Homework set 6 (David K. Cheng, Fundamentals of Engineering Electromagnetics)

P. 5-2 Find the total magnetic flux through a circular toroid with a rectangular cross section of height h. The inner and outer radii of the toroid are a and b, respectively. A current I flows in N turns of closely wound wire around the toroid. Determine the percentage of error if the flux is found by multiplying the cross-sectional area by the flux density at the mean radius. What is the error if b/a=5?

P. 5-3 A direct current I flows in a straight filamentary conductor .

a) Prove that **B** at a point P, whose location is specified by the perpendicular distance r and the two angles α_1 and α_2 shown in Fig. 5-24 is

$$\mathbf{B}_P = \mathbf{a}_\phi \frac{\mu I}{4\pi r}\left(\sin\alpha_2 - \sin\alpha_1\right) \qquad (5\text{-}135)$$

b) Verify that Eq. (5-135) reduces to Eq. (5-35) when the wire is infinitely wrong.

P. 5-6 A current I flows in the inner conductor of an infinitely long coaxial line and returns via the outer conductor. The radius of the inner conductor is a, and the inner and outer radii of the outer conductor are b and c, respectively. Find the magnetic flux density $\mathbf{B}$ for all regions and plot $|\mathbf{B}|$ versus r.

P. 5-7 A thin conducting wire of length $3w$ forms a planar equilateral triangle. A direct current I flows in the wire. Find the magnetic flux density at the center of the triangle.

P. 5-9 A direct current I flows in an infinitely long wire of a radius 2 (mm) along the z-axis.

a) Obtain the vector magnetic potential $\mathbf{A}$ at r>2 (mm) from the expression of $\mathbf{B}$ in Eq. (5-12). Choose the reference zero potential at wire surface.

b) If I =10 (A), determine from $\mathbf{A}$ the total amount of magnetic flux passing through a square loop specified by z=±0.3 (m) and y=0.1 (m) and 0.7 (m).