CBCS SCHEME

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17EC36

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Engineering Electromagnetics

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 complete form. **(06 Marks)**

b. Two particles having charges 2nc and 5nc are spaced 80cm apart. Determine the $\overline{E}$ at a point is situated at a distance of 0.5m from each of the two particles. Use $\varepsilon r = 5$. (Use Bakelite medium). **(06 Marks)**

c. Identical point charges of 3μc are located at the four corners of the square of 5cm side, find the magnitude of the force on any one charge? **(08 Marks)**

OR

2 a. Derive expression for E due to infinite line charge from first principle. **(08 Marks)**

b. Two uniform line charges of density 4n c/m and 6n c/m lie in x = 0 plane at y = +5m and – 6m respectively. Find E at $(4, 0, 5)^m$. **(06 Marks)**

c. Define E and D, Hence establish the relation between D and E. **(06 Marks)**

Module-2

3 a. State and prove Gauss divergence theorem. **(06 Marks)**

b. If $D = \frac{5r^2}{4}\hat{a}_r\ c/m^2$. (in spherical system) then evaluates both sides of the divergence theorem for the volume enclosed by r = 4m, and $\theta = \pi/4$ radians. **(08 Marks)**

c. Prove that $\rho_v = \nabla \cdot D$. **(06 Marks)**

OR

4 a. Establish relation $E = -\nabla v$ **(06 Marks)**

b. Electrical potential at an arbitrary point in free space is given as $V = (x+1)^2 + (y+2)^2 + (z+3)^2$ Volts at p(2, 1, 0). Find :

i) V ii) $\overline{E}$ iii) $|\overline{E}|$ iv) $|\overline{D}|$ v) ρ_v **(08 Marks)**

c. Derive continuity of current equation. **(06 Marks)**

Module-3

5 a. Derive Laplace and Poisson's equations and write Laplace Equation in all 3 co-ordinate systems. **(08 Marks)**

b. State and prove uniqueness theorem. **(07 Marks)**

c. Calculate the numerical values for V and ρ_v at P in free space if $V = \frac{4yz}{x^2+1}$ at P(1, 2,3). **(05 Marks)**

OR

6 a. An assembly of two concentric spherical shells is considered. The inner spherical shell is at a distance of 0.1m and is at a potential of 0 volts. The outer spherical shell is at a distance of 0.2m and at a potential of 100V. The medium between them is a free space. Find $\overline{E}$ and $\overline{D}$ using spherical co-ordinate system. **(06 Marks)**

b. State and prove Ampers circuital law. **(08 Marks)**

c. At a point P(x, y, z) the components of vector magnetic potential $\overline{A}$ are given as

$Ax = 4x + 3y + 2z$

$Ay = 5x + 6y + 3z$ and

$Az = 2x + 3y + 5z$

Determine $\overline{B}$ at point P and state its nature. **(06 Marks)**

Module-4

7 a. Derive an expression for the force on a differential current element placed in a magnetic field and deduce the result for straight conductor in a uniform magnetic field. **(08 Marks)**

b. A point charge Q = 18nc has a velocity of 5×10^6 m/s in the direction $\overline{a}_v = 0.6\hat{a}_x + 0.75\hat{a}_y + 0.3\hat{a}_z$.

Calculate the magnitude of the force exerted on the charge by the field

i) $\overline{E} = -3\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z$ K v/m

ii) $\overline{B} = -3\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z$ MT

iii) $\overline{B}$ & $\overline{E}$ acting together. **(06 Marks)**

c. State and explain Lorentz force equation. **(06 Marks)**

OR

8 a. Define : i) Magnetization ii) Permeability. **(04 Marks)**

b. If $\overline{B} = 0.05$ x $\hat{a}_y$ T in a material for which magnetic susceptibility $X_m = 2.5$. Find

i) μ_r ii) μ iii) $\overline{H}$ iv) $\overline{M}$ v) $\overline{J}$ vi) $\overline{J}_b$ **(08 Marks)**

c. Discuss the boundary conditions at the interface between two media of different permiabities? **(08 Marks)**

Module-5

9 a. Derive Maxwell's Equations in point form and Integral form for Time varying fields. **(08 Marks)**

b. For a lossy dielectric $\sigma = 5$ s/m, $\varepsilon_r = 1$ the electric filed intensity is E = 100 sin 10^{10} t. Find J_c and J_d and frequency at which both have Equal Magnitudes. **(04 Marks)**

c. Starting from Maxwell's Equation Derive the wave equation for a uniform plane wave travelling in free space. **(08 Marks)**

OR

10 a. State and prove Poynthing theorem. **(08 Marks)**

b. Deduce the expressions for α and β for a uniform plane wave propagation in good conducting medium. **(06 Marks)**

c. Wet Marshy soil is characterized by $\sigma = 10^{-2}$ s/m, $\varepsilon_r = 15$ and $\mu_r = 1$. At the frequencies 60Hz, 1 MHz, 100 MHz and 10 GHz indicate whether the soil may be considered a conducting dielectric or neither. **(06 Marks)**