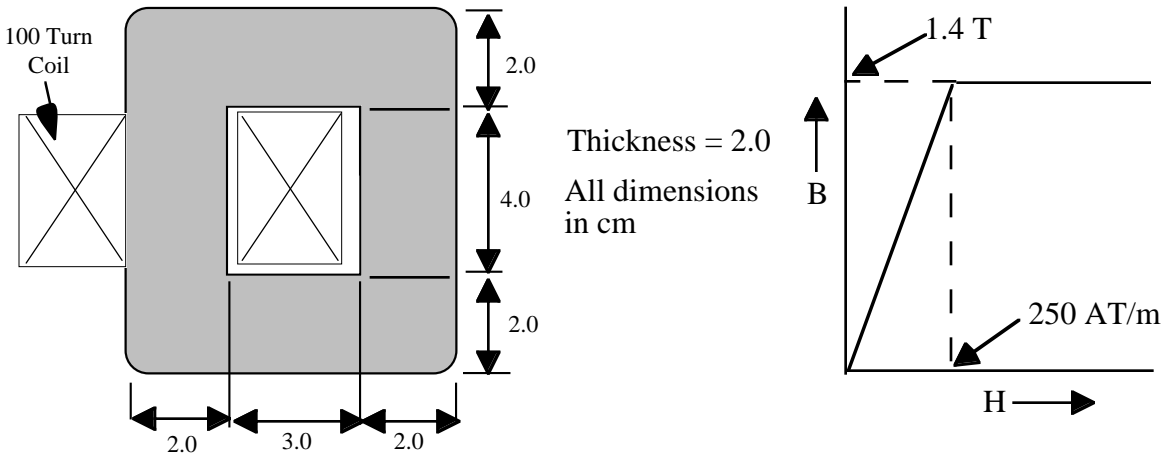


Required Homework Problem 3
Magnetic System Analysis



The inductor shown above utilizes a new core material which has the characteristics shown in the figure, a linear B-H relation up to 1.4 T with a sharp saturation holding at $B = 1.4$ T for any value of $H > 250$ AT/m.

a) Find the DC current required to produce flux densities of 1.0 T and 1.4 T in the core. For these currents find the inductance of the inductor. (20 points)

$$\begin{array}{l}
 \text{B} = 1.0 \text{ T} \qquad \qquad \text{B} = 1.4 \text{ T} \\
 I_m = \underline{\hspace{2cm}} \text{ A} \quad I_m = \underline{\hspace{2cm}} \text{ A} \\
 L = \underline{\hspace{2cm}} \text{ h} \quad L = \underline{\hspace{2cm}} \text{ h}
 \end{array}$$

b) Find the inductance for a coil current that results in $H = 600$ AT/m. (10 points)

$$L = \underline{\hspace{2cm}} \text{ h}$$

c1) Find the minimum length of an air gap which will keep the core in the linear region for a current which would produce an $H = 600$ AT/m in the core without an air gap (same current as part b). Find the inductance of this new inductor which allows increased current before saturation occurs. (30 points)

$$\text{gap} = \underline{\hspace{2cm}} \text{ mm} \quad L = \underline{\hspace{2cm}} \text{ h}$$

c2) For a transformer using the E-I lamination shown on the next sheet, find the number of turns needed to result in a core flux density of 1.55 T for an applied voltage of 120 V rms at 60 hz. For this condition find the core loss and the exciting current. (30 points)

$$N = \text{_____ turns}$$

$$I_{\text{ex}} = \text{_____ A rms}$$

$$P_{\text{core}} = \text{_____ w}$$

d) Find the values of a core loss resistor and a magnetizing reactance in a parallel connected model which can be used to model the open circuit (on the secondary) behavior of the transformer. (10 points)

OPTIONAL: Use a wire table to estimate the largest size wire that would fit, using your number of turns, into half of the winding space (the other half is for the secondary). For the sake of simplicity, assume the only unusable space in the winding space is because the wires are round. Then make a (very) rough calculation of how long the N turns of wire would be and ,using the ohms/meter data from the wire table, its approximate resistance. (20 points)

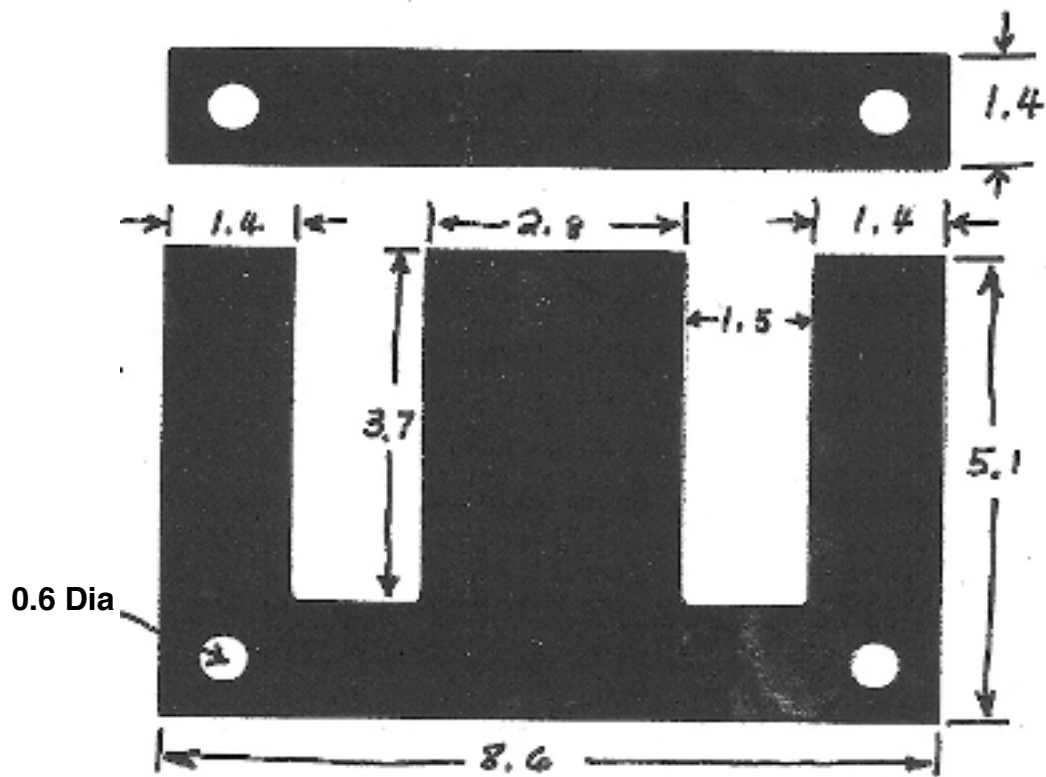
$$R_{\text{cl}} = \text{_____ } \Omega$$

$$X_{\text{m}} = \text{_____ } \Omega$$

$$\text{Max wire size} = \# \text{ _____}$$

$$R \approx \text{_____ } \Omega$$

Required Homework Problem 3



All dimensions in cm

Stack Height = 2.80 cm

Material M 43 - 24 Gauge

Density of material = 7.85 gm/cc