S. E. (EXTC) Sem IV (R)

Con. 5828–09. (REVISED COURSE) SP–7850

Electromagnetic Wave Theory

(3 Hours) [Total Marks : 100

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31/12/09

2.30 to 5.30 p.m.

N.B. : (1) Question No. **1** is **compulsory**,
(2) Attempt any **four** from remaining **six**.
(3) Assume any **suitable** data if **required**.
(4) **Figures** to **right** indicates **full** marks.

1. Solve any **four** :– **20**

   (a) Convert $P\left(10, \frac{\pi}{6}, \frac{\pi}{3}\right)$ in cylindrical.

   (b) State and prove Gauss's law.

   (c) What is energy density in electrostatic field write its formula.

   (d) Show that energy store in parallel plate capacitor is $\frac{1}{2}CV^2$.

   (e) State and explain Amp. ckt law.

2. (a) It is required to hold 3 equal point charge of +Q each in equilibrium at the corner of an equilateral triangle. Calculate the point charge which will do this if placed at the centre of a triangle. **10**

   (b) A charge density $e_s = 0{\cdot}5$ nc/m^2 covers the infinite plane $-x + 3y - 6z - 6$ m. Find electric field intensity on the side containing the origin. **10**

3. (a) Given that $D = 30e\,\hat{a}_r^{-r/b} - 2\frac{z}{b}\hat{a}_z\,(c/m^2)$ in cylindrical co-ordinates, find the outward flux crossing the right circular cylinder described by r = 2b, z = 0 and z = 5b (m). **10**

   (b) Find the work done in moving a point charge Q = 10 μC from origin to the point $\left(3m, \frac{\pi}{4}, \frac{\pi}{2}\right)$ in spherical co-ordinates. The equation of field is **10**

   $$E = 10r\hat{a}_r + \frac{5}{r\sin\theta}\cdot\hat{a}_\phi\ (v/m).$$

4. (a) A total charge of $\frac{40}{3}$ nc is uniformly distributed over a circular ring of rai 2 m placed on z = 0 plane with center at origin. Find electric potential at (0, ϕ, 5). **10**

   (b) Derive the equation of potential interms of dipole moment. **10**

5. (a) Write short note on scalar and vector magnetic potential. **10**

   (b) State uniqueness theorem and give its proof. **10**

6. (a) Define Poynting vector. Obtain integral form of Poynting theorem and explain each term. **10**

(b) Explain significance of Maxwell's equation. Also explain the concept of displacement current or current density. **10**

7. (a) Given that the electric field intensity of an electromagnetic wave in non-conducting dielectric medium with permittivity $\Sigma = 9\Sigma_0$ and permeability μ_0 is $\bar{E}(z, t) = \hat{a}_y \, 5 \cos\left(10^9 t - \beta z\right) v/m$ Find the magnetic field intensity $\bar{H}$ and the value of β. **10**

(b) Explain depth of penetration (Skin Depth). Find the skin depth at frequency 1·6 MHz in Aluminium whose $\sigma = 38{\cdot}2$ Ms/m and $\mu_r = 1{\cdot}0$. Also find propagation constant and wave velocity in this medium (Assume $\alpha = \beta = 1/\delta$) **10**
