B.E.Fourth Semester (Electrical Engineering (Electronics & Power)) (C.B.S.)

Elements of Electromagnetic

P. Pages : 3

NKT/KS/17/7279

Time : Three Hours

Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.

1. a) Given points A(x = 2, y = 3, z = -1) and $B(\rho = 4, \phi - 50°, z = 2)$, find the distance from **6**

i) A to the origin

ii) B to the origin

iii) A to B

b) Given three points A(2, -1, 2) ; B(-1, 1, 4) and C(4, 3, -1). Find - **7**

i) the angle between $\bar{R}_{AB}$ and $\bar{R}_{AC}$

ii) the area of triangle ABC

iii) a unit vector perpendicular to ABC

OR

2. a) Transform the vector field $\bar{W} = 10\bar{a}_x - 8\bar{a}_y + 6\bar{a}_z$ to cylindrical coordinate system, at point P(10, -8, 6). **6**

b) Given points $P(\rho = 5, \phi = 60°, Z = 2)$ & $Q(\rho = 2, \phi = 110°, Z = -1)$ in cylindrical co-ordinate system. Find : **7**

i) Unit vector in Cartesian co-ordinates at P directed towards Q.

ii) Unit vector in cylindrical co-ordinates at P directed towards Q.

3. a) A charge of IC is at (2, 0, 0). What charge must be placed at (-2, 0, 0) which will make Y component of total $\bar{E}$ zero at the point (1, 2, 2) ? **6**

b) Find total charge inside the volume for each of following - **7**

i) $\rho_v = 10z^2 \, e^{-0.1x} \sin \pi y \quad -1 \le x \le 2,\ 0 \le y \le 1,\ 3 \le z \le 3.6$

ii) $\rho_v = 4xyz^2,\ 0 \le \rho \le 2,\ 0 \le \phi \le \pi/2,\ 0 \le z \le 3$

OR

4. a) Calculate electric field intensity at a point A(1, 2, 3) in free space caused by a charge $Q_1 = 5\,nC$ at a point (2, 3, 5) and another charge $Q_2 = 4\,nC$ at R(3, 0, 3) **6**

b) State Coulomb's law. Derive an expression for electric field intensity at a point due to infinite line charge. **7**

5. a) Given the electric flux density $\overline{D} = 0.3r^2\,\overline{a}_r\ nc/m^2$ in free space - **7**

i) Find $\overline{E}$ at r = 2, $\theta = 25°$, $\phi = 90°$

ii) Find the total charge within the sphere r = 3

iii) Find the total electric flux leaving the sphere r = 4.

b) Given $\overline{D} = \dfrac{5r^2}{4}\overline{a}_r\ c/m^2$ in spherical co-ordinates. Evaluate both sides of divergence theorem for the volume of the sphere enclosed by r = 4m. **7**

OR

6. a) Define electric potential show that $\overline{E} = -\nabla V$. **7**

b) Given $V = 100\,xy^2z + 50\,Z^2 V$ in free space. Find $\overline{D}$ and ρ_V at (3, 3, 3) **7**

7. a) Derive the boundary conditions at the boundary between two perfect dielectrics. **7**

b) The region z < 0 contains dielectric for which $\in_{r_1} = 2.5$ and the region z > 0 is characterized by $\in_{r_2} = 4$. Let $\overline{E}_1 = -30\,\overline{a}_x + 50\overline{a}_y + 70\overline{a}_z\ V/m$ and find **7**

i) E_{N_1} ii) $\overline{E}_{t_1}$ iii) E_{t_1} iv) E_1 v) θ_1

OR

8. a) Derive the expression for capacitance for a parallel plate capacitor. **7**

b) Given $V = \dfrac{50\sin\theta}{r^2}$ volts in free space. Determine whether or not V satisfies laplace equation. **7**

9. a) Derive the expression for magnetic field intensity due to an infinite filament carrying current I in it. **7**

b) In the region $0 \le \rho \le 0.5\,m$ in cylindrical co-ordinates, the current density is $\overline{J} = 4.5\,e^{-2\rho}\,\overline{a}_z\ A/m^2$ and $\overline{J} = 0$ elsewhere. Use Ampere's circuital law to find $\overline{H}$ every where. **6**

OR

10. a) Evaluate both sides of Stoke's Theorem for the field $\overline{H} = 6xy\,\bar{a}_x - 3y^2\bar{a}_y$ 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 $\bar{a}_z$. **7**

b) State and explain Amperes circuital law and Biot Savarts law. **6**

11. a) State Maxwell's equation for steady fields in their point form for time varying electric and magnetic fields. **7**

b) Given the magnetic flux density $\overline{B} = 6\cos(10^6 t)\sin(0.01x)\bar{a}_z$ mT. **6**

i) Find the magnetic flux passing through the surface z = 0, $0 \le x \le 20\,\text{m}$, 0<y<3 at t = 1 μ sec.

ii) Find the value of the closed line integral of $\overline{E}$ around the perimeter of the surface specified above at t = 1 μ sec.

OR

12. Write short notes on : **13**

i) Phase constant.

ii) Attenuation const.

iii) Depth of penetration

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