CBCS Scheme

USN | | | | | | | | | | | **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 $Q_1 = 25nC$ be located at A(4, −2, 7) and charge $Q_2 = 60nC$ 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 $\rho_L = 40\mu C/m$ 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 = 20V 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 = 20V at $\rho = 3m$

ii) 2 concentric conducting spheres V = 50V at r = 3m and V = 20V at r = 5m. **(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, $2 \le x \le 5, -1 \le y \le 1, z = 0$. Let the positive direction of $\vec{ds}$ be $\hat{a}_z$. **(08 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.

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

i) $\vec{E} = -18\hat{a}_x + 5\hat{a}_y - 10\hat{a}_z$ V/m

ii) $\vec{B} = -4\hat{a}_x + 4\hat{a}_y + 3\hat{a}_z$ T

iii) Both are present simultaneously. (08 Marks)

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 $\vec{B} = 0.05x\hat{a}_y T$ in a material for which $\chi_m = 2.5$. Find

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

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
i) Point form ii) Integral from. (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 $E_s = 200\,\underline{|30^\circ} \cdot e^{-j250z}\,\hat{a}_x$ V/m.
Find β, w, f, λ, η, $|\vec{H}|$ (06 Marks)

c. State and prove Poynting theorem (08 Marks)

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