) C/m^2, find the total charge enclosed using divergence theorem.	**04**
	(c)	Define potential gradient. Prove that E = -grad V	**07**
Q.4	**(a)**	State the point form of Ohm's law	**03**
	(b)	Derive the continuity equation $\nabla \cdot J = -\frac{\partial \rho_v}{\partial t}$	**04**
	(c)	State and explain uniqueness theorem	**07**
		OR	
Q.4	**(a)**	State and explain Biot Savart's law	**03**

(b)	Starting from the point form of Gauss' law, derive Poisson's and Laplace's equations	**04**
(c)	Given the vector magnetic potential A = -ρ^2/4 a_z Wb/m^2, calculate the total magnetic flux crossing the surface, $\Phi = \pi/2$, 1< ρ <2m, 0< z <5m.	**07**

Q.5	**(a)** State and explain Lorentz force equation	**03**
	(b) Explain the term 'displacement current' in brief	**04**
	(c) For uniform magnetic field intensity, prove that torque on a closed circuit is given by the cross product of magnetic dipole moment and flux density.	**07**

OR

Q.5	**(a)** Explain Stoke's theorem in brief.	**03**
	(b) Explain in brief, different types of magnetic materials	**04**
	(c) Discuss Maxwell's equations in integral form and point form. Explain how they relate and electric and magnetic fields with each other. State applications of the same	**07**

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