Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (OLD) EXAMINATION – WINTER 2018

Subject Code:151002 **Date: 16/11/2018**

Subject Name: Engineering Electromagnetics

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.**

Q.1 **(a)** Explain the concept of dot product and vector product with the help of proper equations and vector diagrams. **07**

(b) State Coulomb's law. Derive the expression for following: **07**

i. Scalar & Vector form of Coulomb's law,

ii. Electric field intensity.

Q.2 **(a)** What do you mean by boundary conditions? Derive the boundary conditions at the interface between two dielectric materials with permittivities ε_1 and ε_2. **07**

(b) Write down point and integral forms of all four Maxwell's equations for steady & time-varying electro-magnetic fields. **07**

OR

(b) An infinitely long coaxial cable is carrying current I by the inner conductor of radius 'a' and –I by the outer conductor of radii 'b' and 'c', where c>b. Derive the expressions for **H** at (i) $\rho < a$, (ii) $a < \rho < b$, (iii) $b < \rho < c$, (iv) $\rho > c$. **07**

Q.3 **(a)** Using del operator, explain the following in brief: **07**

i. Gradient of a scalar

ii. Curl of a vector

(b) Write a detailed note on the divergence & its physical interpretation. **07**

OR

Q.3 **(a)** Derive the expression for the following: **07**

i. The divergence theorem

ii. Stoke's theorem

(b) Illustrate the concept of *skin depth* and *skin effect* in good conductors. **07**

Q.4 **(a)** Derive **07**

i. Maxwell's 1st equation for electrostatics

ii. Maxwell's 3rd equation for electrostatics.

(b) Given the potential field $V=2x^2y - 5z$, and a point $P(-4, 3, 6)$, find following at point P : the potential V, the electric field intensity **E**, the direction of **E**, the electric flux density **D**, and the volume charge density ρ_v. **07**

OR

Q.4 **(a)** Derive **07**

i. Lorentz force equation

ii. Point form of Ohm's law.

(b) Three infinite uniform sheets of charges are located in the 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. Determine **E** at the point $P(2, 5, -5)$ & $Q(4, 2, -3)$. **07**

Q.5 **(a)** A current filament carrying 15 A in the $\mathbf{a}_z$ direction lies along the entire z axis. Find **H** in rectangular coordinates at: (i) $P_A(20^{1/2}, 0, 4)$. **07**

(b) Find the magnitude of current density in a sample of silver for which $\sigma = 6.17 \times 10^7$ S/m and $\mu_e = 0.0056$ m^2/V·s if: (a) the drift velocity is 1.5 μm/s; (b) the electric field intensity is 1 mV/m; (c) the sample is a cube 2.5 mm on a side having a voltage of 0.4 mV between opposite faces; (d) the sample is a cube 2.5 mm on a side carrying a total current of 0.5 A. **07**

OR

Q.5 **(a)** Determine an expression for the volume charge density associated with each of the following **D** fields: **07**

(a) $\mathbf{D} = 4xy/z\ \mathbf{a}_x + 2x^2/z\ \mathbf{a}_y - 2x^2y/z^2\ \mathbf{a}_z$;

(b) $\mathbf{D} = z\sin\varphi\ \mathbf{a}_\rho + z\cos\varphi\ \mathbf{a}_\varphi + \rho\sin\varphi\ \mathbf{a}_z$;

(b) A slab of dielectric material has a relative dielectric constant of 3.8 and contains a uniform electric flux density of 8 nC/m^2. If the material is lossless, find: (a) E; (b) P; (c) the average number of dipoles per cubic meter if the average dipole moment is 10^{-29} C·m. **07**

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