ECE 385 – Fall 2024

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HW #1

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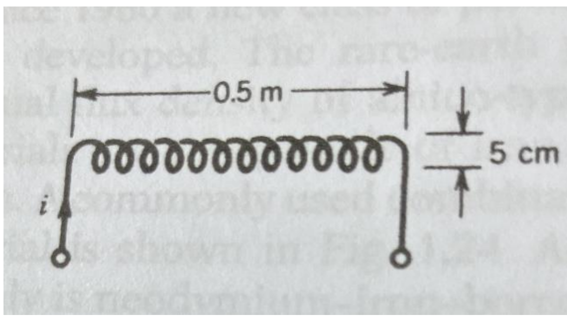
Problem 1

The long solenoid coil shown in Fig. p1.1 has 250 turns. As its length is much greater than its diameter, the field inside the coil may be considered uniform. Neglect the field outside.

(a) Determine the field intensity (H) and flux density (B) inside the solenoid (i=100A).

(b) Determine the inductance of the solenoid coil.

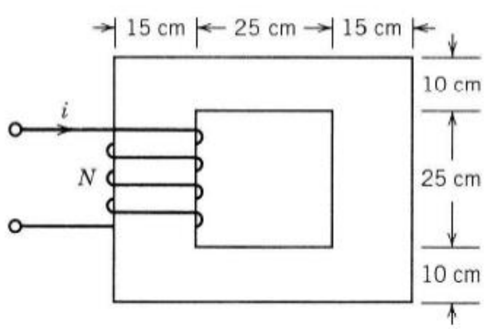


Problem 2

In the magnetic system of figure below, two sides are thicker than the other two sides. The depth of the core is 10 [cm], the relative permeability of the core μr = 2000, the number of turns N = 300, and the current flowing through the coil is i = 1 [A].

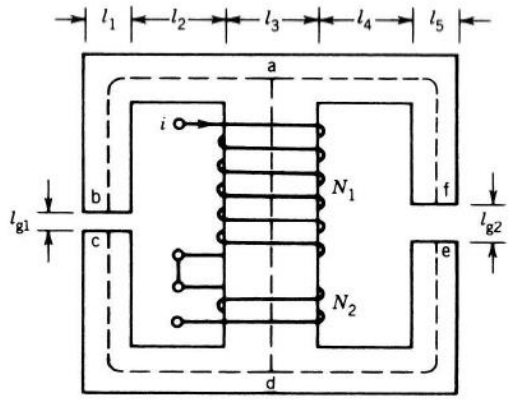
(a) Determine the flux in the core.

(b) Determine the flux densities in the parts of the core.



Problem 3

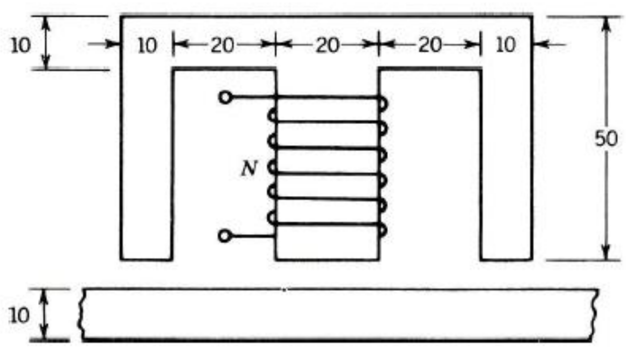
The magnetic circuit of figure below provides flux in the two air gaps. The coils (N1 = 700, N2 = 200) are connected in series and carry a current of 0.5 [A]. Neglect leakage flux, reluctance of the iron (i.e., infinite permeability), and fringing at the air gaps. Determine the flux and flux density in the air gaps.



$l_{g1} = 0.05$ cm, $l_{g2} = 0.1$ cm
$l_1 = l_2 = l_4 = l_5 = 2.5$ cm
$l_3 = 5$ cm
depth of core = 2.5 cm

Problem 4

The electromagnet shown in figure below can be used to lift a length of steel strip. The coil has 500 turns and can carry a current of 20 [A] without overheating. The magnetic material has negligible reluctance at flux densities up to 1.4 [T]. Determine the maximum air gap for which a flux density of 1.4 [T] can be established with a coil current of 20 [A]. Neglect magnetic leakage and fringing of flux at the air gap.



Problem 5

A coil wound on a magnetic core is excited by the following voltage sources.
(a) 100 [V], 50 [Hz].
(b) 110 [V], 60 [Hz].
Calculate the hysteresis losses and eddy current losses with these two different sources. For hysteresis loss, consider n = 2.

Problem 6

The magnetic circuit of figure below has the following parameters: N = 100 turns, Ac = Ag = 5 [cm2], μ c = ∞. Determine the air gap length, lg, to provide a coil inductance of 10 [mH].