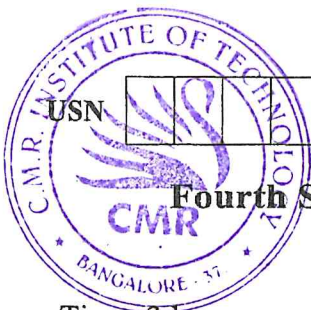


CBCS SCHEME



18EE45

Fourth Semester B.E. Degree Examination, July/August 2022 Electromagnetic Field Theory

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. Define Scalar and Vector, for a given two vectors :
 $\vec{A} = 2\vec{a}_x - 5\vec{a}_y - 4\vec{a}_z$ and $\vec{B} = 3\vec{a}_x + 5\vec{a}_y + 2\vec{a}_z$, solve to find the Dot product and angle between two vectors. (08 Marks)
- b. Obtain the relationship between Rectangular and Cylindrical coordinates. (06 Marks)
- c. Construct the Cartesian component of the vector,
 $\vec{H} = 20\vec{a}_r - 10\vec{a}_\phi + 3\vec{a}_z$ at $P(x = 5, y = 2, z = -1)$. (06 Marks)

OR

- 2 a. State and explain the Coulomb's law. (06 Marks)
- b. Define Electric Field Intensity at a point. Derive an expression for field intensity due to infinite line charge. (08 Marks)
- c. State and prove Gauss's law. (06 Marks)

Module-2

- 3 a. Show that Electric Field intensity is expressed as Negative Gradient of Scalar Potential. (08 Marks)
- b. Calculate the potential at the centre of a square with a side $a = 2$ mtr, while charges $2 \mu\text{C}$, $-4 \mu\text{C}$, $6 \mu\text{C}$ and $2 \mu\text{C}$ are located at its 4 corners. (06 Marks)
- c. Define Electric dipole. Obtain the expression for potential and electric field intensity due to a dipole. (06 Marks)

OR

- 4 a. Derive the boundary conditions between a conductor and dielectric. (08 Marks)
- b. Derive the continuity of current equation. (06 Marks)
- c. Obtain the expression for energy stored in a capacitor. (06 Marks)

Module-3

- 5 a. Derive the Poisson's and Laplace equations from Gauss law in point form in all the three co-ordinate system. (08 Marks)
- b. State and explain Biot-Savart law and Ampere's circuital law. (08 Marks)
- c. Solve to find the current density, given : $\vec{H} = (3y - z)\vec{a}_x + 2x\vec{a}_y$ A/m. (04 Marks)

OR

- 6 a. State and prove the Stoke's theorem. (08 Marks)
- b. Verify the potential field, given satisfies the Laplace's equation, $V = r \cos \phi + z$. (06 Marks)
- c. Derive the equation for point form of Ampere's law. (06 Marks)

Module-4

- 7 a. Derive an expression for force between two conductors carrying current in opposite direction. (08 Marks)
- b. A current element 4 cm long is along y-axis with a current of 10 mA flowing in y-direction. Determine the force on the current element due to the magnetic field, if $\vec{H} = \frac{5}{\mu} \hat{a}_x$ A/M. (06 Marks)
- c. State and explain Lorentz force equation. (06 Marks)

OR

- 8 a. Derive the boundary conditions at the interface between two magnetic materials of different permeabilities. (08 Marks)
- b. Derive an expression for inductance of solenoid. (06 Marks)
- c. Given a ferrite material which will operate in a linear mode with $B = 0.05$ Tesla. Let $\mu_r = 50$. Calculate values of X_m , M and H . (06 Marks)

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- 9 a. State and explain Faraday's law. (06 Marks)
- b. What are the drawbacks of Ampere's law? Hence derive an expression for modified ampere's law. (08 Marks)
- c. Write Maxwell's equation in point form and integral form of time varying fields. (06 Marks)

OR

- 10 a. State and explain Poynting's theory with derivation $\vec{P} = \vec{E} \times \vec{H}$. (08 Marks)
- b. The magnetic field intensity of uniform plane wave in air is 20 A/m in \hat{a}_y direction. The wave is propagating in \hat{a}_z direction at an angular frequency of 2×10^9 rad/sec. Find
 (i) Phase shift constant.
 (ii) Wavelength.
 (iii) Frequency. (06 Marks)
- c. Briefly explain the skin effect in conductors. (06 Marks)
