AQ – 2651

First Semester M. Sc. (Applied Electronics) (CBS) Examination

(New)

ELECTRIC AND MAGNETIC FIELD

1 AE 4

P. Pages : 4

Time : Three Hours] [Max. Marks : 80

Note : (1) Due credit will be given to neatness and adequate dimensions.
(2) Assume suitable data wherever necessary.
(3) Retain the construction lines.
(4) Illustrate your answer wherever necessary with the help of neat sketches.

1. (a) The vertices of a triangle are located at (4, 1, –3), (–2, 5, 4) and (0, 1, 6). Find the three angles of the triangle. 7

(b) Find :—

(i) The vector component of $F = 10a_x - 6a_y + 5a_z$ that is parallel to $G = 0.1a_x + 0.2a_y + 0.3a_z$;

(ii) The vector component of F that is perpendicular to G. 6

OR

2. (a) Calculate the distance between the following pairs of points :—

(a) (2, 1, 5) and (6, –1, 2)

(b) (3, $\pi/2$, –1) and (5, $3\pi/2$, 5)

(c) (10, $\pi/4$, $3\pi/4$) and (5, $\pi/6$, $7\pi/4$). 7

(b) Find the gradient of the following scalar fields:

(i) $U = \rho^2 z \cos 2\phi$

(ii) $W = 10\ r \sin^2\phi \cos \phi$ 6

3. (a) Derive an expression for the electric field intensity $\bar{E}$ due to a infinitely extended uniform line charge density ρL. 7

(b) Evaluate both sides of the divergence theorem for the field $\mathbf{D} = 2xya_x + x^2ay$ C/m² and the rectangular parallelepiped formed by the planes x = 0 and 1, y =0 and 2 and z = 0 and 3. 7

OR

4. (a) Three infinite uniform sheets of charge are located in free space as follows: 3 nC/m² at z = –4, 6 nC/m² at z = 1, and –8 nC/m² at z = 4. Find **E** at the point :—

(i) P_A (2, 5, –5);

(ii) P_B (4, 2, –3) 7

(b) Given the potential field in cylindrical coordinates, $V = \frac{100}{(z^2+1)} \rho\cos\phi$ V, and point P at ρ = 3m, $\phi = 60^0$, z = 2m, find values at P for (a) V; (b) E; (c) E; (d) dV/dN; (e) $\mathbf{a}_N$ 7

5. (a) Drive an expression for magnetic field intensity due to an infinitely long straight filament carrying a direct current I along z axis. 6

(b) State and prove stokes theorem. 7

OR

6. (a) Calculate the value of the vector current density in cylindrical coordinates at P_B (1.5, 90^0, 0.5) if $H = \frac{2}{\rho}$ (cos 0.2 ϕa_ρ) 7

(b) Explain following :—

Scalar magnetic potential

Vector magnetic potential. 6

7. (a) Let Region 1(z<0) be composed of a uniform dielectric material for which ε_r = 3.2, while Region 2 (z > 0) is characterized by ε_r = 2. Let **D**1 = –30**a**x + 50**a**y + 70**a**z nC/m² find :–

(i) $\mathbf{D}_{N_1}$;

(ii) $\mathbf{D}_{t_1}$;

(iii) θ_1;

(iv) D_{N_2};

(v) D_{t_2};

(vi) θ_2 8

(b) Find the amplitude of the displacement current density adjacent to an automobile antenna where the magnetic field intensity of an FM signal is $Hx = 0.15 \cos [3.12 (3x10^8t-y)]$ A/m 5

OR

8. (a) Obtain magnetic boundary condition and show that

$$M_{t_2} = \frac{\chi_{m_2}}{\chi_{m1}} M_{t_1} - \chi_m{}^k$$

where χ_m is magnetic susceptibility and

k is surface current 7

(b) Derive the boundary condition at the interface of two dielectric media. 6

9. (a) Derive the wave equations and write its phasor form. 7

(b) The phasor magnetic field intensity for a 400 MHz uniform plane wave propagating in a certain lossless material is $(2a_y - j5a_z)e^{-j25x}$ A/m. Knowing that the maximum amplitude of E is 1500V/m, find β, η, λ, v_p, μ_r, ε_r. 7

OR

10. (a) Discuss the reflection of a plane wave incident normally on an interface between two different media in terms of reflection and transmission coefficient. 7

(b) Define following :—

(i) Loss tangent

(ii) Skin depth

(iii) Brewster angle. 7

11. (a) Obtain the radiation resistance for a short dipole and monopole. 6

(b) With any example, explain pattern multiplication method to obtain radiation pattern. 7

OR

12. (a) Describe uniform linear array and obtain its radiation pattern. 8

(b) Define the following terms

Radiation resistance.

Retarded potential. 5