AU – 2516

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

ELECTROMAGNETIC FIELDS

Paper – 3 ET 05

(USC – 11828)

P. Pages : 4

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) Due credit will be given to neatness and adequate dimensions.
(3) Assume suitable data wherever necessary.
(4) Illustrate your answer wherever necessary with the help of neat sketches.
(5) Use pen of Blue / Black ink / refill only for writing the answer book.

SECTION A

1. (a) Given points A(2,5,−1), B(3,−2,4) and C(−2,3,1) Find

(i) $\overline{R_{AB}} \cdot \overline{R_{AC}}$

(ii) Angle between $\overline{R_{AB}}$ and $\overline{R_{AC}}$

(iii) Vector projection of $\overline{R_{AB}}$ on $\overline{R_{AC}}$ 2+2+3=7

(b) Transform each of the following vectors to spherical co – ordinate system at the point specified

(i) $5\,\hat{a}x$ at A $(4, 25^0, 120^0)$

(ii) $4\,\hat{a}x - \hat{a}y - 4\hat{a}z$ at B $(-2,-3,4)$ 3+4=7

OR

2. (a) Find $\overline{\nabla} \times \overline{H}$ for

(i) $\overline{H} = xyz\,(\hat{a}x + \hat{a}y)$ at P (3,2,1)

(ii) $\overline{H} = e\phi z\,\hat{a}z$ at Q $(2, 30^0, 3)$ 6

(b) Explain in brief the divergence of a vector. 3

(c) Find the volume enclosed by the surface defined by $3<r<5$, $0.1\pi<\theta<0.3\pi$ and $1.2\pi<\phi<1.6\pi$. 5

3. (a) Derive the expression for Electric field intensity due to sheet of charge. Compare it with Electric Field intensity due to line charge. 6+1=7

(b) If $V = \frac{60 \sin\theta}{r^2}$ volt in free space and point P is located at $(3, 60^0, 25^0)$,

Find :—

(i) V_P

(ii) E_P

(iii) ρ_v at point P. 6

OR

4. (a) Derive an expression for Potential difference between two points A and B, in the vicinity of Electric field due to point charge Q. 7

(b) If $\overline{D} = 6\,xyz^3\,\hat{a}x + 3x^2z^2\,\hat{a}y + 6x^2yz\,\hat{a}z\ C/m^2$, find total charge enclosed by the region bounded by $x=1$ and $x=3$, $y=0$ and $y=1$ and $z=-1$ and $z=1$. 6

5. (a) State Ampere's circuital law. Also obtain its point form. 7

(b) Find magnetic field intensity in cartession co-ordinate at point $P(1.5, 2, 3)$ caused by the current carrying filament of 24 amp in $\hat{a}z$ direction and extending from $z=0$ to $z=6$. 6

OR

6. (a) Derive an expression for magnetic field intensity at the center of circular wire carrying current I in anticlockwise direction. The radius of circle is a and the wire is located in xy plane. 7

(b) Find magnetic field intensity within magnetic material if Magnetization $M = 150\,A/m$ and $\mu = 1.5 \times 10^{-5}\,H/m$. 6

SECTION B

7. (a) Derive boundary conditions at the interface of a conductor and free space. Explain in brief equipotential surface. 6+2=8

(b) Assume a homogeneous medium of infinite extent with $\epsilon = 2 \times 10^{-10}\,F/m$, $\mu = 1.25 \times 10^{-5}\,H/m$ and $\sigma = 0$. Let $\overline{E} = 400 \cos (10^9 t - kz)\,\hat{a}x\ V/m$. If all fields vary sinusoidally, use Maxwell's equations to find :—

(i) $\overline{D}$ (ii) $\overline{B}$ (iii) K. 1+3+2=6

OR

8. (a) Derive the Maxwell's equation $\nabla \cdot D = \rho_v$. Enlist all Maxwell's equations in integral form for time varying fields. 4+2=6

(b) Region 1 is characterised by $\mu r_1 = z$ while region 2 has $\mu r_2 = 5$. If two regions are separated by $3x - 2y + 5z = 0$ and if $\overline{H}_1 = 4\hat{a}x + 6\hat{a}y - 3\hat{a}z\ A/m$, Find $\overline{H}_z$. 8

9. (a) Derive Poynting theorem and give significance of each terms in the theorem. 6

(b) A 150 MHz uniform plane wave in a free space is travelling in $\hat{a}x$ direction. The electric field intensity has a maximum amplitude of $200\,\hat{a}y + 400\,\hat{a}z\ V/m$ at point $P(10, 30, -40)$ at $t = 0$. Find $\omega, \beta, \lambda, \eta$, $\overline{E}(x,y,z,t)$ and $H(x,y,z,t)$. 7

OR

10. (a) For a wave propagating through dielectric medium in x-direction with electric component in y-direction, obtain expression of intrinsic impedance. 7

(b) Derive the expression for reflection coefficient (r) and transmission coefficient (T) for an electromagnetic wave of perfect dielectric interface for normal incidence. 6

11. Obtain expression for electric field and magnetic field radiated by small alternating current element Idl. 13

OR

12. (a) Explain the concept of,

    (i) Scalar magnetic potential

    (ii) Retarded potential. 6

    (b) Derive the expression for vector magnetic potential. 7