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10EE44

Fourth Semester B.E. Degree Examination, June/July 2019

Field Theory

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. State and explain Coulamb's law. **(06 Marks)**

b. State Gauss' law. Obtain an expression for electric field intensity 'E' due an infinite sheet of charge using Gauss' law. **(08 Marks)**

c. Given that $\vec{D} = 2xya\hat{x} + x^2a\hat{y}$ c/m^2. Evaluate both sides of divergence theorem for the surface defined by $0 \le x \le 1; 0 \le y \le 2; 0 \le z \le 3$. **(06 Marks)**

2 a. Show that electric field intensity 'E' as the negative gradient of potential (V). **(06 Marks)**

b. Obtain continuity equation, derive its point form. **(06 Marks)**

c. A point charge of 1.6 nc is located at the origin in free space. Find the potential at r = 0.7 m if (i) the zero reference is at infinity (ii) the zero reference is at r = 0.5 m. **(08 Marks)**

3 a. Derive Laplace and Poisson's equations and write down the equations in all coordinate systems. **(06 Marks)**

b. Using Laplace equation, determine the distribution of potential and electric field intensity between two spherical conductors separated by a dielectric. The inner conductor is having a potential of V_o while the outer conductor is grounded. **(07 Marks)**

c. Let $V = \frac{\cos 2\phi}{\rho}$ in free space, find the volume charge density at point A(ρ = 0.5, $\phi = 60°$, z = 1). **(07 Marks)**

4 a. State and prove Stoke's theorem. **(06 Marks)**

b. Given that $B = 2.5\sin\left[\frac{\pi x}{z}\right]^{e^{-2y}} a\hat{z}$ Wb/m^2. Find the total flux (magnetic) crossing a strip $z = 0, y \ge 0, 0 \le x \le 2$m. **(07 Marks)**

c. Write a note on scalar and vector magnetic potentials. **(07 Marks)**

PART – B

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

b. State and prove the boundary conditions at the interface between two magnetic media of different permeabilities placed in a magnetic field. **(07 Marks)**

c. Find the magnetic field intensity at point P for the given piece of conductor. [Refer Fig.Q5(c)]

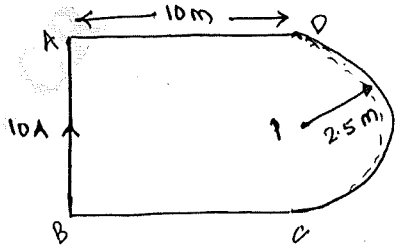

Fig.Q5(c) **(07 Marks)**

6 a. Differentiate between motional emf and transformer induced emf. **(06 Marks)**

b. Write a note on retarded potential. **(06 Marks)**

c. Determine the value of K such that the followings pairs of fields satisfy Maxwell's equation where $\sigma = 0$, $\rho_v = 0$.

$\vec{E} = (Kx - 100t)a\hat{y}$ V/m $\quad\quad$ $\vec{H} = (x + 20t)a\hat{z}$ A/m

$\mu = 0.25$ H/m $\quad\quad$ $\epsilon = 0.01$ F/m **(08 Marks)**

7 a. State and explain Poynting's theorem. Explain each term in Poynting equation. **(08 Marks)**

b. Explain propagation of wave in good dielectric medium. **(07 Marks)**

c. A 400 MHz uniform plane wave travelling in water for which $\sigma = 0$; $\mu_r = 1$ and $\epsilon_r = 80$. Calculate:

i) Attenuation constant
ii) Phase constant
iii) Wave length
iv) Intrinsic impedance **(05 Marks)**

8 a. What is standing wave? Define SWR. What is its relation with reflection coefficient? **(06 Marks)**

b. Find the value of standing wave ratio when reflection coefficient is $\pm 1/2$. **(06 Marks)**

c. A 1 MHz uniform plane wave with a power density of 1.28 MW/m^2 is normally incident on to fresh water lake having $\epsilon_r = 78$, $\mu_r = 1$. Determine the fraction of the incident power that is: (i) Reflected (ii) Transmitted **(08 Marks)**

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