

# CBCS SCHEME

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  $Q_1 = 25\text{nc}$  be located at  $A(4, -2, 7)$  and a charge  $Q_2 = 60\text{nc}$  be at  $B(-3, 4, -2)$ . Find  $\vec{E}$  at  $C(1, 2, 3)$ . Also find the direction of the electric field. Given  $\epsilon_0 = 8.854 \times 10^{-12}\text{F/M}$ . (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  $50\text{nc}$  each are located at  $A(1, 0, 0)$ ,  $B(-1, 0, 0)$ ,  $C(0, 1, 0)$  and  $D(0, -1, 0)$  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  $P_L = 40\text{nc/m}$ , 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  $D = 4xy\hat{a}_x + 2(x^2 + y^2)\hat{a}_y + 4yz\hat{a}_z \text{ c/m}^2$ . Evaluate both sides of the divergence theorem and find the charge enclosed within the rectangular parallelepiped  $(0 \leq x \leq 2)$ ,  $(0 \leq y \leq 3)$  and  $(0 \leq z \leq 5)\text{m}$ . (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  $6\text{nc}$  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)  $V = 20\text{V}$  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)

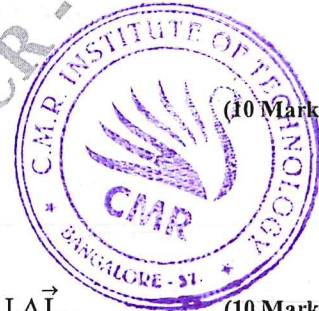
Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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  $\vec{E} = 500V/m$  at  $P(r = 1, \phi = 22.5^\circ, z = 2)$ . (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,  
 $I_1 \Delta \vec{L}_1 = 10^{-5} \hat{a}_z$  A.M at  $P_1(1, 0, 0)$  and  
 $I_2 \Delta \vec{L}_2 = 10^{-5} (0.6 \hat{a}_x - 2 \hat{a}_y + 3 \hat{a}_z)$  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.

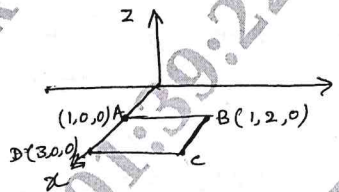


Fig.Q8(b).

(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 1 volt/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  $1W/m^2$  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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