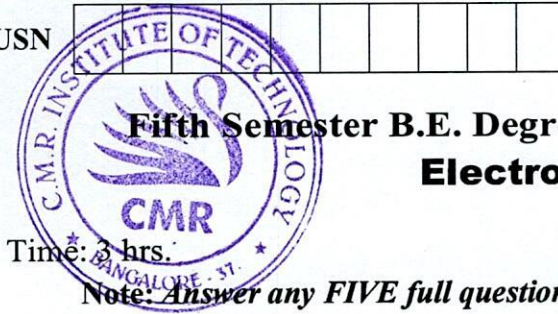


CBCS SCHEME

USN

18EC55



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 $\vec{D} = xy^2z^2 \vec{a}_x + x^2yz^2 \vec{a}_y + x^2y^2z \vec{a}_z$ C/m² find i) an expression for ρ_v ii) the total change within the cube defined by $0 \leq x \leq 2$; $0 \leq y \leq 2$; $0 \leq z \leq 2$. (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 $D = 0.3r^2 \vec{a}_r$ nC/m² in free space.
 - i) Find E at Pt. P($r=2$; $\theta=25^\circ$; $\phi=90^\circ$).
 - 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 $E = (1) 5 \vec{a}_x$ V/m (2) $5x \vec{a}_x$ 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 $IdL = 10^{-3}(2 \vec{a}_x + 4 \vec{a}_y - \vec{a}_z)$ 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 $B = -2\vec{a}_x + 3\vec{a}_y + 4\vec{a}_z$ mT is present in free space. Find the vector force exerted on a st. wire carrying 12A current in the \vec{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 cm². 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)
