CBCS SCHEME

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17EC36

Third Semester B.E. Degree Examination, Jan./Feb. 2021
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 vector form. **(04 Marks)**

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

c. Let a point charge $Q_1 = 25nc$ be located at A(4, –2, 7) and a charge $Q_2 = 60nc$ be at B(–3, 4, –2). Find $\vec{E}$ at C(1, 2, 3). Also find the direction of the electric field. Given $\epsilon_0 = 8.854 \times 10^{-12} F/M$. **(08 Marks**

OR

2 a. Define electric field intensity and flux density also derive an expression for electric field intensity $\vec{E}$ at a point due to many charges. **(07 Marks)**

b. Point charges of 50nc each are located at A(1, 0, 0), B(–1, 0, 0), C(0, 1, 0) and D(0, –1, 0)m find the total force on the charge at A and also find $\vec{E}$ at A. **(08 Marks)**

c. A uniform line charge of infinite length with $P_L = 40nc/m$, lies along the Z-axis. Find $\vec{E}$ at (–2, 2, 8) in air. **(05 Marks)**

Module-2

3 a. State and prove Gauss Law for point charge. **(06 Marks)**

b. Define potential difference and absolute potential. **(04 Marks)**

c. In the given relation $D = 4xy\hat{a}_x + 2(x^2 + y^2)\hat{a}_y + 4yz\hat{a}_z \, c/m^2$. Evaluate both sides of the divergence theorem and find the charge enclosed within the rectangular parallelpiped $(0 \le x \le 2)$, $(0 \le y \le 3)$ and $(0 \le z \le 5)$m. **(10 Marks)**

OR

4 a. State and prove divergence theorem. **(04 Marks)**

b. Derive point form of continuity equation for current. **(08 Marks)**

c. A point charge of 6nc 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 = 20V at (–0.5, 1, –1). **(08 Marks)**

Module-3

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

b. By applying Laplace equation find the expression for capacitance between the two concentric spheres. Make suitable assumptions. **(12 Marks)**

OR

6 a. Derive the expressions for Poisson's and Laplace's equation. **(04 Marks)**

b. State and explain Biot – Savart Law. **(06 Marks)**

c. Given the potential field $V = [Ar^4 + Br^{-4}]\sin 4\phi$:

i) Show that $\nabla^2 V = 0$

ii) Find A and B such that V = 10V and $\vec{E} = 500$V/m at P(r = 1, $\phi = 22.5°$, z = 2). **(10 Marks)**

Module-4

7 a. Derive an expression for magnetic forces on :

i) Moving point charge and

ii) Differential current element. **(10 Marks)**

b. Two differential current elements,

$I_1 \Delta \vec{L}_1 = 10^{-5}\,\hat{a}_2$ A.M at $P_1(1, 0, 0)$ and

$I_2 \Delta \vec{L}_2 = 10^{-5}(0.6\hat{a}_x - 2\hat{a}_y + 3\hat{a}_2)$ A.M at $P_2(-1, 0, 0)$

are located in free space. Find vector force exerted on $I_2 \Delta \vec{L}_2 = I_1 \Delta \vec{L}_1$. **(10 Marks)**

OR

8 a. Drive the magnetic boundary conditions at the interface between the two different magnetic materials. Discuss the conditions. **(10 Marks)**

b. A sq. loop carrying 2mA current is placed in the field of an infinite filament carrying current of 15Amp as shown in Fig.Q8(b). Find the force exerted on the sq loop.

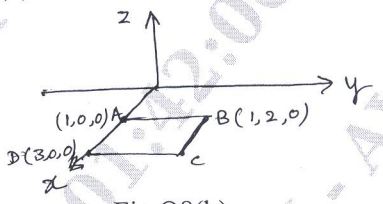

Fig.Q8(b). **(10 Marks)**

Module-5

9 a. Write a Maxwell's equations in point form and integral form. **(06 Marks)**

b. A uniform plane wave with an intensity of electric field equal to 1volt/m is travelling in free space. Find the magnitude of the associated magnetic field. **(04 Marks)**

c. State and explain pointing theorem. **(10 Marks**

OR

10 a. State and explain Faraday's Law of electromagnetic induction. **(04 Marks)**

b. Starting from Maxwell's equation obtain the general wave equations in electric magnetic fields. **(08 Marks)**

c. A UPW with 10MHz frequency has average pointing vector $1 W/m^2$ if the medium is perfect dielectric with $\mu_r = 2$, and $\epsilon_r = 3$, $\mu_0 = 4\pi \times 10^{-7}$H/m, $\epsilon_0 = 8.854 \times 10^{-12}$F/m ;

Find :

i) Velocity

ii) Wavelength

iii) Intrinsic impedance

iv) rms value of electric field. **(08 Marks)**

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