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10EE44

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
Field Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***

PART – A

1 a. State and explain Coulomb's law in vector form. **(06 Marks)**

b. Derive an expression for electric field Intensity due to a finite length of wire kept along x-axis. **(08 Marks)**

c. Find electric flux density at P(6, 8, -10), caused by
   i) A point charge of 30mc at the origin.
   ii) An uniform line charge $\rho_l = 40\mu c/m$ along z-axis.
   iii) The uniform surface charge density $\rho_s = 57.2\mu c/m^2$ on the plane x = 9m. **(06 Marks)**

2 a. Find electric field intensity between the concentric conducting cylindrical capacitor using Gauss law (the radii are a and b respectively) and b > a. **(06 Marks)**

b. A vector field if given by $\vec{E} = -8xy\hat{a}_x - 4x^2\hat{a}_y + \hat{a}_z \, v/m$ the charge of 6c is to be moved from B(1, 8, 5) to A(2, 18, 6).
   Find the work done in each of the following case:
   i) The path is selected as $y = 3x^2 + z, z = x + 4$
   ii) Straight line from B to A. **(06 Marks)**

c. Derive an expression for normal component and tangential component of D and E in dielectric-dielectric interface. **(08 Marks)**

3 a. Given the potential field $V = (A\rho^4 + B\rho^{-4})\sin 4\phi$ i) Show that $\nabla^2 V = 0$ ii) Select A and B so that V = 100V and $|\vec{E}| = 500V/m$ at $P(\rho = 1, \phi = 22.5°, z = 2)$. **(08 Marks)**

b. State and discuss Uniqueness theorem. **(06 Marks)**

c. Find the energy stored in a system of three equal point charge of 2ηc arranged in a line with a 0.5m separation between them. **(06 Marks)**

4 a. State Biot Savart's law. Derive an expression for magnetic flux density at a given point due to a current carrying element of finite length. **(06 Marks)**

b. Find the value of magnetic flux density at point 'P' for the current circuit shown in Fig.Q.4(b). **(06 Marks)**

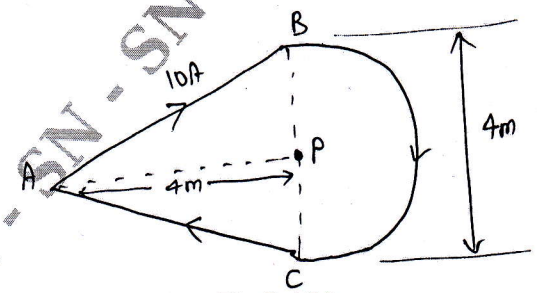

Fig.Q.4(b)

c. Derive an expression for magnetic field intensity both inside and outside a conductor of radius 'a' meter. The conductor carries a current of I Amps. Sketch the field. **(08 Marks)**

PART – B

5 a. Determine the force between two parallel conductors carrying a current of 'I' Amp in opposite direction. **(08 Marks)**

b. A coil of 500 turns it wound on a closed iron ring of mean radius 10cm and cross sectional area of $3cm^2$. Find the self inductance of the winding if the relative permeability of iron is 800. If a current of 10A if passed in a wire, find the energy stored. **(05 Marks)**

c. Derive an expression for magnetic energy density applied to magneto statics. **(07 Marks)**

6 a. A 3 turn loop with $0.5m^2$ area situated in air has a uniform magnetic field normal to the plane of the loop. If the flux density changes 5mT/sec, what is the emf appearing at the terminals of the loop. If the emf at the loop terminals if 100mv, what if the rate of change of magnetic field? **(04 Marks)**

b. List Maxwell's equation in differential and integral form applied to both electric and magnetic fields. Also determine the value of 'K' in the following pair of fields in free space such that they satisfy the Maxwell's equation $\vec{D} = 5x\hat{a}_x - 2y\hat{a}_y + kz\hat{a}_z\ \mu c/m^2$ and $\vec{B} = 2\hat{a}_y$ mT. **(08 Marks)**

c. Derive an expression for retarded electric scalar potential and retarded vector magnetic potential. **(08 Marks)**

7 a. State and explain Poynting's theorem. **(10 Marks)**

b. A wave propagating in a lossless dielectric has a component

$\vec{E} = 500\cos(10^7 t - \beta z)\hat{a}_x$ v/m and

$\vec{H} = 1.1\cos(10^7 t - \beta z)\hat{a}_y$ A/m.

If the wave is travelling at v = 0.5C,

find: i) μ_r ii) ε_r iii) β iv) λ v) z or η **(10 Marks)**

8 Write short notes on:

a. Reflection of uniform plane

b. Skin depth and its significance

c. Standing wave ratio

d. Solution for wave equation in a medium where $\sigma \neq 0$. **(20 Marks)**

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