B.E. Fourth Semester (Elect. Engg. (Elect. & Power Elect)) (CGS)

10543 : Electro Magnetic Theory : 4 EP 02 / 4 EX 02 / 4 EL 02 / 4 EE 02

P. Pages : 3 | AU - 2581

Time : Three Hours | Max. Marks : 80

Notes :
1. Answer **three** question from Section A and **three** question from Section B.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answer necessary with the help of neat sketches.
5. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

1. a) State and explain the concept of scalar dot product and cross product. Also explain the importance of $\hat{a}_N$. **6**

b) Convert the vector field **7**

$\overline{G} = 8\hat{a}x$ at $P(2,3,4)$

in a) Spherical co-ordinate system
b) Cylindrical co-ordinate system

OR

2. a) State and explain the concept of line integral, surface Integral and volume Integral in brief. **6**

b) The surfaces $r = 2 \& 4$, $\theta = 30° \& 50°$, $\phi = 20° \& 60°$ **7**

Find :
a) Enclosed volume
b) Find the length of the longest line that lies entirely within the surface.

3. a) Derive the point form of Gauss to law. **7**

b) Evaluate both sides of Divergence theorem for $\overline{D} = 2xy\,\hat{a}x + x^2\hat{a}y\ e/m^2$ for the region $x = 0 \& 1$, $y = 0 \& 2$, $z = 0 \& 3$. **7**

OR

4. a) What is potential Gradient? Prove that $\nabla V = -\overline{E}$. **7**

b) Give the potential field **7**

$V = (A\rho^4 + B\rho^{-4})\sin 4\phi$

i) Show that $\nabla^2 V = 0$
ii) Select A & B so that
$V = 100V$, and $|\overline{E}| = 500\,V/m$
at $P(\rho = 1, \phi = 22.5°, z = 2)$

5. a) State and explain Boundary condition between two materials of different permittivity and show that $\frac{\tan\theta_1}{\tan\theta_2} = \frac{\varepsilon_1}{\varepsilon_2}$. 7

b) Let $\bar{E} = 18\hat{a}x - 11\hat{a}y + 8.5\hat{a}z$ V | m 6
at the conductor free space boundary find the magnitude of
i) $\bar{E}$ ii) $\bar{E}_N$
iii) $\bar{E}_T$ iv) ρ_S

OR

6. a) A slab of dielectric material has a relative dielectric constant of 3.8 and contains a uniform electric flux density of $8\,nc/m^2$. If the material is lossless find : 6
a) E
b) P
c) Average number of dipoles per cubic meter if the average dipole moment is 10^{-29} c.m.

b) Find the relative permitivity of the dielectric material present in a parallel plate capacitor if 7
a) $S = 0.12\,m^2$, $d = 80\,\mu m$, $V_0 = 12V$ and it contains $1\,\mu J$ energy.
b) Energy density is $100\,J/m^3$
$V_0 = 200V$, $d = 45\,\mu m$
c) $E = 200\,kV/m$, $\rho_s = 20\,\mu c/m^2$ and $d = 100\,\mu m$.

SECTION - B

7. a) Show that $\bar{\nabla} \times \bar{H} = \bar{J}$ using Amper's law. 7

b) Find $\bar{H}$ in rectangular components at $P(2,3,4)$ if there is : 7
a) Current filament of 8 mA on z-axis &
b) Three current sheets of $-1.5\hat{a}x$ at $y = 2$, $1.7\hat{a}x$ at $y = 4$ and $2\hat{a}x$ at $y = 1$.

OR

8. a) State and Explain : 7
a) Biot - Stawart's Law.
b) Stoke's Theorem
c) Amper's circuital law.

b) The magnetic field intensity is given in a certain region of space 7
$\bar{H} = \left[(x+2y)/z^2\right]\hat{a}y + (2/z)\hat{a}z$ A | m
a) Find $\bar{\nabla} \times \bar{H}$
b) Find $\bar{J}$
c) Use $\bar{J}$ to find total current through $z = 4$, $1 \le x \le 2$, $3 \le y \le 5$ in $\hat{a}z$ direction.

9. a) Two homogeneous linear isotropic material have an interface at $x = 0$ at which there is a surface current $\overline{K} = 100\,\hat{a}y\,A\,|\,m$. for $x < 0\ \mu r_1 = 2$ and $x > 0\ \mu r_2 = 5$ if $\overline{H} = 150\,\hat{a}x - 400\,\hat{a}y + 250\,\hat{a}z\,A\,|\,m$ Find : a) $\overline{H}_2$ b) $|\overline{B}_1|$ c) $\overline{B}_2$. **7**

b) Derive the expression of Energy stored in magnetic field. **6**

OR

10. a) Explain the concept of Inductance, magnetic dipole moment and magnetization. **6**

b) Find the magnetization in the magnetic material where : **7**

a) $\mu = 1.8 \times 10^{-5}\,H\,|\,m,\ H = 120\,A\,|\,m$

b) $B = 300\,\mu T,\ \&\ x_m = 15$

11. a) State and Derive Poynting theorem. **6**

b) Determine weather the following pairs of fields satisfy Maxwell's equation or not. **7**

$\overline{E} = 3y\ \hat{a}y,\ \overline{H} = 4x\,\hat{a}x$

OR

12. a) Prove that : **6**

$$\overline{\nabla} \times \overline{E} = -\frac{\partial \overline{B}}{\partial t}$$ Using Faraday's Law of EMI.

b) A 10 GHz uniform plane wave with the amplitude of $15\,V/m$, travelling in a free space. **7**
Find :

a) Velocity of propagation
b) Characteristic Impedance
c) β
d) λ
e) Magnitude of H.

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