

Seat  
No.

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मधुर - 043

## Electromagnetic Engineering (1020)

P. Pages : 2

Time : Three Hours

Max. Marks : 100

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Solve **any two** questions from each unit.
5. Each question carry equal ten marks.
6. Assume suitable data wherever necessary.

### UNIT - I

1. a) Derive an expression for Electric Field intensity  $\vec{E}$  due to infinite uniform line charge  $\rho_L$  C/m. 10  
b) Let  $\vec{D} = y^2 z^3 \cdot \vec{a}_x + 2xyz^3 \cdot \vec{a}_y + 3xy^2 z^2 \cdot \vec{a}_z$  pc/m<sup>2</sup> in free space find : 10  
i) Total flux passing through surface  $x = 3$   
 $0 \leq y \leq 2, 0 \leq z \leq 1$  in direction away from origin.  
ii)  $|\vec{E}|$  at point P (3, 2, 1)  
iii) Total charge in incremental sphere of radius of  $2\mu\text{m}$  centered at P (3,2,1)  
c) Find work done in moving a  $5\mu\text{C}$  charge from origin to point P (2,-1,4) in  $\vec{E} = 2xyz \cdot \vec{a}_x + x^2 z \vec{a}_y + x^2 y \vec{a}_z$  V/m through the path using  
i) Straight line segment. 10 ii)  $x = -2y, z = 2x$ .

### UNIT - II

2. a) Starting from Gauss's law derive an poisson's and laplace's equation. Write laplace's equation in all co-ordinate system. 10  
b) A potential field is given as  $V = 100 \cdot e^{-5x} \cdot \sin 3y \cdot \cos 4z$  volts let point 'P' ( $0.1, \pi/12, \pi/24$ ) is located in free space conductor boundary. At point 'P' calculate : (i) V (ii)  $\vec{E}$  (iii)  $E_N$  (iv)  $E_t$  (v)  $\rho_s$ . 10  
c) If region  $Y < 0$  contains dielectric material having  $\epsilon R_1 = 2.5$  while  $y > 0$  contains  $\epsilon R_2 = 4$  Let  $\vec{E}_1 = -30\vec{a}_x + 50\vec{a}_y + 70\vec{a}_z$  V/m  
Find : (i)  $E_{N_1}$  (ii)  $\vec{E}_{t_1}$  (iii)  $E_{t_1}$  (iv)  $E_1$  (v)  $\theta_1$  (vi)  $\theta_2$  (vii)  $|\vec{D}_1|$  10

## UNIT - III

3. a) Using Biot Savart law find magnetic field intensity  $\vec{H}$  due to finite conductor carries current 'I' Amp on z-axis. 10
- b) Let  $\vec{H} = -y(x^2 + y^2)\vec{a}_x + x(x^2 + y^2)\vec{a}_y$  A/m in  $z = 0$  plane for  $-5 \leq x \leq 5$ ,  $-5 \leq y \leq 5$ . Find total current I flows in  $\vec{a}_z$  direction using both sides of Stoke's theorem for a Rectangle  $-1 < x < 1$ ,  $-2 < y < 2$ . 10
- c) The region  $\rho = 3.5$  to  $4.5$  cm,  $\phi = 0$  to  $2\pi$ ,  $z = 0$  to  $2$  cm is in free space contains  $\vec{H} = \frac{70}{\rho} \cdot \vec{a}_\phi$  A/m. Find  $V_m$  at  $\rho = 3.8$  cm,  $\phi = 110^\circ$ ,  $z = 0.5$  cm
- if i)  $V_m = 0$  at  $\phi = 0$  if barrier is at  $\phi = 180^\circ$   
 ii)  $V_m = 0$  at  $\phi = 0$  if barrier is at  $\phi = 90^\circ$   
 iii)  $V_m = 0$  at  $\phi = 180^\circ$  if barrier is at  $\phi = 0^\circ$  10

## UNIT - IV

4. a) Write Maxwell's equations for time varying field & free space in integral and point form. 10
- b) A UPW is given by  $E_s = 200 \angle 30^\circ \cdot e^{-j250} \cdot \vec{a}_x$  calculate  
 (i)  $\beta$  (ii)  $\omega$  (iii)  $f$  (iv)  $\lambda$  (v)  $\eta$  (vi)  $H_s$  (vii)  $|\vec{E}|$  at  $z = 8$  mm &  $t = 6$  psec. 10
- c) i) Explain properties of UPW. 5  
 ii) Calculate propagation constant and intrinsic impedance for  $b = 4$  s/m,  $\epsilon = 80 \epsilon_0$ ,  $\mu = \mu_0$ ,  $F = 10^9$  Hz. 5

## UNIT - V

5. a) Explain Broad side and end Fire Array in detail. 10
- b) A thin dipole is  $\lambda/15$  long. Calculate its gain & effective Aperture. 10
- c) Write a short note on : 10  
 i) Reciprocity Theorem  
 ii) Pattern Multiplication.

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