EE331 — Homework #14–**Last one!** / Due Friday, May 1, 2020 **at the beginning of class**

1. Do Example #28 except let $\mathbf{E} = 3\hat{\mathbf{a}}_y$ V/m, $\mathbf{B} = 5\hat{\mathbf{a}}_z$ Wb/m^2, and the particle start from rest at the origin.

2. Repeat Prob. #1 with everything the same except $\mathbf{B} = 0$.

3. Repeat Prob. #1 with everything the same except $\mathbf{E} = 0$.

4. Three infinite lines L_1, L_2, and L_3 defined by $(x = 0,\ y = 0)$, $(x = 0,\ y = 4)$, and $(x = 3,\ y = 4)$, respectively, carry filamentary currents 100 A in the $-\hat{\mathbf{a}}_z$ direction, 200 A in the $+\hat{\mathbf{a}}_z$ direction, and 300 A in the $+\hat{\mathbf{a}}_z$ direction, respectively. Find the force per unit length on (a) L_2 due to L_1 and (b) L_3 due to L_1.

5. (a) A loop of current in the yz plane has a current in the counter-clockwise direction. What is the direction of the magnetic moment? (b) A loop of current is placed in the xy plane in a uniform magnetic field in the positive x direction. If the current in the loop is in the clockwise direction, what is the direction of the torque on the loop? (c) A filamentary current along the x axis has a current in the $\hat{\mathbf{a}}_x$ direction. A square loop of current in the xy plane centered at (0,10,0) has a current in the counter-clockwise direction. What is the direction of the net force on the loop?

6. (a) A small magnet placed at the origin produces $\mathbf{B} = -0.5\hat{\mathbf{a}}_z$ mWb/m^2 at $(10, 0, 0)$. Find $\mathbf{B}$ at $(3, 4, 0)$. (Hint: This is like the dipole problem you did for electrostatics except that here you have to find the magnetic flux density. In magnetostatics, it's more common to find $\mathbf{B}$ than to find $\mathbf{H}$ because of the fact that $\mathbf{E}$ can be zero.) In a certain material, $\mu = 4.6\mu_0$ and $\mathbf{B} = 5x\hat{\mathbf{a}}_z$ Wb/m^2. Find (b) χ_m and (c) $\mathbf{H}$.

7. (a) Region 1 ($x < 0$) is free space, while region 2 ($x > 0$) is a magnetic material with $\mu = 50\mu_0$. If $\mathbf{B}_1 = 40\hat{\mathbf{a}}_x - 30\hat{\mathbf{a}}_y + 10\hat{\mathbf{a}}_z$ mWb/m^2, find $\mathbf{H}_2$. (b) Find the energy density in region 2.

8. (a) A solenoid of length 10 cm and radius 1 cm has 450 turns. Calculate its inductance. (b) A coaxial transmission line has inner conductor of radius $a = 2.5$ mm and outer conductor of radius $b = 6$ mm. Assuming that the space between the conductors is a nonmagnetic material, i.e., $\mu_r = 1$, calculate the inductance per unit length. Now we've come full circle. Smiley face.