Reading assignment
Ulaby, 5-1, 5-2, 5-4
Connor and Salon   VI-1 VI-13

Software
div_curl_example.m

Problem 1 - Magnetic field properties
Run div_curl_example.m. Which of the fields shown are possible magnetostatic fields? Which are possible electrostatic fields?

Problem 2 - Symmetry
Three standard geometries for analytical magnetostatic calculations are shown below.
a. Use the right hand rule (thumb along the current direction, fingers for $\mathbf{B}$) and determine the direction of $\mathbf{B}$ in each case.
b. All 3 geometries can best be analyzed in cylindrical coordinates. For each, determine whether $\mathbf{B}$ is a function of $r$, $\phi$, and/or $z$.
(Example from electric fields, $\mathbf{E}$ of cylindrically symmetric charge is only a function of $r$.)

Coaxial cable
I is in z direction

Solenoid
I is in $\phi$ direction

Toroid
I wraps around core
Problem 3 - Ampere's Law
A long solenoid has a current density of \( \mathbf{J} = J_0 a_\varphi \) for \( a < r < b \) and is 0 everywhere else. Ignore end effects.

a. Find the magnetic flux density, \( \mathbf{B} \) for \( r < a \). Be sure to sketch the line integral paths you use. Assume \( \mathbf{B} = 0 \) for \( r > b \).

b. Check your answer to part a. by evaluating \( \nabla \cdot \mathbf{B} \) and \( \nabla \times \mathbf{B} \).

c. Find \( \mathbf{B} \) for \( a < r < b \). Sketch the line integral path you use.

d. Check your answer to part c. by evaluating \( \nabla \cdot \mathbf{B} \) and \( \nabla \times \mathbf{B} \).

e. Plot \( B_z \) vs \( r \).

f. Show that \( \mathbf{B} = 0 \) for \( r > b \).