KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
ELECTRICAL ENGINEERING DEPARTMENT

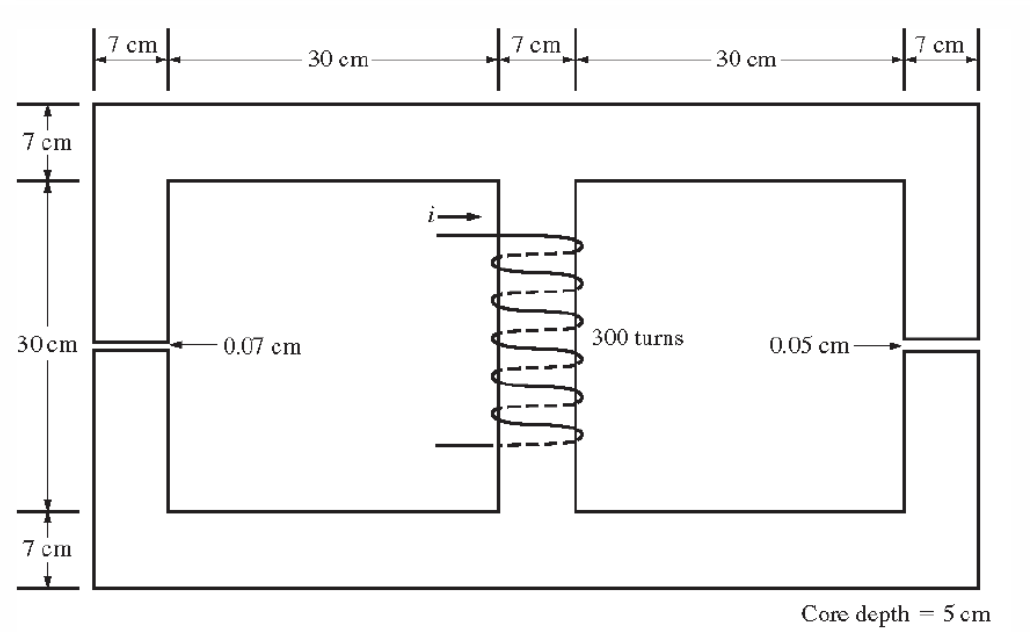
EE 306 – Term 192

HW # 2: Magnetic Circuits

Due Date: (Feb. 16th for UT Classes and Feb. 17th for MW Classes)

Problem # 1:

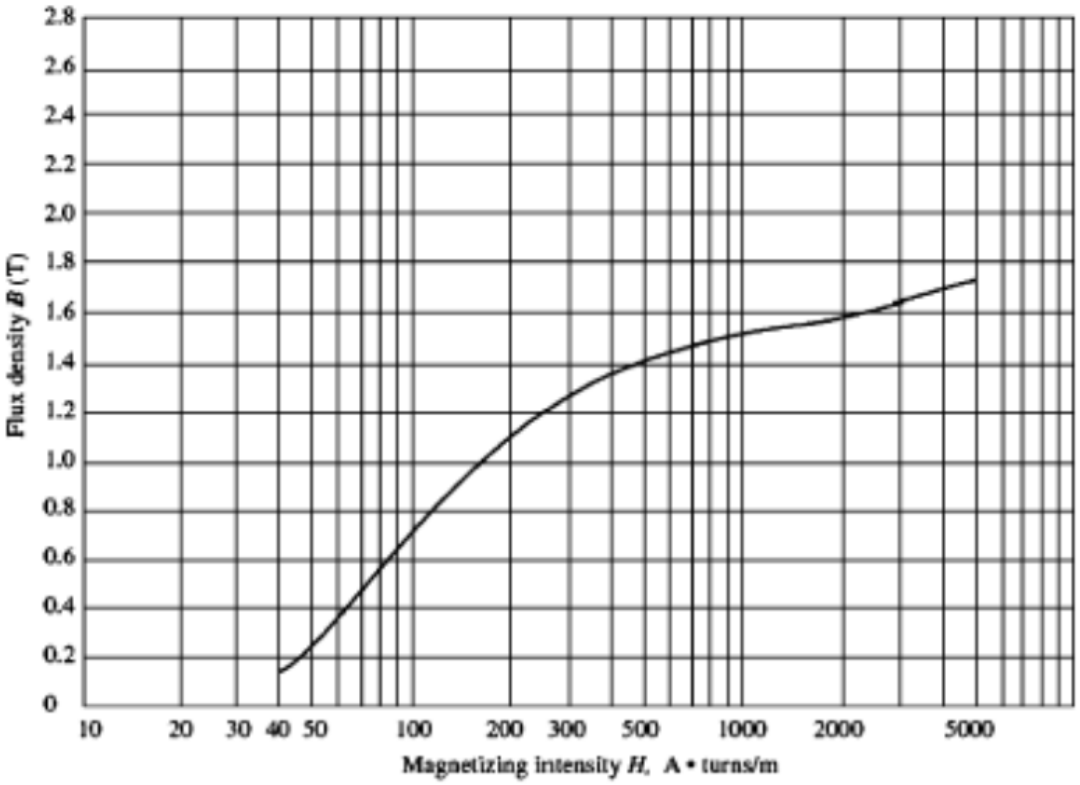
A ferromagnetic core with a relative permeability of 1500 is shown below. The dimensions are as shown in the diagram, and the depth of the core is 5 cm. The air gaps on the left and right sides of the core are 0.050 and 0.070 cm, respectively. Because of fringing effects, the effective area of the air gaps is 5 percent larger than their physical size. If there are 300 turns in the coil wrapped around the center leg of the core and if the current in the coil is 1.0 A, what is the flux in each of the left, center, and right legs of the core? What is the flux density in each air gap?



Problem # 2:

A square magnetic core has a mean path length of 55 cm and a cross-sectional area of 150 cm^2 . A 200-turn coil of wire is wrapped around one leg of the core. The magnetization curve of the core material is shown in the figure below.

(a) How much current is required to produce 12 mWb of flux in the core?
(b) What is the relative permeability of the core at that level of current?
(c) What is its reluctance?
(d) Repeat part (a) if an air-gap of length 1 mm is cut across the core.
Assume a 5% increase in the effective air-gap area to account for fringing.



Problem # 3:

(a) The total iron loss in the core of a transformer having volume 0.16 cm^3 is 2170 W when excited at 50 Hz. The hysteresis loop of the core material, taken to some maximum flux density B_{max}, has an area of 9 cm^2 when drawn to scales of:

1 cm = 0.1 Wb/m^2 and 1 cm = 250 AT/m

Calculate the hysteresis and eddy-current losses of the core in watts?

(b) Repeat **Part (a),** if the same core of the transformer is excited to the same maximum flux density as in Part (a) but at the frequency of 60 Hz. Also, what will be total iron losses in the transformer core at 60 Hz?