CBCS SCHEME

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15EE45

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Electromagnetic Field Theory

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Given two vector combinations $\vec{A}+\vec{B}=2\vec{a_x}+3\vec{a_y}-3\vec{a_z}$ and $\vec{A}-\vec{B}=4\vec{a_x}+\vec{a_y}+\vec{a_z}$. Find

i) The value of $\vec{A}$ and $\vec{B}$ in vector form

ii) Cross product of $\vec{A}$ and $\vec{B}$

iii) Dot product of $\vec{A}$ and $\vec{B}$ **(06 Marks)**

b. Given the Rectangular components of vector $\vec{H}=20\vec{a_\rho}-10\vec{a_\phi}+3\vec{a_z}$ at point P(5, 2, −1) **(05 Marks)**

c. State and explain Coulomb's law in vector form. **(05 Marks)**

OR

2 a. State and explain Gauss law. Find electric field intensity at a distance 'r' from an infinite line charge using Gauss law. **(06 Marks)**

b. Given the electric flux density $\vec{D}=5\text{Sin}\,\theta\,\vec{a_\theta}+5\text{Sin}\,\phi\vec{a_\phi}$ at $P\left(0.5,\frac{\pi}{4},\frac{\pi}{4}\right)$. There exist spherical volume charge of radius 'a' with uniform charge density of ρ_v. Obtain electric field intensity as a function of radius r.verify Divergence theorem for r < a and r > a. **(08 Marks)**

c. State the relationship between rectangular and cylindrical corrdinates. **(02 Marks)**

Module-2

3 a. A charge of 10nc is located at $P_1(0, 0, 5)$ and another charge of −5nc at P_2 (0, 0, −5). Find the coordinate of point at which $\vec{E}$ is zero. **(06 Marks)**

b. Show that $\vec{E}$ is expressed as negative gradient of scalar potential. **(06 Marks)**

c. Calculate the numerical value of V and ρ_v in free space if $V=\frac{4yz}{x^2+1}$ at P(1, 2, 3). **(04 Marks)**

OR

4 a. Obtain the boundary condition between Dielectric and conductor. **(06 Marks)**

b. Derive current continuity Equation with usual notation. **(04 Marks)**

c. Find the Energy stored in free space for the region $2*10^{-3}\text{m} < r < 3*10^{-3}\text{m}$, $0<\theta<\frac{\pi}{2}, 0<\phi<\frac{\pi}{2}$. Given the potential field is $V=\frac{200}{r}$ volts. **(06 Marks)**

Module-3

5 a. Starting form point from of Gauss law derive Laplace equation and Poisson's equation. Also derive uniqueness theorem. **(08 Marks)**

b. Determine whether the given potential field satisfy Laplace equation $V = r \cos\phi + z$. **(02 Marks)**

c. Assume the space between inner and outer conductors of co-axial cylindrical structure is filled with electron cloud having volume charge density $\rho_v = \dfrac{A}{r}$ for $a < r < b$, where a and b are radii of inner and outer conductor. The inner conductor is maintained at a potential of V_0 and outer conductor at ground. Determine the potential distribution in the region $a < r < b$. **(06 Marks)**

OR

6 a. Find magnetic field Intensity at point P for the circuit shown in Fig Q6(a). **(06 Marks)**

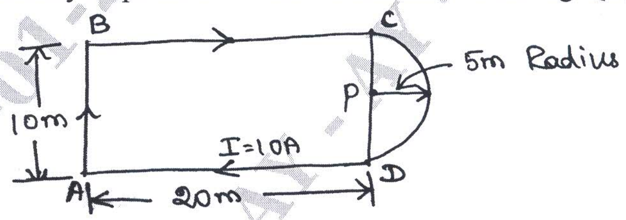

Fig Q6(a)

b. Distinguish Scalar Magnetic Potential and vector magnetic potential. Also prove that $A = \dfrac{\mu_0}{4\pi}\int_{vol}\dfrac{J}{r}\cdot dv$ **(06 Marks)**

c. State Biot Savart's law and Ampere's circuital law. **(04 Marks)**

Module-4

7 a. Derive an expression for force between two parallel conductors carrying a current of 'I' amps in opposite direction. **(07 Marks)**

b. Current flowing in conductor A and B are 500A and 800A respectively. Net force acting on conductor B is 2N/m. Find current in conductor C and also its direction. Refer the below Figure. [Fig Q7(b)]. **(06 Marks)**

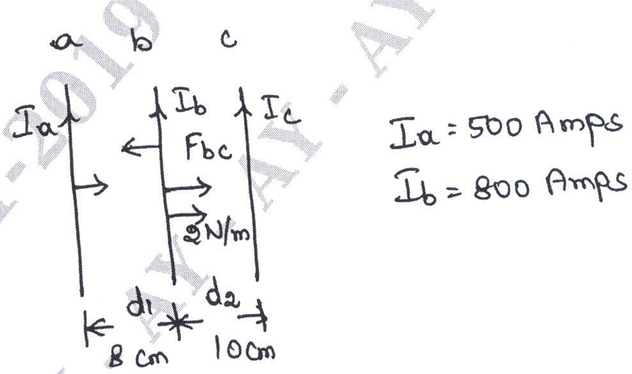

Fig Q7(b)

c. Obtain the Relation between J and ρ_v. **(03 Marks)**

OR

8 a. Obtain magnetic boundary condition if the boundary carries zero surface current. **(08 Marks)**

b. With neat sketch obtain and derive an expression for inductance of a co-axial cable. **(08 Marks)**

Module-5

9 a. List Maxwell's Equation for Time varying field in point form and Integral form. **(06 Marks)**

b. Starting from Ampere's circuital law derive and expression for Displacement current density for time varying fields. **(06 Marks)**

c. A conductor carries a steady current of "I" amps. The components of current density vector $\vec{J}_x = 2ax$ and $\vec{J}_y = 2ay$. Find the third component $\vec{J}_z$. Derive any relation used. **(04 Marks)**

OR

10 a. A short vertical antenna erected on the surface of perfectly conducting earth produces effective field strength $E_{eff} = 100 \sin\theta$ mV/m at points at a distance of 1 mile from the antenna. Compute the poynting vector and total power radiated. **(08 Marks)**

b. A conductor of circular cross section of radius 'a' m and length 'ℓ' m carrying a current of I amps of conductivity σ. Find power loss in the conductor over the surface of cylindrical conductor carrying current of 'I' amps and show that it is equal to power loss in the conductor. **(08 Marks)**

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