1. (a) The magnetic structure shown in Figure 1 is made of cast steel.
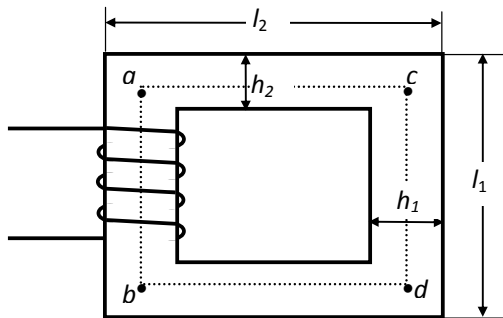

Figure 1

Use the *B-H* curve of the core shown in Figure 2 to find the permeability and the relative permeability of the core material at flux density levels of 0.6 T, and 1.2 T.
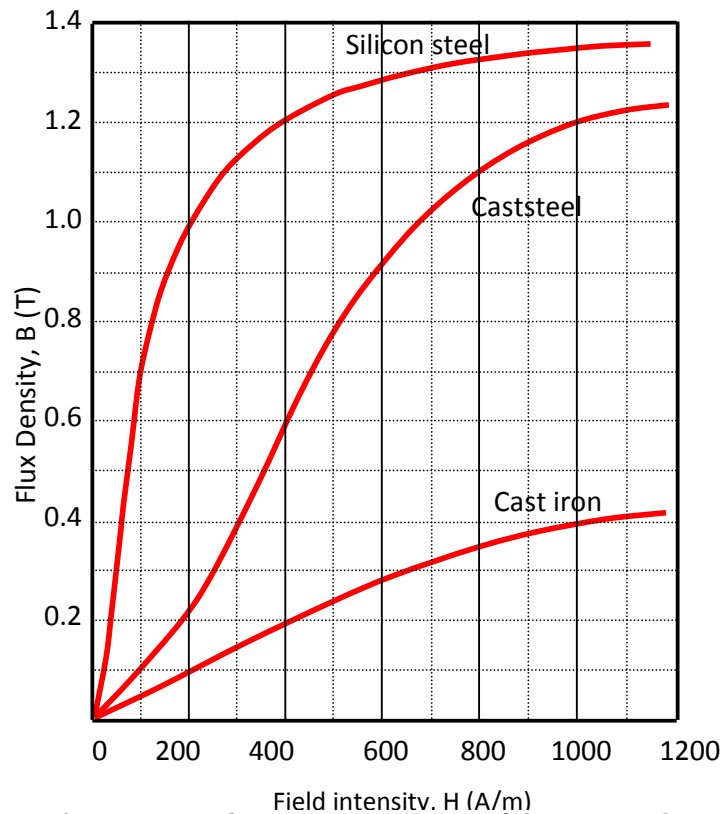

Figure 2 Typical magnetization curves of three materials

(b) The magnetic circuit shown in the Figure 3 has a cross section of 5 cm² and the relative permeability of 800. The coil has 400 turns and carries a current of 2.5 A. Ignoring the fringing, find:

   (i)   the flux density in each air gap, and hence their ratio,

   (ii)   what will be the ratio of these flux densities if the reluctance of the core were ignored?
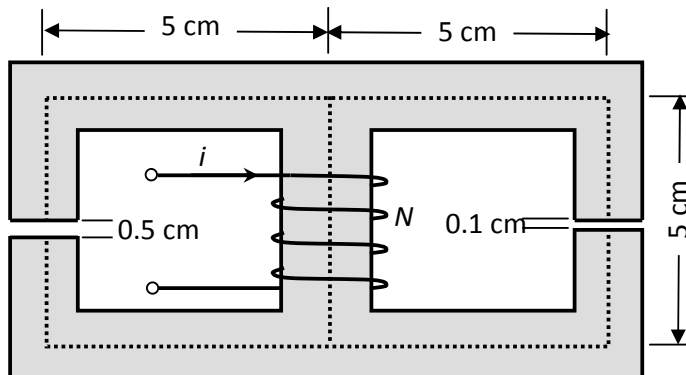

Figure 3. Magnetic circuit for Problem1 (b)

2. When a voltage source with 220 V (rms) with frequency of 50 Hz is applied to an iron core inductor shown in Figure 4, the eddy current loss is 25 W out of the total iron loss of 60 W. What will be the total iron loss if the source voltage magnitude is kept fixed but the frequency is doubled? Assume that Steinmetz's index for iron core is equal to 2.
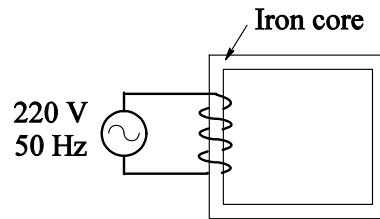
Iron core

220 V
50 Hz

Figure 4

3. Calculate inductance of the inductor being realized as shown in Figure 5, ignoring reluctances of the iron core paths.
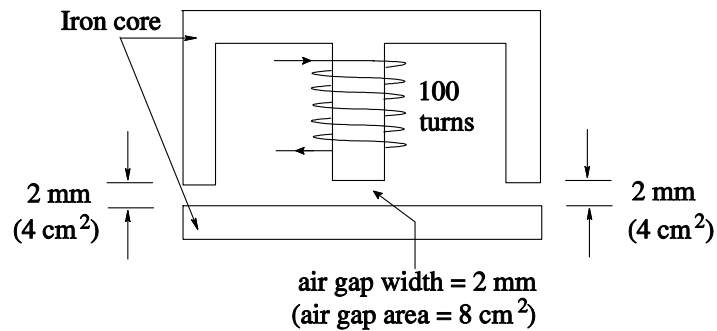
Iron core

100
turns

2 mm
$(4\ cm^2)$

2 mm
$(4\ cm^2)$

air gap width = 2 mm
(air gap area = 8 cm^2)

Figure 5