B.E. Electronics & Communication Engineering & (Telecom. Eng) Sem IV

EN/ET403-Paper-I : Electromagnetic Fields (Elect,x)

P. Pages : 2 **GUG/W/16/3899**

Time : Three Hours * 4 0 1 9 * Max. Marks : 80

Notes : 1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.

1. a) Prove that **8**

i) $\nabla \cdot (\nabla \times A) = 0$ ii) $\nabla \times (\nabla V) = 0$

b) Express the vector field (i) $\overline{w} = (x - y)\, a_{\hat{y}}$ in cylindrical co-ordinates. **8**
ii) Give the field $\overline{F}$ in Cartesian co-ordinates if $\overline{F} = \rho \cos\phi \, a_{\hat{\rho}}$.

OR

2. a) For a vector field $\overline{A} = 30 e^{-\rho} a_{\hat{\rho}} - 2z a_{\hat{z}}$, determine if the field is solenoidal at $P(2, 30^{o}, 5)$ **8**

b) The vector $\overline{R}_{AB}$ extends from point $A(1,2,3)$ to B. If the length of $\overline{R}_{AB}$ is 10 units and its direction is given by $\hat{a} = 0.6 a_{\hat{x}} + 0.64 a_{\hat{y}} + 0.48 a_{\hat{z}}$, find co-ordinates of Point B. **8**

3. a) In free space line charge $\rho_L = 100 \, nc/m$ lines on entire z axis while a point charge 100 nc is at P (2,0,0). Find $\overline{E}$ at (a) (3,1,0) (b) (4,3,2). **8**

b) Derive electric field intensity due to infinite uniform sheet of charge density $\rho_s \, c/m^2$. **8**

OR

4. a) 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 $\overline{E}$ at the point. **8**
(i) $P_A(2, 5, -5)$ (ii) $P_B(4, 2, -3)$ (iii) $P_C(-1, -5, 2)$

b) State and Prove Divergence theorem. **8**

5. Given the flux density $\overline{D} = \frac{2\cos\theta}{r^3} a_{\hat{r}} + \frac{\sin\theta}{r^3} a_{\hat{\theta}} \; c/m^2$. Evaluate both sides of divergence theorem for the region defined by $1 < r < 2$, $0 < \theta < \pi/2$, $0 < \phi < \pi/2$. **16**

OR

6. a) Derive Magnetic field intensity due to an infinite filament carrying current I in it. **8**

b) Evaluate both sides of stokes theorem for the field $\bar{H} = 6xy\, a_{\hat{x}} - 3y^2\, a_{\hat{y}}$ A/m and the rectangular path around the region $2 \le x \le 5,\ -1 \le y \le 1,\ z = 0$ Let the positive direction of $d\bar{s}$ be $a_{\hat{z}}$. **8**

7. a) Write Maxwells equation for static and time varying field. **8**

b) Find the amplitude of displacement current density. **8**

i) adjacent to an automobile antenna where magnetic field intensity of an FM signal is $H_X = 0.15 \cos[3.12\ (3 \times 10^8 t - y)]$ A/m

ii) In the air space at a point within a large power distribution transformer where $\bar{B} = 0.8 \cos\left[1.257 \times 10^{-6}\ (3 \times 10^8 t - x)\right] a_{\hat{y}}$ T.

OR

8. a) State and prove uniqueness theorem. **8**

b) Derive continuity equation for time varying field. **8**

9. a) A material for which $\epsilon_r = 1.5,\ \mu_r = 1$ has conductivity σ Let $\bar{E} = 60 \cos(10^5 t)\, a_{\hat{x}}$ v/m Find (i) J_c (ii) J_d (c) the conductivity for which the displacement current density and conduction current have equal amplitudes. **8**

b) Derive wave equation for time varying field. **8**

OR

10. a) The magnetic field intensity of a uniform plane wave in air is 20 A/m in $a_{\hat{y}}$ direction. The wave is propagating in $a_{\hat{Z}}$ direction at a frequency of 2 G rad/sec. Find **8**

i) Wavelength ii) The frequency

iii) The period iv) The amplitude and direction of $\bar{E}$.

b) Write short notes on: **8**

i) Snells law.

ii) Brewster angle

iii) Stair effect

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