AU – 2509

Third Semester B. E. (Electronics and Telecommunication Engg.) Examination

ELECTROMAGNETIC FIELD

Paper – 3 XT 3 / 3 XN 03

(USC – 10593)

P. Pages : 3

Time : Three Hours] [Max. Marks : 80

Note : (1) Separate answer book must be used for each section in the subject Geology, Engineering material of civil branch and Separate answer book must be used for Section A and B in Pharmacy and Cosmetic Tech.
(2) Answer **Three** questions from Section A and **Three** questions from Section B.
(3) Due credit will be given to neatness and adequate dimensions.
(4) Assume suitable data wherever necessary.
(5) Use pen of Blue/Black ink/refill only for writing the answer book.

SECTION A

1. (a) State and prove Stoke's theorem. 7

(b) A vector field is given by

$\overline{G} = 24xy^2\ \hat{a}_x + 12\ (x^2 + z)\ \hat{a}_y + 18y^2\ \hat{a}_z$ and P(1, –2, 1), Q(3, –1, 2) are any two points.
Find :

(i) $\overline{G}$ at point P

(ii) Unit vector along $\overline{G}$ at point Q

(iii) Unit vector along $\overline{G}$ at point P 6

OR

2. (a) Given two points C(–3, 2, 1) and D($\gamma = 5$, $\theta = 20^0$, $\phi = 70^0$)
Find :

(a) The spherical co-ordinate of C

(b) The rectangular co-ordinate of D

(c) The distance from C to D 6

(b) A vector $\overline{A} = (2xy\ \hat{a}_x - 5x^2y\ \hat{a}_z)$ Calculate both sides of divergence theorem for volume enclosed by $1 \leq x \leq 2$, $0 \leq y \leq 1$ and $0 \leq z \leq 2$. 7

3. (a) Three uniform sheets of charge are located in free space as follows $3nc/m^2$ at $z = -4$, $6nc/m^2$ at $z = 1$ and $-8nc/m^2$ at $z = 4$ find $\overline{E}$ at point (a) $P_A(2, 5, -5)$ (b) $P_B(4, 2, -3)$

(b) Obtain an expression for electric field intensity due to infinite long line charge with line charge density ρ_L c/m.

OR

4. (a) Derive Maxwell's equation $\nabla \cdot \overline{D} = \rho_v$ for static electric field.

(b) A point charge of $6\mu c$ is located at the region, a uniform line charge density of 180 nc/m lies along the x-axis and a uniform sheet of charge equal to 25 nc/m^2 lies in $z = 0$ plane. Find $\overline{D}$ at A(0, 0, 4).

5. (a) Show that the magnetic field intensity due to infinite filament on z axis is given by

$$\overline{H}_\phi = \frac{I}{2\pi\rho}\ \hat{a}_\phi$$

7

(b) Find the current flowing due to field $\overline{H} = 10^6\ r \sin\theta\ \hat{a}_\phi$ A/m over the region $r = 1$ mm $0 \leq \theta \leq \pi/6$ and $0 \leq \phi \leq 2\pi$. 7

OR

6. (a) Derive Maxwell's equation $\overline{\nabla} X \overline{H} = \overline{J}$ for static electric field. 7

(b) Evaluate the closed line integral of $\overline{H}$ about the rectangular path $P_1(2, 3, 4)$ to $P_2(4, 3, 4)$ to $P_3(4, 3, 1)$ to $P_4(2, 3, 1)$ to P_1. Given

$\overline{H} = 8z\ \hat{a}_x - 4x^3\ \hat{a}_z$ A/m 7

SECTION B

7. (a) The magnetic flux density is $\overline{B} = 6 \cos(10^6\ t) \cdot \sin(0.01\ x)\ \hat{a}_z$ mT. Find the magnetic flux passing through surface $z = 0$, $0 < x < 20$ m, $0 < y < 3$ m at $t = 1$ μs. 6

(b) Obtained boundary condition at the interface of two dielectric medium. 7

OR

8. (a) For time varying field show that $\overline{\nabla} X \overline{H} = \overline{J} + \frac{\partial \overline{D}}{\partial t}$ 7

(b) Find the value of k so that each of the following pairs of fields satisfy Maxwell's equation in the region where $\sigma = 0$ and $\varrho_v = 0$.

(a) $\overline{E} = (k_x - 175t)\ \hat{a}_y$ v/m, $\overline{H} = (x + 35t)\ \hat{a}_z$ A/m $\mu = 0.35$ H/m, $\epsilon = 0.01$ F/m.

(b) $\overline{D} = 6x\hat{a}_x - 4y\hat{a}_y + k_z\hat{a}_z\ \mu c/m^2\ \overline{B} = 2\ \hat{a}_y'\ mT$

$\mu = \mu_0$ and $\epsilon = \epsilon_0$. 6

9. (a) Derive an expression for reflection coefficient (Γ) and transmission coefficient (T) for an electromagnetic wave at perfect dielectric-dielectric interface for normal interface. 7

(b) Show that for good conductor attenuation and phase constant is given by $\alpha = \beta = \sqrt{\pi f \mu \sigma}$. 7

OR

10. (a) Consider a material for which $\mu_r = 1$, $\epsilon_r = 4$ and loss tangent is 0.1. Calculate conductivity (σ), wavelength (λ) and velocity (v) at frequency of 50 Hz. 7

(b) Derive the Poynting theorem and give significance of each term in the theorem. 7

11. Derive the expression for power radiated and radiation resistance of small alternating current element Idl. 13

OR

12. Derive the expression for field radiated by half wave dipole assuming a sinusoidal current distribution. Hence show that the radiation resistance is 73Ω. 13