THE CITADEL
THE MILITARY COLLEGE OF SOUTH CAROLINA

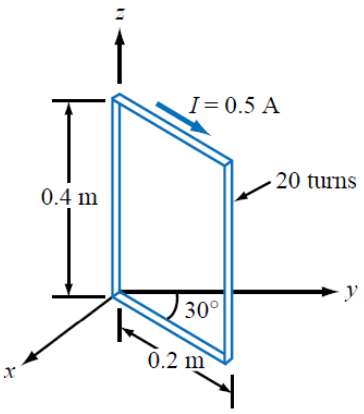
Department of Electrical and Computer Engineering

ELEC 318 Electromagnetic Fields **HW #7, due March 19th, 2015**

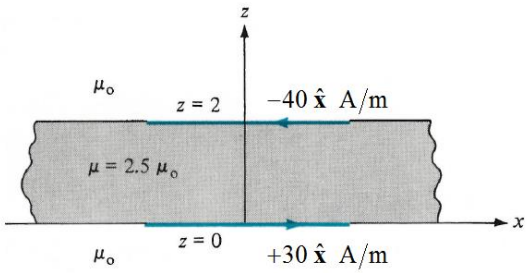
Reading Assignment: Chapter 5 (all)
Chapter 6 (through Section 6.6)

Written Assignment:

1. The rectangular loop shown in the figure consists of 20 closely-wrapped turns and is hinged along the z axis. The plane of the loop makes an angle of 30° with the y axis and the current in the windings is 0.5 A. The loop experiences a magnetic flux density of $2.4\,\hat{\mathbf{y}}$ Wb/m^2. Using a magnetic moment, determine (a) the magnitude of the torque exerted on the loop, and (b) the direction of rotation when viewed from above.



2. Region $0 \le z \le 2$ m is filled with an infinite slab of magnetic material ($\mu = 2.5\mu_0$). The surfaces of the slab at $z = 0$ and $z = 2$ m, respectively, carry surface currents of $30\,\hat{\mathbf{x}}$ A/m and $-40\,\hat{\mathbf{x}}$ A/m as shown in the figure. Determine the magnetic flux density for (a) $z < 0$, (b) $0 < z < 2$ m, and (c) $z > 2$ m.



3. Determine, in terms of the DC current I, how much magnetic energy is stored in the insulating medium of a 3-m-long air-filled section of a coaxial transmission line, given that the radius of the inner conductor is 5 cm and the inner radius of the outer conductor is 10 cm.

4. A coaxial cable has an outer radius b and inner radius a. If the internal and external inductances are equal and a = 8 mm, determine b. You may take the internal inductance of the wire to be $L_{\text{int}} = \mu_0 l/8\pi$.

5. Determine the mutual inductance between the rectangular loop and the infinite line current in the figure when $a = b = r_0 = 1$ m.