

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC SEM-III Examination-Dec-2011

Subject code: X31102**Date: 15/12/2011****Subject Name: Engineering Electromagnetics****Time: 2.30 pm -5.00 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) With the help of neat sketches, briefly explain the cylindrical coordinate system. Also give the dot table relating to the vectors in cylindrical & rectangular coordinate systems with justification. **07**
- (b) The three vertices of triangle are located at A(6,-1,2), B(-2,3,-4) & C(-3,1,5) determine a) the vector projection of $\mathbf{R}_{AB}$ on $\mathbf{R}_{AC}$ b) the area of the triangle c) a unit vector perpendicular to the plane in which the triangle is located. **07**

- Q.2** (a) Explain the experimental law of coulomb & derive the expression for electric field intensity due to line charge located on z axis. **07**
- (b) Infinite uniform line charge is located at $y = 3, z = 5$, Find the $\mathbf{E}$ at the a) P(0,6,1) b) Q(5,6,1) for line charge $\rho_L = 30 \text{ nC/m}$. **07**

OR

- (b) 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 electric field intensity $\mathbf{E}$ at point a) P(2, 5, -5) b) Q(-2, 4, 5). **07**
- Q.3** (a) Describe the experimental setup of Faraday's law & define the term displacement flux & displacement density. Also prove Gauss's law. **07**
- (b) For the given field $\mathbf{D} = (2\cos\theta/r^3) \mathbf{a}_r + (\sin\theta/r^3) \mathbf{a}_\theta \text{ C/m}^2$, evaluate both sides of the divergence theorem for the region bounded by $1 < r < 2, 0 < \theta < 90^\circ, 0 < \phi < 90^\circ$. **07**

OR

- Q.3** (a) Explain the energy density in the electrostatic field. **07**
- (b) Define the term Divergence & Derive point form of Gauss's law. Also find the numerical value of $\text{div } \mathbf{D}$, for given $\mathbf{D} = (2xyz - y^2) \mathbf{a}_x + (x^2z - 2xy) \mathbf{a}_y + x^2y \mathbf{a}_z$ at point P(2, 3, -1). **07**
- Q.4** (a) Explain the boundary conditions for perfect dielectric material. **07**
- (b) Calculate the V & using point form of Gauss's Law determine volume charge density ρ_v at point P ($\rho = 3, \theta = 60^\circ, z = 2$) for the given potential $V = 5 \rho^2 \cos 2\theta$. **07**

OR

- Q.4** (a) Explain uniqueness theorem. **07**
- (b) Find Electric Field Intensity $\mathbf{E}$ at point P(3, 1, 2) for the field of two coaxial conducting cylinders, $V = 50 \text{ V}$ at $\rho = 2 \text{ m}$ and $V = 20 \text{ V}$ at $\rho = 3 \text{ m}$. **07**

- Q.5 (a)** State & explain Bio Savart law & derive the expression for magnetic field intensity for infinitely long straight filament carrying a direct current I at distant point. **07**
- (b)** Two differential current elements, $I_1 \Delta \mathbf{L}_1 = 3 \times 10^{-6} \mathbf{a}_y$ A m at $P_1(1,0,0)$ and $I_2 \Delta \mathbf{L}_2 = 3 \times 10^{-6} (-0.5 \mathbf{a}_x + 0.4 \mathbf{a}_y + 0.3 \mathbf{a}_z)$ A m at $P_2(2, 2, 2)$, are located in free space. Find the vector force exerted a) on $I_1 \Delta \mathbf{L}_1$ by $I_2 \Delta \mathbf{L}_2$ b) on $I_2 \Delta \mathbf{L}_2$ by $I_1 \Delta \mathbf{L}_1$. **07**

OR

- Q.5 (a)** Explain Poynting's theorem & Describe the skin effect. **07**
- (b)** Explain the Faraday's law for time varying field. Also Describe the retarded potentials. **07**
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