Indian Institute of Technology Madras
PH1020, 2018
Tutorial-6

1. Consider a plane boundary between two media of permeability μ_1 and μ_2, as shown in Figure 1. Find the relation between the angles θ_1 and θ_2. Assume that the media are linear with $\vec{B}$ and $\vec{H}$ in the same direction.

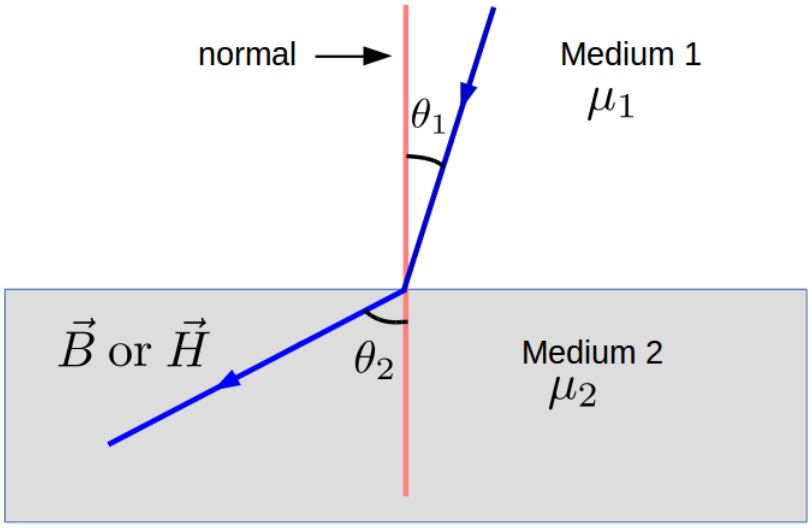

Figure 1

2. A sphere of a linear magnetic material of susceptibility χ_m is placed in an otherwise uniform magnetic field $\vec{B}_0$. Determine the new field inside the sphere.

3. A long straight wire of radius a is made of a homogeneous, linear magnetic material with a susceptibility χ_m. A uniformly distributed current I flows down the wire. Determine

(a) the magnetic filed at a distance s from the axis of the wire and

(b) the net bound current flowing in the wire.

4. An infinitely long straight wire located along the z-axis carries a steady current I in the positive z-direction. A copper rod is located on the y-axis, such that its ends are at $y = a$ and $y = b$. The rod moves with a constant velocity $\vec{v} = v_0\hat{e}_z$. Find the emf induced in the rod.

5. A long circular cylinder of radius a carries

(a) a uniform magnetisation $\mathbf{M}$ parallel to it's axis. Find the magnetic field due to $\mathbf{M}$ inside and outside the cylinder.

(b) a magnetisation $\mathbf{M} = \frac{M_0 s^2}{a^2}\hat{\phi}$ where $M_0 > 0$ is a constant, s is the distance from the axis, and $\hat{\phi}$ is the usual azimuthal unit vector.

Find $\mathbf{J}_b$,$\mathbf{K}_b$ and the magnetic field $\mathbf{B}$ due to $\mathbf{M}$ inside and outside the cylinder.