# AEP 4210, HOMEWORK #3

DUE FRIDAY, SEPTEMBER 20

To ensure that you get full credit, be sure to *show your work* in the problems that require calculations. Very little credit is given for answers without justification.

You may collaborate with classmates in solving the problems. If you do so, please list their names on your assignment.

Work the following exercises from Kusse–Westwig [KW]:

**1.** II.8(c)

**2.** II.9

**3.** II.12

**4.** III.1

**5.** III.3

**6.** III.5

**7.** [III.20, decomposed] The magnetic field inside an infinitely long solenoid is uniform:

$$\overline{B} = B_0 \widehat{e_z}.$$

(a) Determine the vector potential $\overline{A}$ such that $\overline{B} = \overline{\nabla} \times \overline{A}$.

(b) In this case, the magnetic field can also be obtained as $\overline{B} = \overline{\nabla}\Phi$, where $\Phi$ is a scalar potential. Why is this the case? What is $\Phi$?

The magnetic field inside a solid, straight conducting wire aligned with the $z$-axis and with a uniformly distributed current can be described in polar coordinates with polar unit vectors as

$$\overline{B} = B_0 \frac{r}{r_0} \widehat{e_\phi}$$

where $B_0$ and $\rho_0$ are constants.

(c) The magnetic field can still be derived from a vector potential $\overline{A}$. Determine $\overline{A}$.

(d) The magnetic field can no longer be determined from a scalar potential. Why not?