CBCS SCHEME

USN | 1 | S | B | 1 | 7 | E | C | 0 | 4 | 4 | | 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)**

CBCS SCHEME

USN | 1 | S | B | 1 | 5 | E | C | 0 | 7 | 2 |

15EC36

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
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 and explain Coulomb's law. **(04 Marks)**

b. A charge Q_A = -20 μc is located A(– 6, 4, 7)$_m$ and Q_B = 50 μc at B(5, 8, –2)$_m$ in free space. Find the force exerted on Q_A by Q_B? **(05 Marks)**

c. Define electric field intensity and electric flux density. **(03 Marks)**

d. Calculate the total charge within the volume
$0 \le \rho \le 0.1$, $0 \le \phi \le \pi$, $2 \le z \le 4$, $\rho_v = \rho^2 z^2 \sin 0.6\phi$ **(04 Marks)**

OR

2 a. Obtain an expression for electric field due to infinite line charge. **(06 Marks)**

b. A charge of – 0.3μc is located at A(– 25, 30, 15)cm and a second charge of 0.5 μc is at B(–10, 8, 12)cm. Find E at the origin. **(06 Marks)**

c. A uniform line charge of 2 μc/m is located on the z-axis. Find E in rectangular coordinates at P(1, 2, 3) if the charge exists from $-\infty < z < \infty$. **(04 Marks)**

Module-2

3 a. State and prove Gauss law and derive first Maxwell's equations from it. **(05 Marks)**

b. Given a 60 μc point charge located at the origin. Find the total electric flux passing through the closed surface defined by ρ = 26 cm and z = ± 26 cm. **(04 Marks)**

c. State and prove the Divergence theorem. **(05 Marks)**

d. Given the electric flux density $D = 0.3r^2 \hat{a}_r$ nc/m^2 in free space. Find E at the point P(r = 2, θ = 25°, ϕ = 90°). **(02 Marks)**

OR

4 a. Prove that the work done in moving a charge in the electric field is

$$W = -Q \int_{\text{initial}}^{\text{final}} E.dl$$ **(06 Marks)**

b. Calculate the work done in moving a 4C charge from B(1, 0, 0) to A(0, 2, 0) along the path $y = 2 - 2x$, $\tau = 0$ in the field $E = (5x\, a_x + 5y\, a_y)$ V/m. **(05 Marks)**

c. Show that $\nabla \cdot J = -\frac{\partial \rho_v}{\partial t}$ with usual notations. **(05 Marks)**

Module-3

5 a. Starting from Gauss law, derive Poisson's and Laplace's equations. **(04 Marks)**

b. Calculate ρ_v at point P in free space, if $V = 5\rho^2 \cos 2\phi$ at P(3, π/3, 2) **(06 Marks)**

c. State uniqueness theorem. **(02 Marks)**

d. By using Laplace's equation, derive an expression for the capacitance of a parallel plate capacitor. **(04 Marks)**

OR

6 a. State and explain Biot-Savart's law. **(04 Marks)**

b. By using Ampere's law, derive an expression for $\bar{H}$, magnetic field intensity due to a coaxial cable. **(06 Marks)**

c. Evaluate both sides of Stokes theorem for the field, $H = (6ay\hat{a}_x - 3y^2a_y)$ 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 ds be a_z. **(06 Marks)**

Module-4

7 a. The field $B = (-2a_x + 3a_y + 4\hat{a}_z)$mT is present in free space. Find the vector force exerted on a straight wire carrying a current of 12A in the a_{AB} direction. Given A(1, 1, 1,) and B(2, 1, 1). **(04 Marks)**

b. Two differential current elements, $I_1\Delta L_1 = 3\times10^{-6}$ A-m at $P_1(1, 0, 0)$ and $I_2\Delta L_2 = 3\times10^{-6}(-0.5\hat{a}_x + 0.4\hat{a}_y + 0.3\hat{a}_z)$A-m at $P_2(2, 2, 2)$ are located in free space. Find the vector force exerted on $I_2\Delta L_2$ by $I_1\Delta L_1$. **(06 Marks)**

c. Find the magnetization in a magnetic material where

(i) $\mu = 1.8\times10^{-5}$ H/m and H = 120 A/m

(ii) $\mu_r = 22$, there are 8.3×10^{22} atoms/m and each atom has a dipole moment of 4.5×10^{-27} A/m^2.

(iii) B = 300 μT × χ_m = 15. **(06 Marks)**

OR

8 a. Derive the Magnetic Boundary Condition? **(06 Marks)**

b. Let the permittivity is 5 μH/m in the region 1 where $x < 0$ and 20 μH/m in the region 2 where $x > 0$, and if $H = (300a_x - 400a_y + 500\hat{a}_z)$ A/m and if there is a surface current density $K = (150\hat{a}_y - 200\hat{a}_z)$A/m at $x = 0$.

Find (i) $|H_{t_1}|$ (ii) $|H_{N_1}|$ (iii) $|H_{t_2}|$ (ii) $|H_{N_2}|$ **(06 Marks)**

c. Derive the expression for the energy density in a magnetic field? **(04 Marks)**

Module-5

9 a. State Faraday's laws of electromagnetic induction. Further derive Maxwell's equation from it. **(04 Marks)**

b. Find the amplitude of the displacement current density due to an automobile antenna where the magnetic field intensity of an FM signal is $H_x = 0.15\cos[3.12(3\times10^8t - y)]$ A/m. **(06 Marks)**

c. State Maxwell's equation in both Point form and in Integral form. **(06 Marks)**

OR

10 a. Derive the wave equation in one dimension for an EM wave travelling in free space. **(06 Marks)**

b. The electric field amplitude of the uniform plane wave in the a_z direction is 250 V/m. If $E = E_xa_x$ and $\omega = 1.00$ Mrad/s, find (i) the frequency (ii) the wavelength (iii) the period (iv) the amplitude of H. **(04 Marks)**

c. State and prove Poynting's theorem. **(06 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | |

15EC36

Third Semester B.E. Degree Examination, June/July 2018
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. Define electric field intensity and flux density and also establish the relationship between them. **(04 Marks)**

b. State and explain Coulomb's law of force between two print charges. **(06 Marks)**

c. Two uniform line charges of densities 4 nc/m and 6nc/m lying x = 0 plane at y = 5m and y = -6m respectively. Find electric field intensity at P(4, 0, 5)m. **(06 Marks)**

OR

2 a. Derive an expression for electric field intensity due to infinite line charge. **(08 Marks)**

b. A volume charge density $\rho_v = \frac{5k}{r}$, where $r \neq 0$, k = constant exists within a sphere of radius $\frac{a}{2}$. Determine the magnitude of point charge placed at origin which will produce the same electric field at $r = \frac{a}{2}$. **(08 Marks)**

Module-2

3 a. Derive the Maxwell's first equation in electrostatics. **(04 Marks)**

b. Derive the expression for continuity of current. **(06 Marks)**

c. Find the total charge in a volume defined by six planes for which $1 \le x \le 2$; $2 \le y \le 3$; $3 \le z \le 4$. If $\vec{D} = \left[4x\,\hat{a}_x + 3y^2\,\hat{a}_y + 2z^3\,\hat{a}_z\right]$ c/m^2. **(06 Marks)**

OR

4 a. Briefly explain Gauss's divergence theorem. **(06 Marks)**

b. Obtain an expression for the energy expanded in moving a point charge in an electric field. **(06 Marks)**

c. Let $V = \frac{\cos 2\phi}{r}$ in free space in cylindrical system. Find $\vec{E}$ at B(2, 30°, 1). **(04 Marks)**

Module-3

5 a. With the usual notations, deduce the Poisson's and Laplace's equation from the Maxwell's first equation. **(06 Marks)**

b. Determine whether or not the following vector represents a possible electric field. $\vec{E} = 5\cos z\,\hat{a}_z$ V/m. **(04 Marks)**

c. Prove that the line integral of magnetic field intensity $\vec{H}$ around a closed path is exactly equal to current 'I' enclosed by that path. **(06 Marks)**

OR

6 a. Solve Laplace's equation to determine the capacitance of a coaxial cable when the inner radius is 'a' and outer radius is 'b' respectively. **(08 Marks)**

b. State and explain 'stokes theorem'. **(04 Marks)**

c. Given the vector magnetic potential $\vec{A} = x^2 \hat{a}_x + 2yz\,\hat{a}_y + (-x^2)\hat{a}_z$. Find magnetic flux density. **(04 Marks)**

Module-4

7 a. Derive Lorentz force equation and mention the application of solution. **(05 Marks)**

b. A point charge 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 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. **(06 Marks)**

c. Briefly explain force between differential current elements. **(05 Marks)**

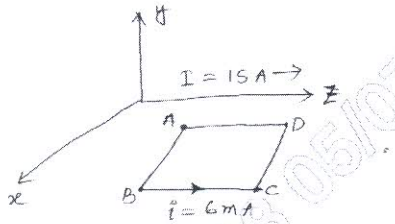
OR

8 a. Discuss the magnetic boundary condition at the interface between two different magnetic materials. **(05 Marks)**

b. Briefly explain potential energy and forces on magnetic materials. **(05 Marks)**

c. A rectangular loop of wire in free space joins A(1, 0, 1), B (3, 0, 1) to C(3, 0, 4) to D (1, 0, 4) to A. The wire carries a current of 6mA flowing in $\hat{a}_z$ direction from B to C. A filamentary current of 15A flows along the entire z-axis in the $\hat{a}_z$ direction as shown in Fig.Q.8(c). Find: i) Force on side BC ii) Force on side AB iii) Total force on loop. **(06 Marks)**

Fig.Q.8(c)



Module-5

9 a. State and explain Faraday's law in point and integral form. **(06 Marks)**

b. Derive Ampere's circuit law in point form and integral form suitable for Time-varying fields. **(07 Marks)**

c. Find the angular frequency at which the conduction current and displacement current are equal in medium with $\sigma = 5.6 \times 10^{-6}$ ℧/m and $\epsilon_r = 40$. **(03 Marks)**

OR

10 a. State and prove Poynting theorem. **(06 Marks)**

b. Briefly explain skin depth and skin effect. **(05 Marks)**

c. A 300MHz uniform plane wave propagation through fresh water for which $\sigma = 0$, $\mu_r = 1$ and $\epsilon_r = 78$. Calculate:

i) Attenuation constant

ii) Phase constant

iii) Wave length

iv) Intrinsic impedance. **(05 Marks)**

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SRI SAIRAM COLLEGE OF ENGINEERING

CBCS Scheme

USN 1 SB 16 EC 069

15EC36

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018
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 and explain Coulomb's law in vector form. **(05 Marks)**

b. Find the electric field $\overline{E}$ at origin, if the following charge distributions are present in free space:

i) Point charge 12 nc at P(2, 0, 6).

ii) Uniform line charge of linear charge density 3 nc/m at x = 2, y = 3.

iii) Uniform surface charge of density $P_s = 0.2$ nc/m^2 at x = 2. **(06 Marks)**

c. Define volume charge density. Also find the total charge within each of the indicated volumes.

i) $0 \le \rho \le 0.1,\ 0 \le \phi \le \pi,\ 2 \le z \le 4;\ \rho_v = \rho^2 z^2 \sin(0.6\phi)$

ii) Universe : $\rho_v = \dfrac{e^{-2r}}{r^2}$ **(05 Marks)**

OR

2 a. Define Electric flux and flux density. **(04 Marks)**

b. Given a 60 μC point charge located at the origin, find the total electric flux passing through:

i) That portion of the sphere γ = 26 cm bounded by $0 < \theta < \dfrac{\pi}{2}$ and $0 < \phi < \dfrac{\pi}{2}$.

ii) The closed surface defined by ρ = 26 cm and z = ±26 cm.

iii) The plane z = 26 cm. **(07 Marks)**

c. Derive the expression for $\overline{E}$ due to infinite line charge of charge density ρ_L (c/m). **(05 Marks)**

Module-2

3 a. State and prove Gauss law for point charge. **(05 Marks)**

b. State and prove divergence theorem. **(05 Marks)**

c. In each of the following parts, find value for div $\overline{D}$ at the point specified:

i) $\overline{D} = (2xyz - y^2)\overline{a}_x + (x^2z - 2xy)\overline{a}y + x^2y\overline{a}_z$ c/m^2 at P_A(2, 3, -1).

ii) $\overline{D} = 2\rho z^2 \sin^2\phi\overline{a}_\rho + \rho z^2 \sin 2\phi\overline{a}_\phi + 2\rho^2 z \sin^2\phi\overline{a}_z$ c/m^2 at P_B(ρ = 2, φ = 110°, z = -1). **(06 Marks)**

OR

4 a. Define potential difference and absolute potential. **(04 Marks)**

b. A point charge of 6 nc is located at 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 V at (-0.5, 1, -1) **(06 Marks)**

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

Module-3

5 a. Derive the expression for Poisson's and Laplace's equation. (05 Marks)

b. Two plates of parallel plate capacitors are separated by distance 'd' and maintained at potential zero and V_0 respectively. Assuming negligible fringing effect, determine potential at any point between the plates. (06 Marks)

c. State and prove uniqueness theorem. (05 Marks)

OR

6 a. State and explain Biot-Savart law. (06 Marks)

b. Find the magnetic flux density at the centre '0' of a square of sides equal to 5m and carrying 10 amperes of current. (06 Marks)

c. At a point p(x, y, z), the components of vector magnetic potential $\overline{A}$ are given as $A_x = 4x + 3y + 2z$, $A_y = 5x + 6y + 3z$ and $A_z = 2x + 3y + 5z$. Determine $\overline{B}$ at point P. (04 Marks)

Module-4

7 a. Derive Lorentz force equation. (05 Marks)

b. Derive an expression for the force on a differential current element placed in a magnetic field. (06 Marks)

c. A conductor 4m long lies along the y-axis with a current of 10 amps in the $\overline{a}_y$ direction. Find the force on the conductor if the field is $\overline{B} = 0.005\,\overline{a}_x$ Telsa. (05 Marks)

OR

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

b. Find the magnetization in a magnetic material where

i) $\mu = 1.8 \times 10^5$ (H/m) and 120 (A/m)

ii) $\mu_r = 22$, there are 8.3×10^{28} atoms/m^3 and each atom has a dipole moment of 4.5×10^{-27} (A/m^2) and

iii) B = 300 μT and $\chi_m = 15$. (06 Marks)

c. Discuss the boundary conditions at the interface between two media of different permeabilities. (06 Marks)

Module-5

9 a. State and explain Faraday's law of electromagnetic induction. (04 Marks)

b. Find the frequency at which conduction current density and displacement current are equal in a medium with $\sigma = 2 \times 10^{-4}$ ℧/m and $\varepsilon_r = 81$. (06 Marks)

c. List Maxwell's equations in point form and integral form. (06 Marks)

OR

10 a. Obtain solution of the wave equation for a uniform plane wave in free space. (06 Marks)

b. State and prove Poynting theorem. (06 Marks)

c. The depth of penetration in a certain conducting medium is 0.1 m and the frequency of the electromagnetic wave is 1.0 MHz. Find the conductivity of the conducting medium. (04 Marks)

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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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SRI SAIRAM COLLEGE OF ENGINEERING

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CBCS Scheme

USN | | | | | | | | | | |

15EC36

Third Semester B.E. Degree Examination, Dec.2016/Jan.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. Point charges of 50 nano-coulomb each are located at A(1, 0, 0), B(–1, 0, 0), C(0, 1, 0) and D(0, –1, 0) in free space. Find the total force on the charge at A. **(08 Marks)**

b. Define electric field intensity and electric flux density. **(04 Marks)**

c. A uniform line charge of infinite length with $\rho_L = 40$ nc/m lies along z axis. Find $\bar{E}$ at (–2, 2, 8) in air. **(04 Marks)**

OR

2 a. Derive the expression for electric field intensity due to infinite line charge. **(08 Marks)**

b. Two particles having charges 2nano-coulomb and 5nano-coulomb are spaced 80 cm apart. Determine the electric field intensity at point "A" situated at a distance of 0.5 m from each of the two particles. Assume dielectric constant of 5. **(08 Marks)**

Module-2

3 a. Evaluate both sides of the divergence theorem for the field $\bar{D} = 2xy\,\hat{a}_x + x^2\,\hat{a}_y c/m^2$ and the rectangular parallel piped formed by the planes x = 0 and 1, y = 0 and 2, and z = 0 and 3. **(08 Marks)**

b. Derive the expression for equation of continuity. **(06 Marks)**

c. Give the vector density $J = 10\rho^2 z\,\hat{a}_\rho - 4\rho\cos^2\phi\,\hat{a}_\rho$ mA/m^2. Determine the total current flowing outward through the circular band. $\rho = 3$, $0 < \phi < 2\pi$, $2 < z < 2.8$. **(02 Marks)**

OR

4 a. State and explain Gauss law in point form. **(05 Marks)**

b. Given the electric field $\bar{E} = 2x\,\hat{a}_x - 4y\,\hat{a}_y$ v/m. Find the work done in moving a point charge +2C from (2, 0, 0,) to (0, 0, 0) and then form (0, 0, 0) to (0, 2, 0). **(05 Marks)**

c. A potential field in free space is expressed as $V = \frac{60\sin\theta}{r^2}$ v. Find the electric flux density at the point (3, 60°, 25°) in spherical co-ordinates. **(06 Marks)**

Module-3

5 a. State and explain uniqueness theorem. **(08 Marks)**

b. Determine the magnetic field intensity $\bar{H}$ at point P(0.4, 0.3, 0), if the 8A current in a conductor inward from infinity to origin on the x axis and outward to infinity along y axis. **(08 Marks)**

OR

6 a. Find the potential and volume charge density at P(0.5, 1.5, 1)m in free space given the potential field V = 6ρϕZ volts. **(08 Marks)**

b. Explain the concepts of scalar and vector magnetic potential. **(08 Marks)**

Module-4

7 a. Derive an equation for the magnetic force between two differential current elements. **(06 Marks)**

b. Find the magnetization in a material where : i) $\mu = 1.8 \times 10^{-5}$ H/m and H = 120 A/m ii) $\mu_r = 22$. There are 8.3×10^{28} atom/m^3 and each atom has a dipole moment of 4.5×10^{-27} A/m^2. iii) B = 300 μT and $X_{on} = 15$. **(06 Marks)**

c. A conductor 4m long lies along the y axis with a current of 10A in the $\overline{ay}$ direction. Find the force on the conductor if the field in the region is $\overline{B} = 0.005\overline{ax}$ Tesla. **(04 Marks)**

OR

8 a. Find the expression for force on differential current element moving in a steady magnetic field. Deduce the result to a straight conductor in a uniform magnetic field. **(08 Marks)**

b. For region 1, $\mu_1 = 4\mu$H/m and for region 2, $\mu_2 = 6\mu$ H/m. The regions are separated by z = 0 plane. The surface current density at the boundary is $\overline{K} = 100\overline{ax}$ A/m. Find $\overline{B}_2$ if $\overline{B}_1 = 2\hat{a}x - 3\hat{a}y + \hat{a}z$ militesla for z > 0. **(08 Marks)**

Module-5

9 a. For the given medium $\varepsilon = 4 \times 10^{-9}$ F/m and σ = 0. Find 'K' so that the following pair of fields satisfy Maxwell's equation :

$\overline{E} = (20y - kt)\overline{ax}$ v/m

$\overline{H} = (y + 2\times10^6 t)\overline{az}$ A/m **(08 Marks)**

b. A plane wave of 16 GHz frequency and E = 10 v/m propagates through the body of salt water having constants ε = 100, $\mu_r = 1$ and σ = 100 S/m. Determine attenuation constant, phase shift, phase velocity and intrinsic impedance of the medium and depth of penetration. **(08 Marks)**

OR

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

b. Find the amplitude of displacement current density in the free space within a large power distribution transformer where $\overline{H} = 10^6 \cos(377t + 1.2566\times10^{-6} z)\hat{ay}$ A/m. **(05 Marks)**

c. The depth of penetration in a conducting medium is 0.1m and the frequency of the electromagnetic wave is 1 MHz. Find the conductivity of the conducting medium. **(03 Marks)**

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CBCS Scheme

USN | 1 | S | B | 1 | 5 | E | C | 0 | 3 | 4 | 15EC36

Third Semester B.E. Degree Examination, Dec.2016/Jan.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. Point charges of 50 nano-coulomb each are located at A(1, 0, 0), B(–1, 0, 0), C(0, 1, 0) and D(0, –1, 0) in free space. Find the total force on the charge at A. **(08 Marks)**

b. Define electric field intensity and electric flux density. **(04 Marks)**

c. A uniform line charge of infinite length with $\rho_L = 40$ nc/m lies along z axis. Find $\bar{E}$ at (–2, 2, 8) in air. **(04 Marks)**

OR

2 a. Derive the expression for electric field intensity due to infinite line charge. **(08 Marks)**

b. Two particles having charges 2nano-coulomb and 5nano-coulomb are spaced 80 cm apart. Determine the electric field intensity at point "A" situated at a distance of 0.5 m from each of the two particles. Assume dielectric constant of 5. **(08 Marks)**

Module-2

3 a. Evaluate both sides of the divergence theorem for the field $\bar{D} = 2xy\,\hat{a}_x + x^2\,\hat{a}_y c/m^2$ and the rectangular parallel piped formed by the planes x = 0 and 1, y = 0 and 2, and z = 0 and 3. **(08 Marks)**

b. Derive the expression for equation of continuity. **(06 Marks)**

c. Give the vector density $J = 10\rho^2 z\,\hat{a}_\rho - 4\rho\cos^2\phi\,\hat{a}_\rho$ mA/m^2. Determine the total current flowing outward through the circular band. $\rho = 3$, $0 < \phi < 2\pi$, $2 < z < 2.8$. **(02 Marks)**

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