

Electrodynamics (PHY 514) : 2006

Assignment 8 :

This problem set is due **Thursday March 2**, at the end of the lecture. Feel free to discuss the problems with others in the class, but you must write your own solutions. Simply writing the answer without showing a derivation will obtain zero credit.

1. Consider an infinite cylindrical shell of radius a aligned in the z -direction carrying surface current density $\mathbf{K} = K_0 \hat{\mathbf{e}}_\phi$. Work in cylindrical coordinates.
 - (a) Show that the magnetic field has no radial component.
 - (b) Show that the magnetic field has no angular component.
 - (c) Show that the magnetic field outside the cylinder vanishes and inside is uniform. Find its value.
 - (d) Find the vector potential both inside and outside the cylinder.
2. Two infinite wires are parallel to each other, and are separated by a distance R . Each carries current I , but the currents run anti-parallel. The pair of wires is surrounded by a cylindrical tube of permeability μ of inner radius a and outer radius b (co-axially). Compute the vector potential outside the cylindrical shell as an expansion in powers of $\cos(n\phi)$.
3. Use the method of images to find the force per unit length on a wire carrying current I , that is parallel to the surface of material with permeability μ , and separated from it by a distance d . What are the image currents that reproduce the magnetic field in both regions.