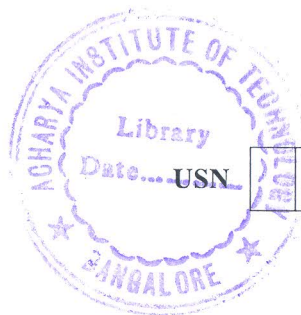


CBCS SCHEME



18EE45

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021 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 vectors
 $A = (6\bar{a}_x + 2\bar{a}_y + 6\bar{a}_z)$ and $B = (-2\bar{a}_x + 9\bar{a}_y - \bar{a}_z)$. Find dot and cross product between two vectors $\bar{A} + \bar{B}$. Are the vectors \perp to each other? (08 Marks)
- b. Obtain the relationship between rectangular and cylindrical co-ordinate system. (06 Marks)
- c. State and explain Coulomb's Law in vector form. (06 Marks)

OR

- 2 a. Find \bar{H} in Cartesian coordinates of the vector field $\bar{H} = 20\bar{a}_\rho - 10\bar{a}_\phi + 3\bar{a}_z$ at the point $P(x = 5, y = 2, z = -1)$. (06 Marks)
- b. State and derive Gauss theorem of electrostatics. (06 Marks)
- c. Two point charges 20nc and -20nc are situated at $Q_1(1, 0, 0)$ and $Q_2(0, 1, 0)$ in free space. Determine electric field intensity (\bar{E}) at $(0, 0, 1)$. (08 Marks)

Module-2

- 3 a. Show that electric field intensity is a negative potential gradient. (07 Marks)
- b. Derive an expression for current continuity equation in point form. (06 Marks)
- c. Derive boundary conditions between conductor and a dielectric medium (free space). (07 Marks)

OR

- 4 a. Determine the work done in carrying a charge $-2C$ from $(2, 1, -1)$ to $(8, 2, -1)$ in the electric field $E = yax + xayV/m$ along the straight lime path joining 2 points. (08 Marks)
- b. What is an electric dipole? Obtain the expression for \bar{E} due to an electric dipole. (05 Marks)
- c. Derive the expression for a potential at a point due to a point charge. (07 Marks)

Module-3

- 5 a. Derive Laplace equation and Poisson's equation from point form of Gauss law in all the three co-ordinate system. (06 Marks)
- b. Verify whether the potential fields given satisfies the Laplace's equation :
 $V = 2x^2 - 3y^2 + z^2$, $V = \rho^2 + z^2$. (07 Marks)
- c. State and explain uniqueness theorem. (07 Marks)

OR

- 6 a. State and explain Blot-Savart's Law and Ampere's circuit Law. (07 Marks)
- b. Derive an expression for magnetic field intensity at a point due to an infinite long straight conductor carrying a current I amps long Z -axis. (07 Marks)
- c. Determine the current density J if the magnetic field intensity.
 $\bar{H} = (3y - 2)\bar{a}_z + 2x\bar{a}_y$ is given. (06 Marks)

Module-4

- 7 a. Derive the expression for Lorentz force equation. (06 Marks)
- b. Given the field $\vec{B} = -2a\vec{x} + 3a\vec{y} + 4a\vec{z}$ m Tesla in free space. Find the vector force exerted on a straight wire carrying a current 12A in a direction given by \vec{a}_{AB} , A(1, 1, 1) and B(2, 1, 1) (07 Marks)
- c. Derive the boundary conditions at the interface between two magnetic materials of different permeabilities. (07 Marks)

OR

- 8 a. Derive the expression for magnetic force between two differential current elements. (07 Marks)
- b. Calculate the inductance of solenoid of 400 turns on a cylindrical tube of 10cm diameter and 50 cm length. Assume solenoid is in air. (07 Marks)
- c. Calculate the self inductance of 3.5m of co-axial cable with $a = 0.8\text{mm}$ and $b = 4\text{mm}$ filled with a material $\mu_r = 50$. (06 Marks)

Module-5

- 9 a. Using Faraday's Law, Derive an expression for transformer emf(varying field, path is stationary). (07 Marks)
- b. State Maxwell's equation in point and integral form for time varying fields from Faraday's Law. (06 Marks)
- c. The circular loop conductor at $Z = 0$ plane has a radius of 0.1m has a resistance of 5Ω , if $B = 0.2\sin 10^3 t a_z T$. Find the current in the coil. (07 Marks)

OR

- 10 a. Explain skin effect and obtain the expression to find skin depth. (07 Marks)
- b. State and explain poynting theorem. (07 Marks)
- c. A uniform plane wave with 10MHz frequency has average poynting vector $1\text{W}/\text{m}^2$, if the medium is perfect dielectric with $\mu_r = 2$, $\epsilon_r = 3$, find : i) velocity ii) wavelength iii) intrinsic impedance. (06 Marks)

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