CBCS SCHEME

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18EC55

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Electromagnetic Wave

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. State and explain Coulomb's law in vector form. **(10 Marks)**

b. If $\overline{D} = xy^2z^2\,\bar{a}_x + x^2yz^2\,\bar{a}_y + x^2y^2z\,\bar{a}_z$ c/m^2 find i) an expression for ρ_v ii) the total change within the cube defined by $0 \le x \le 2$; $0 \le y \le 2$; $0 \le z \le 2$. **(10 Marks)**

OR

2 a. Obtain an expression for electric field intensity due to infinite line charge. **(10 Marks)**

b. Define the following terms in electric field density i) Line charge ii) Surface charge iii) volume charge. **(10 Marks)**

Module-2

3 a. State and prove Gauss law for point charge. **(05 Marks)**

b. State and prove divergence theorem. **(05 Marks)**

c. Give the electrical tube density $D = 0.3r^2\,\bar{a}_r$ nc/m^2 in free space.

i) Find E at Pt. P($r = 2$; $\theta = 25°$; $\phi = 90°$).

ii) Find the total change within the sphere $r = 3$

iii) Find the total electric flux leaving the sphere $r = 4$. **(10 Marks)**

OR

4 a. Obtain an expression for integral form of work done in moving a Pt. Charge Q from one position to another position. **(08 Marks)**

b. Calculate the work done in moving a 4C charge from B(1, 0, 0) to A(0, 2, 0) along the path $y = 2 - 2x$, $z = 0$ in the field E = (1) $5\,\bar{a}_x$ V/M (2) $5x\,\bar{a}_x$ V/m **(06 Marks)**

c. A 15 nc point charges ρ_S at the origin in free space. Calculate V_1 if point P is located at P(-2, 3, -1) and V = 0 at (6, 5, 4). **(06 Marks)**

Module-3

5 a. Drive the Poisson's and Laplaces equations. **(08 Marks)**

b. State the prove the Stoke's theorem. **(06 Marks)**

c. Let $V = 2xy^2z^3$ and $E = E_0$ given point P(1, 2, -1). Calculate i) V at P ii) E at P iii) ρ_v at P. **(06 Marks)**

OR

6 a. State and prove the Amperes circuital law. **(06 Marks)**

b. Drive the expression for vector magnetic potential. **(06 Marks)**

c. A current element $IdL = 10^{-3}(2\,a_x + 4a_y - a_z)$ A/m located at A(-5, 3 -2) produces a field dH at B(3, -4, 3) i) Give a unit vector in the direction at dH at B ii) Find d(H) at B. **(08 Marks)**

Module-4

7 a. Derive an expression for the Force between differential current elements in magnetic field. **(06 Marks)**

b. The field $B = -2\bar{a}_x + 3\bar{a}_y + 4\bar{a}_z$ mT is present in free space. Find the vector force exerted on a st. wire carrying 12A current in the a_{AB} direction given A(1, 1, 1) and B(2, 1, 1). **(08 Marks)**

c. An air core toroid has 500 turns mean radius of 15 cm cross sectional area of 6 cm^2. The magnetic motive force is 2000 AT. Calculate total reluctance flux, flux density, field intensity inside the core. **(06 Marks)**

OR

8 a. Write note on forces on magnetic materials. **(10 Marks)**

b. Write a note on magnetic circuits. **(10 Marks)**

Module-5

9 a. Drive the expression for a stationary closed path in a time varying field statically induced EMF. **(06 Marks)**

b. State Maxwell's equation in both point form and in integral form. **(06 Marks)**

c. Find the frequency at which conduction current density and displacement current density are equal in a medium with $\sigma = 2 \times 10^{-4}$ and $\epsilon_r = 81$. **(08 Marks)**

OR

10 a. State and explain poynting theorem. **(08 Marks)**

b. Define the following terms in uniform plane wave i) phase velocity ii) Intrinsic impedance iii) wave length. **(06 Marks)**

c. The depth at penetration in a certain conducting medium is 0.1 m and the frequency of the electromagnetic wave is 1.0 MHz. Find the conductivity of the conducting medium. **(06 Marks)**

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