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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech III Semester End Examinations (Supplementary) - February, 2018

Regulation: IARE – R16

ELECTROMAGNETIC FIELD THEORY

(Electrical and Electronics Engineering)

Time: 3 Hours

Max Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT – I

1. (a) Evaluate electric field E due to an infinite sheet of charge and obtain Laplace's equation. [7M]
- (b) Find E at the origin if the following charge distributions are present in free space [7M]
 - i. point charge, 12nC at $P(2, 0, 6)$;
 - ii. uniform line charge density, 3nC/m at $x = -2, y = 3$;
 - iii. uniform surface charge density, 0.2nC/m^2 at $x = 2$
2. (a) Planes $x=2$ and $y=3$ respectively carry charges 10 nC/m^2 and 15 nC/m^2 . If the line $x=0, Z=2$ carries charge $10\pi\text{ nC/m}$. Calculate E at $(1,1,-1)$ due to the 3 charge distributions. [7M]
- (b) Obtain the electric field at any point due to an infinite line charge. Verify the result using Gauss's law. [7M]

UNIT – II

3. (a) Find the capacitance of parallel plate capacitor. Given $V=0$ at $x=0$; $V=V_0$ at $x=d$. [7M]
- (b) A charge distribution with spherical symmetry has density [7M]

$$\rho_v = (\rho_0 r) / R \quad 0 \leq r \leq R$$

$$= 0 \quad r > R$$
 Determine "E" every where.
4. (a) Differentiate between conductor and dielectric. Obtain conductor-dielectric boundary conditions. [7M]
- (b) Two extensive homogenous isotropic dielectrics meet on plane $Z = 0$. For $Z > 0$, $\epsilon_{r1} = 4$ and for $Z < 0$, $\epsilon_{r2} = 3$. A uniform electric field $E_1 = 5U_x - 2U_y + 3U_z\text{ kV/m}$ exists for $Z \geq 0$. Find [7M]
 - i. E_2 for $Z \geq 0$
 - ii. The angles E_1 and E_3 make with the interface.
 - iii. Energy densities (J/m^3) in both dielectrics

UNIT – III

5. (a) Explain the relation between Magnetic Flux, Magnetic Flux Density and Magnetic Field Intensity. [7M]
- (b) A circular loop located on $X^2 + Y^2 = 9, Z = 0$, carries a direct current of 10 Amps along U_O . Find H at (0,0,4) and (0,0,-4). [7M]
6. (a) Explain Amperes circuital law and mention its applications. [7M]
- (b) A Solenoid of length “l” and radius “a” consists of “N” turns of wire carrying current “I”. Show that at point “P” along its axis $H = \frac{nI}{2}(\cos \theta_2 - \cos \theta_1)U_z$ where $n = \frac{N}{l}$, θ_1, θ_2 are the angles subtended at P by the end turns. Also show that if $l \gg a$ at the centre of the solenoid $H=nI U_z$. [7M]

UNIT – IV

7. (a) Find the torque vector on a square loop having corners (-2,-2,0), (2,-2,0), (2,2,0) and (-2,2,0) about the origin by $\mathbf{B} = 0.6\mathbf{a}_x - 0.4\mathbf{a}_y$ T when a current of 0.5A is flowing through the loop. [7M]
- (b) Explain the concept of vector magnetic potential. [7M]
8. (a) Describe about forces due to magnetic fields and derive the expression of torque due to magnetic dipoles. [7M]
- (b) Determine the Magnetic moment of an electric circuit formed by the triangular loop shown in Figure 1. [7M]

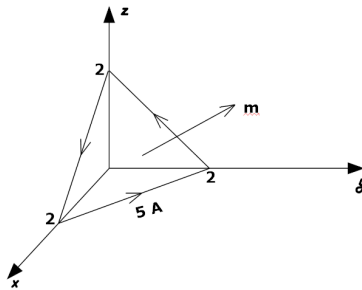


Figure 1

UNIT – V

9. (a) Derive Maxwell’s equation from Ampere’s law and write the applications of ampere’s circuital law. [7M]
- (b) The magnetic circuit in the below Figure 2 has a uniform cross-section of $10^{-3}m^2$. If the circuit is energized by a current $i_1 = 3 \sin 100\pi t$ Amperes in the coil of $N_1=200$ TURNS. Find the emf induced in the coil of $N_2=100$ TURNS. Assume that $\mu=500 \mu_0$ [7M]

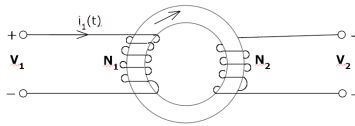


Figure 2

10. (a) Write short notes on [7M]
 i) FDM
 ii) FEM

- (b) The loop shown in Figure 3 is inside a uniform magnetic field $B = 50U_x \frac{mWb}{m^2}$. If side DC of the loop cuts the flux lines at frequency of 50Hz and the loop lies in yz-plane at time t=0. Find induced EMF at t=1ms. [7M]

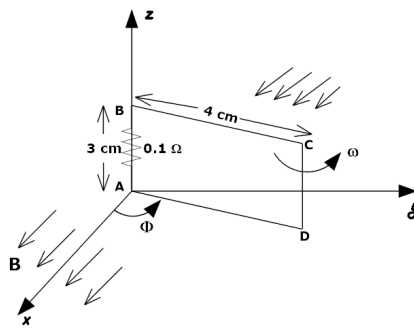


Figure 3

