

CBCS Scheme

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15EC36

Third Semester B.E. Degree Examination, June/July 2017 Engineering Electromagnetics

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. State vector form of Coloumb's law of force between two point charges and indicate the units of the quantities in the equation. (04 Marks)
- b. Let a point charge $Q_1 = 25\text{nC}$ be located at $A(4, -2, 7)$ and charge $Q_2 = 60\text{nC}$ be at $B(-3, 4, -2)$. Find \vec{E} at $C(1, 2, 3)$ and find the direction of \vec{E} . (10 Marks)
- c. Define electric field intensity due to number of point charge in a vector form. (02 Marks)

OR

- 2 a. Derive an expression for the electric field intensity due infinite line charge. (06 Marks)
- b. Define electric flux density. Find \vec{D} in Cartesian co-ordinate system at a point $p(6, 8, -10)$ due to a point charge of 40mC at the origin and a uniform line charge of $\rho_L = 40\mu\text{C/m}$ on the z-axis. (10 Marks)

Module-2

- 3 a. State and prove Gauss law as applied to an electric field. (06 Marks)
- b. Given that $\vec{A} = 30e^{-r}\hat{a}_r - 2z\hat{a}_z$, in the cylindrical co-ordinates. Evaluate both sides of the divergence theorem for the volume enclosed by $r = 2, z = 0$ and $z = 5$. (10 Marks)

OR

- 4 a. Define the electric scalar potential. Derive an expression for potential due to point charge. (06 Marks)
- b. A point charge of 6nC is located at the origin in free space find potential of point P if P is located at $(0.2, -0.4, 0.4)$ and i) $V = 0$ at infinity ii) $V = 0$ at $(1, 0, 0)$ iii) $V = 20\text{V}$ at $(-0.5, 1, -1)$. (10 Marks)

Module-3

- 5 a. Starting with point form of Gauss law deduce Poisson's and Laplace's equation. (03 Marks)
- b. State and Prove uniqueness theorem (05 Marks)
- c. Find V at $(2, 1, 3)$ for the field of
 - i) 2 co-axial conducting cylinders $V = 20\text{V}$ at $\rho = 3\text{m}$
 - ii) 2 concentric conducting spheres $V = 50\text{V}$ at $r = 3\text{m}$ and $V = 20\text{V}$ at $r = 5\text{m}$. (08 Marks)

OR

- 6 a. State and explain Biot - Savart's law. (04 Marks)
- b. Evaluate both sides of the Stoke's theorem for the field $\vec{H} = 6xy\hat{a}_x - 3y^2\hat{a}_y$, A/m and the rectangular path around the region, $2 \leq x \leq 5, -1 \leq y \leq 1, z = 0$. Let the positive direction of $d\vec{s}$ be \hat{a}_z . (08 Marks)

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- c. At a point p(x, y, z) the components of vector magnetic potential \vec{A} are given as $A_x = 4x + 3y + 2z$, $A_y = 5x + 6y + 3z$ and $A_z = 2x + 3y + 5z$. Determine \vec{B} at point P.

(04 Marks)

Module-4

- 7 a. A point charge of $Q = -1.2C$ has velocity $\vec{V} = (5\hat{a}_x + 2\hat{a}_y - 3\hat{a}_z)$ m/s. Find the magnitude of the force exerted on the charge if
- $\vec{E} = -18\hat{a}_x + 5\hat{a}_y - 10\hat{a}_z$, V/m
 - $\vec{B} = -4\hat{a}_x + 4\hat{a}_y + 3\hat{a}_z$, T
 - Both are present simultaneously.
- b. Derive an expression for the force on a differential current element placed in a magnetic field. (04 Marks)
- c. A conductor 4m long lies along the y-axis with a current of 10.0A in the \hat{a}_y direction. Find the force on the conductor if the field in the region is $\vec{B} = 0.005\hat{a}_x$, T. (04 Marks)

OR

- 8 a. If $\vec{B} = 0.05x\hat{a}_x$, T in a material for which $\chi_m = 2.5$. Find
- μ_r
 - μ
 - \vec{H}
 - \vec{M}
 - \vec{J}
 - \vec{J}_b
- b. Write a on magnetic circuits (04 Marks)
- c. Write a note on forces on magnetic materials. (04 Marks)

Module-5

- 9 a. Explain Displacement current density and conduction current density. (04 Marks)
- b. List Maxwell's equations for steady and time varying fields in
- Point form
 - Integral form.
- (06 Marks)
- c. Do the fields $\vec{E} = E_m \sin x \sin t \hat{a}_y$ and $\vec{H} = \frac{E_m}{\mu_0} \cos x \cos t \hat{a}_z$ satisfy Maxwell's equations? (06 Marks)

OR

- 10 a. What is Forward travelling wave and Backward travelling wave in free space? (02 Marks)
- b. A uniform plane wave in free space is given by $E_x = 200 \sqrt{30} \cdot e^{-j250z} \hat{a}_x$, V/m. Find β , w , f , λ , η , $|\vec{H}|$ (06 Marks)
- c. State and prove Poynting theorem (08 Marks)
