

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 \mathbf{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 \mathbf{E} , the direction of \mathbf{E} , the electric flux density \mathbf{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 \mathbf{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 \mathbf{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 $\mu_e = 0.0056$ m²/V·s if: (a) the drift velocity is $1.5 \mu\text{m/s}$; (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) $\mathbf{D} = z \sin\phi \mathbf{a}_\rho + z \cos\phi \mathbf{a}_\phi + \rho \sin\phi \mathbf{a}_z$;
- (b) A slab of dielectric material has a relative dielectric constant of 3.8 and contains a uniform electric flux density of 8 nC/m². 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**
