

(Library) Electromagnetic Wave Theory

Con-2410-07.

ND-9389

(REVISED COURSE)

(3 Hours)

[Total Marks : 100

- N.B.** (1) Question No. 1 is **compulsory**.
 (2) Attempt any **four** questions out of remaining **six** questions.
 (3) Assume any suitable data if **necessary**.
 (4) **Figures** to the **right** indicate **full** marks.

1. Attempt any **four** of the following :—

20

- (a) Prove that the curl of the gradient of a scalar function is zero.
 (b) State the defining conditions of special gaussian surface.
 (c) State and explain Amperes circuital law.
 (d) Prove that a static electric field is irrotational and the static magnetic field is solenoidal.
 (e) Show that the electrostatic energy stored in a parallel plate capacitor is given by $\frac{1}{2} cv^2$.

2. (a) Derive an expression for the Electric field Intensity due to an infinite sheet charge. 10
 (b) Charge lies in the $z = -3$ m plane in the form of a square sheet defined by $-2 \leq x \leq 2$ m, $-2 \leq y \leq 2$ m. with charge density $\rho_s = 2(x^2 + y^2 + 9)^{3/2}$ nc/m². Find E at the origin. 10

3. (a) Given that $D = \left(\frac{10x^3}{3}\right) \bar{a}_x$ c/m², evaluate both sides of the divergence theorem for the volume of cube, 2 m on an edge, centered at the origin and with edges parallel to the axes. 10

- (b) For a line charge $\rho_L = \left(\frac{10^{-9}}{2}\right)$ c/m on the Z - axis find V_{AB} where A is $(2m, \frac{\pi}{2}, 0)$ and B is $(4m, \pi, 5m)$. 10

4. (a) Find the capacitance of a co-axial conductor of length l , where inner and outer radii are γ_1 of γ_2 respectively. 10

- (b) If $V = \frac{60 \sin \theta}{r^2}$ volts in free space and point P is located at $r = 3$ m, $\theta = 60^\circ$ and $\phi = 25^\circ$, find 10

(i) V at P (ii) \bar{E} at P (iii) $\frac{dy}{dN}$ at P (iv) \hat{a}_n at P (v) ρ_v at P.

5. (a) Using Biot Savart law find the magnetic field intensity at any pt. P due to a finite length conductor placed along Z-axis. 10

- (b) Evaluate both the sides of Stoke's theorem for the portion of the sphere specified by $r = 4$ m, $0 \leq \theta \leq 0.1 \pi$, $0 \leq \phi \leq 0.3 \pi$. Given $\bar{H} = 6r \sin \phi \bar{a}_r + 18r \sin \theta \cos \phi \bar{a}_\phi$. 10

6. (a) State and explain Maxwell equation for time-varying fields. 10

- (b) If $v = v_m \sin wt$ is the voltage applied to a capacitor and I is the current flowing through it, then show that the displacement current through the capacitor is equal to the conduction current I . 10

7. (a) Define Poynting vector. Obtain the integral form of the Poynting theorem and explain each of the terms. **10**
- (b) A lossy dielectric has $\mu_r = 1$, $\epsilon_r = 50$ and $\sigma = 20$ mho/s at 15.9 MHz, electromagnetic wave propagating through this medium. Find attenuation constant α , phase constant β , velocity of propagation and intrinsic impedance of the medium. **10**