magnetic flux crossing the surface $\phi = \pi/2$, $1 \le \rho \le 2m$, $0 \le z \le 5$. 4

6. (*a*) Calculate skin depth and propagation constant at a frequency of 100 MHz in copper where $\sigma = 5{\cdot}8 \times 10^7$ mhos/m and $\mu_r = 1$. 4

(*b*) Show that, in a perfect conductor, the static electric field and all time varying fields are zero. 6

7. (*a*) Explain briefly the reflection of a plane wave at normal incidence. 5

(*b*) The plane wave $E = 30\cos(wt - z)a_x$ V/m in air normally hits a lossless medium having $\mu = \mu_0$, $\varepsilon = 4\varepsilon_0$ at $z = 0$. Find Γ, τ and S. 5

8. Write short notes on (any *two*) : 5×2

(*i*) Uniqueness theorem

(*ii*) Wave polarization

(*iii*) Poisson's equation

(*iv*) Faraday's law.

(Set-R_1)

B.Tech - 6th
Electromagnetic Theory

Full Marks : 70

Time : 3 hours

Answer Q. No. 1 and any five from the remaining questions

The figures in the right-hand margin indicate marks

1. Answer the following questions : 2×10

(*a*) State and prove divergence theorem.

(*b*) State Gauss law and its application.

(*c*) $D = (x + z)a_y$. Transform the vector to cylindrical and spherical coordinates.

(*d*) The finite sheet $0 \le x \le 1$, $0 \le y \le 1$ on the $z = 0$ plane has a charge density $\rho_s = xy(x^2 + y^2 + 25)^{3/2}$ nC/m^2. Find the total charge on the sheet.

(*e*) Define a dielectric material and under what conditions it will be linear, homogenious and isotropic.

(*f*) What is equipotential surface and what is its use.

(*g*) State Ampere circuit law. Using stoke theorem derive Maxwell's third equation.

(*h*) What are the boundary conditions that H or B must statisfy at the interface between two different media.

(*i*) What is meant by skin effect ? Mention its significance.

(*j*) Define standing wave ratio. What happens to the amplitudes of its travelling waves.

2. (*a*) Given vectors $A = 3a_x + 4a_y + a_z$ and $B = 2a_y - 5a_z$. Find the angle between A and B. 5

(*b*) Three field quantities are given by

$$P = 2a_x - a_z,\ Q = 2a_x - a_y + 2a_z,$$
$$R = 2a_x - 3a_y + a_z.$$

Determine : (*i*) $(P+Q)\times(P-Q)$ (*ii*) $Q.R \times P$ (*iii*) The component of P along Q. 5

3. (*a*) Define coulomb's law. Derive the force and electric field intensity on point charges $Q1$ and $Q2$. 5

(*b*) Briefly explain any two applications of Gauss law. 5

4. (*a*) Find the resistance of a spherical capacitor having inner radius '*a*' and outer radius '*b*', filled with a lossy dielectric having material parameters σ and ε. 5

(*b*) A coaxial cable contains an insulating material of conductivity α. If the radius of the central wire is '*a*' and that of the sheath is '*b*'. Show that the conductance of the cable per unit length is

$$G = \frac{2\pi\sigma}{\ln b/a}.$$ 5

5. (*a*) State and explain Poynting theorem. 6

(*b*) Given the magnetic vector potential $A = \rho^2/4a_z$ Wb/m. Calculate the total