Unit II Static Magnetic Fields

Vector Magnetic Potential and Magnetic Flux Density

1. At a point P(x,y,z) the components of vector magnetic potential $\overline{A}$ are given as $A_x = 4x + 3y + 2z, A_y = 5x + 6y + 3z$ and $A_z = 2x + 3y + 5z$. Determine B at the point P.

2. If the vector magnetic potential is given by $A = \frac{10}{x^2 + y^2 + z^2} \mu_x$, obtain the magnetic flux density in vector form.

Magnetic Field Intensity , Magnetic Flux Density and Current Density

3. A rectangular loop (8x4) m, carrying 10A is placed on z=0 plane. Find the field intensity at (4, 2, 0) m.

4. Verify the curl equation. Given $H = 0.2z^2 a_x$ for z>0 and H=0 elsewhere. If the path of integration is around a square with side(d) centered at(0,0,z) in the y=0 plane, when z >2d.

5. A magnetic circuit employs an air core toroid with 500 turns, cross sectional area 6 cm^2 mean radius 15 cm and coil current 4 A. Determine the reluctance of the circuit, flux density and magnetic field intensity.

6. Find the magnetic field intensity at the origin due to a current element, IdL=$3\pi(u_x + 2u_y + 3u_z)\mu A.m$, at the point P(3,4,5) in free space.

7. A magnetic field,

$$\overline{H} = 3\cos x \quad \overline{a_x} + z\cos x \quad \overline{a_y}, A/m \quad for\, z \geq 0$$
$$= 0 for z < 0$$

is applied to a perfectly conducting surface in x,y plane. Find the current density on the conducting surface.

Force

8. Explain the tracing of a charged particle motion in x-y plane, in the region of crossed electric field $E=E_o\, a_y$ and magnetic field $B= B_o\, a_z$. Assume that the charge 'q' having mass 'm' start at t=0 at the point (x_o,y_o,t) with initial velocity $V = V_{xo}\, a_x + V_{yo}\, a_y$. What is the result for $B_o=0$?

9. The forces experienced by a test charge 'q' for three different velocities at a point in a region of electric and magnetic fields are given by

$$F_1 = qE_o a_x \qquad \text{for } V_1 = V_o a_x$$

$$F_2 = qE_o(2a_x + a_y) \qquad \text{for } V_2 = V_o a_y$$

$$F_3 = qE_o(a_x + a_y) \qquad \text{for } V_3 = V_o a_z$$

where E_o and V_o are constants. Find the electric field (E) and magnetic field (B) at the point in question?

10. Two wires carrying current in the same direction of 3A and 6A are placed with their axes 5cm apart, free space permeability = $4\pi x 10^{-7}\, H/m$. Calculate the force between them in kg/m length.

11. A rectangular loop in the xy plane with sides b_1 and b_2 carrying a current I lies in a uniform magnetic field $B = a_x B_x + a_y B_y + a_z B_z$. Determine the force and torque on the loop.

12. Determine the force per metre length between two long parallel wires A and B separated by 5cm in air and carrying currents of 40amps. in the same direction.

13. Find the force exerted between current carrying conductors kept in '1' meter distance and carries the current in the same direction.

Using B-H Curve

14. A magnetic material is made of mild steel. The central limb is wound with 800 turns and has a cross-section of 8 cm^2 and length of 12 cm. Each of the outer limb has a cross-section of 5cm^2 and length of 30 cm. The air gap length at the central limb is 1mm. Calculate the current required to set up a flux of 1.3mWb in the central limb. Data for the B-H curve is given below:

B	**1.1**	**1.3**	**1.35**	**1.5**	**1.625**
H	**500**	**850**	**1000**	**2000**	**3800**