Department of Physics, Shiv Nadar Institution of Eminence

Spring 2025

PHY102: Introduction to Physics-II

Tutorial – 10

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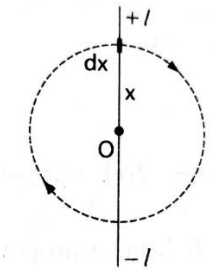
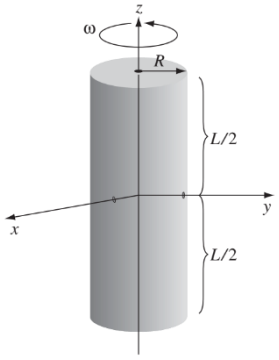
1. A steady current *I* flows down a long cylindrical conductor of radius *a*. The current density at a distance *r* from the axis of the conductor is proportional to *r*. Calculate the magnetic field both inside and outside as a function of *r*.

2. Find the magnetic vector potential of a finite segment of straight wire carrying a current *I*. Using the expression of the vector potential find the expression of magnetic field.
[Hint: Put the wire on the z-axis from z_1 to z_2 and use the relation $A = \frac{\mu_0}{4\pi}\int \frac{Idl}{r}$]

3. A straight wire of length $2l$ carries a charge λ per unit length. It rotates uniformly with an angular velocity ω about an axis passing through its mid-point and perpendicular to its length. Show that the equivalent magnetic dipole moment is of magnitude $(1/3)\lambda\omega l^3$.



4. A thin glass rod of radius R and length L carries a uniform surface charge σ. It is set spinning about its axis, at an angular velocity ω. Find the magnetic field at a distance $s \gg R$ from the axis, in the xy plane as shown in the figure.
[Hint: treat it as a stack of magnetic dipoles.]



5. Calculate the torque exerted on the square loop shown in the figure, due to the circular loop (assume r is much larger than a or b). If the square loop is free to rotate, what will the equilibrium orientation be?