CBCS SCHEME

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17EE45

Fourth Semester B.E. Degree Examination, June/July 2019
Electromagnetic Field Theory

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Obtain the relationship between rectangular and cylindrical co-ordinate system. **(06 Marks)**

b. Find dot product, cross product and unit vector of $\overline{A}$ for the following vectors :

$\overline{A} = 3\overline{ax} + 4\overline{ay} - 5\overline{az}$

$\overline{B} = -6\,\overline{ax} + 2\overline{ay} + 4\overline{az}$ **(08 Marks)**

c. State and explain Coulomb's law in vector form. **(06 Marks)**

OR

2 a. Give the Cartesian coordinates of the vector field $\overline{H} = 20\overline{a\rho} - 10\overline{aQ} + 3\overline{az}$ at the point P(x=5, y=2, z=−1). **(08 Marks)**

b. State the prove Gauss divergence theorem. **(06 Marks)**

c. If $\overline{D} = (2y^2z - 8xy)\overline{ax} + (4xyz - 4x^2)\overline{ay} + (2xy^2 - 4z)\overline{az}$. Determine div of D at P(1, −2, 3). **(06 Marks)**

Module-2

3 a. Prove that electric-field intensity is expressed as negative gradient of scalar potential. **(07 Marks)**

b. Derive current continuity equation with usual notation. **(06 Marks)**

c. Obtain the boundary conditions between Dielectric and Conductors. **(07 Marks)**

OR

4 a. Given V = $2x^2y - 5z$ at point P(−4, 3, 6) find potential, electrified intensity and volume charge density. **(05 Marks)**

b. Derive the expression for capacitor of a parallel plate capacitor containing 2 dielectrics . **(07 Marks)**

c. Obtain the expression for energy density in free space for electrostatic field. **(08 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. Prove the uniqueness of solution using uniqueness theorem. **(08 Marks)**

c. State and explain Biot-Savart's law and Ampere's circuit law. **(06 Marks)**

OR

6 a. Verify the potential field given satisfies the Laplace's equation $V = 2x^2 - 3y^2 + z^2$. **(05 Marks)**

b. Obtain the equation for curl$(\nabla \times \bar{H}) = \bar{J}$ by considering differential surface element and equations. **(08 Marks)**

c. If a field given $\bar{F} = (x + 2y + az)\bar{ax} + (bx - 3y - z)\bar{ay} + (4x + cy + 2z)\bar{az}$, find the constants a, b, c such that the field is irrotational. **(07 Marks)**

Module-4

7 a. State and explain Lorentz force equation. **(05 Marks)**

b. A point charge Q = 18nc has a velocity of 5×10^6m/s in the direction $\bar{au} = 0.6\bar{ax} + 0.75\bar{ay} + 0.3\bar{az}$. Calculate the magnitude of the force exacted on the charge by the field :

i) $\bar{E} = -3\bar{ax} + 4\bar{ay} + 6\bar{az}$ KV/m

ii) $\bar{B} = -3\bar{ax} + 4\bar{ay} + 6\bar{az}$ mT

iii) $\bar{B}$ and $\bar{E}$ together acting. **(08 Marks)**

c. Derive the boundary conditions at the interface between two magnetic materials of different permeabilites. **(07 Marks)**

OR

8 a. Derive the equation for magnetic force between two differential current elements. **(07 Marks)**

b. Derive the expression for the inductance of a solenoid and torroid. **(07 Marks)**

c. Consider an air core torroid with 500 turns cross sectional area of $6cm^2$ and mean radius of 15cm and carries current of 4amps. Find reluctance, $\bar{B}$, $\bar{H}$. **(06 Marks)**

Module-5

9 a. State and explain Faraday's law. **(05 Marks)**

b. List Maxwell's equations for time varying fields in integral form and point form. **(08 Marks)**

c. Explain skin depth and skin effect. Derive the expression for skin depth. **(07 Marks)**

OR

10 a. State and explain Pointing theorem with derivation $\bar{P} = \bar{E} \times \bar{H}$. **(07 Marks)**

b. Derive expression for displacement current density for time varying fields. **(07 Marks)**

c. A 300MHz uniform plane wave propagates through fresh water for which $\sigma = 0$, $\mu_r = 1$, $\epsilon_r = 78$. Calculate attenuation constant, phase constant, wavelength intrinsic impedance $(\alpha, \beta, \lambda, \eta)$. **(06 Marks)**

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