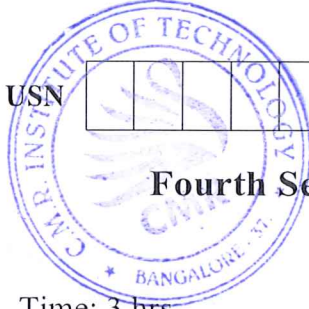


CBCS SCHEME



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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.

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 \vec{A} for the following vectors :
 $\vec{A} = 3\vec{ax} + 4\vec{ay} - 5\vec{az}$
 $\vec{B} = -6\vec{ax} + 2\vec{ay} + 4\vec{az}$ (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 $\vec{H} = 20\vec{ap} - 10\vec{aQ} + 3\vec{az}$ at the point $P(x=5, y=2, z=-1)$. (08 Marks)
- b. State the prove Gauss divergence theorem. (06 Marks)
- c. If $\vec{D} = (2y^2z - 8xy)\vec{ax} + (4xyz - 4x^2)\vec{ay} + (2xy^2 - 4z)\vec{az}$. 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 $\text{curl}(\nabla \times \bar{H}) = \bar{J}$ by considering differential surface element and equations. (08 Marks)
- c. If a field given $\bar{F} = (x + 2y + az)\bar{a}_x + (bx - 3y - z)\bar{a}_y + (4x + cy + 2z)\bar{a}_z$, 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 $Q = 18\text{nc}$ has a velocity of $5 \times 10^6\text{m/s}$ in the direction $\bar{a}_u = 0.6\bar{a}_x + 0.75\bar{a}_y + 0.3\bar{a}_z$. Calculate the magnitude of the force exacted on the charge by the field :
- i) $\bar{E} = -3\bar{a}_x + 4\bar{a}_y + 6\bar{a}_z$ KV/m
- ii) $\bar{B} = -3\bar{a}_x + 4\bar{a}_y + 6\bar{a}_z$ 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 (α , β , λ , η). (06 Marks)
