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 ρ = 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)**

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 $\vec{H} = \frac{E_m}{\mu_o}\cos x \cos t\,\hat{a}_z$ 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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