ELEC 435
Problem Set 5
Due: October 3, 2014

Homework Problems.

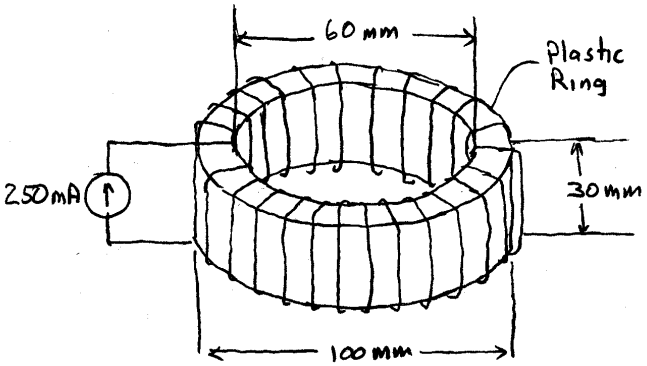
H5.1 The coil below consists of 5000 turns of copper wire wound around a plastic ring having a rectangular cross section.

(a) Determine the maximum and minimum values of the magnetic field intensity within the toroidal coil.

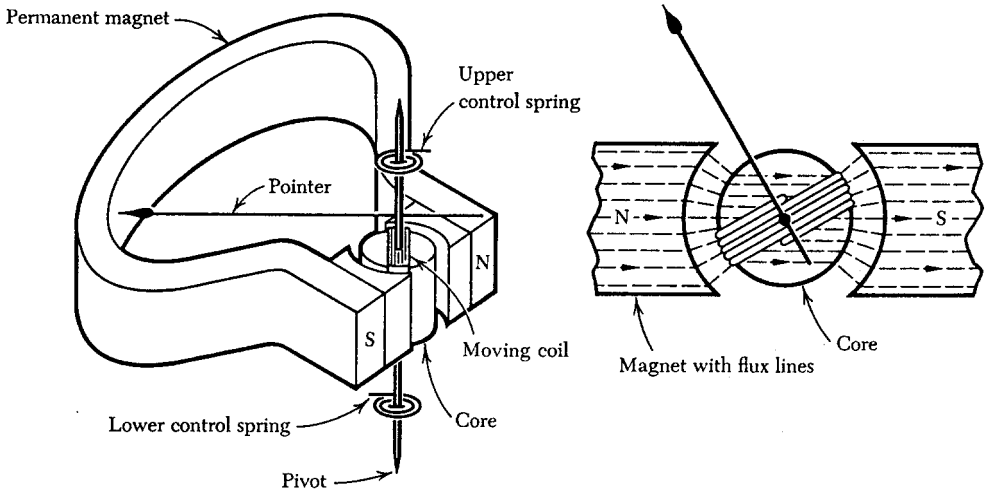
(b) What is the total magnetic flux within the torus?

(c) What is the average flux density inside the torus? Compare this to the flux density midway between the inner and outer edges of the coil?

(d) What is the flux density outside the torus?



H5.2 The figure below is a diagram of a d'Arsonval moving coil meter for measuring current. The permanent magnet and core assembly produce a radial flux density of 0.4 T in the air gaps. The rotating coil is 15 mm high and 20 mm wide, with 2000 turns of very fine wire. The electrical connections to the coil are made through the spiral control springs which together exert a restoring torque of $10^{-5}\mathrm{N}\cdot\mathrm{m/rad}$. Determine the coil current required to produce the 70° rotation that corresponds to full-scale deflection.



H5.3 The magnetic circuit in Figure **??** is made of transformer steel having B-H curve shown in Figure **??** (figures on back of page).

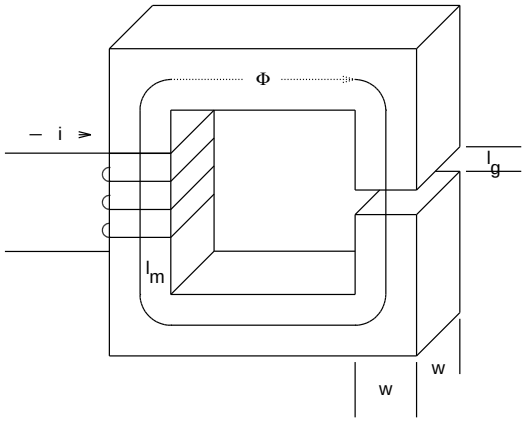


Figure 1: Magnetic circuit with air gap.

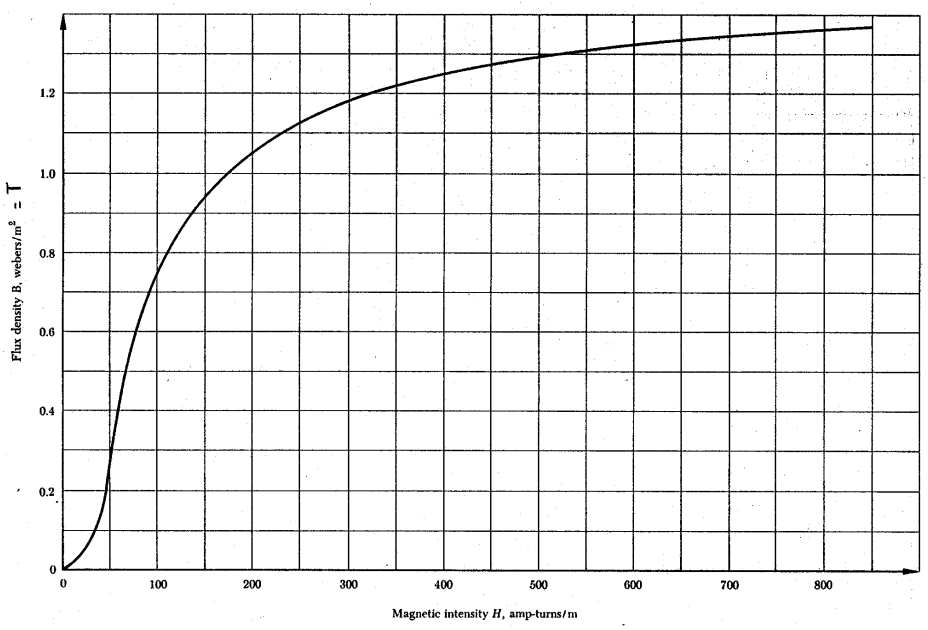


Figure 2: B-H curve for transformer steel.

Assume l_m = 100 mm, g = .1mm, and w = 10 mm. Neglect fringing and leakage. Determine the number of turns and the current in the coil to produce a flux density of 1 T in the air gap.

Quiz Problems.

Q5.1 The figure at the right is a cutaway view of a device intended to fire coils of copper wire into outer space. Each coil is 20 cm in diameter and contains 100 turns of 0.25 mm diameter wire. A permanent magnet (the hatched area in the figure) produces a flux density of 1 T in the gap. Sliding contacts (not shown) provide current to the coil. If the coil is placed at the bottom of the tube and a current of 1 A is applied, what will be the velocity of the coil when it leaves the tube? (Some possibly useful numbers: the specific gravity of copper is 8.9 $\mathrm{g/cm^3}$ and its resistivity is $1.7 \times 10^{-8}\Omega\mathrm{m}$.)