Information Technology University, Lahore

Electrical Machines
BSEE-19 Fall 2021
Assignment No. 1

Issue Date: Friday Oct. 01, 2021

Due Date: Saturday Oct. 09, 2021 (Upload on Google classroom before 5:00 pm)

Total Marks: 100

Course Instructor: Ms. Hadia Sajjad

Carefully Read Instructions

1. Please upload the assignment as a single file in scanned version (pdf format) on Google Classroom before the deadline.
2. Your Name and Registration Number should be mentioned on the assignment.
3. Handwriting must be very neat and legible. Please show all steps in your calculutaions. You may lose points otherwise.
4. Please submit your own work only. Please review the University Plagiarism Policy.
5. Late submissions will be entertained.

Question 1: (10)

Answer the following questions?

a. What are Real, Reactive and Apparent Power? What units are they measured in? How are they related?
b. Explain hysteresis in terms of magnetic domain theory? What are the eddy current losses and how can they be minimized?

Question 2: (20)

A ferromagnetic core with a relative permeability of 1500 is shown in Figure 1.1. The dimensions are as shown in the figure, 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?

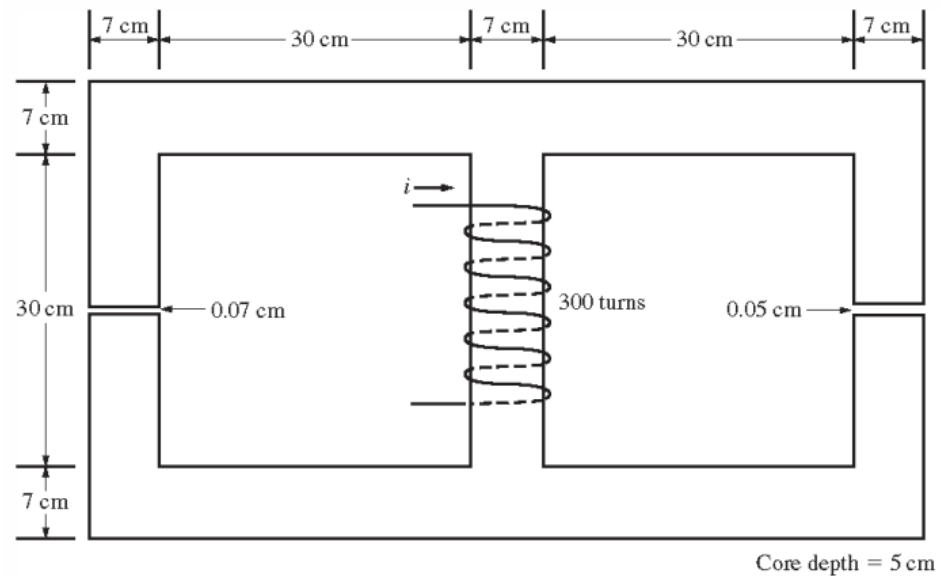

Figure 1.1: The ferromagnetic core

Question 3: (20)

A two-legged core is shown in Figure 1.2. The winding on the left leg of the core (N1) has 600 turns, and the winding on the right (N2) has 200 turns. The coils are wound in the directions shown in the figure. If the dimensions are as shown, then what flux would be produced by currents i_1 = 0.5 A and i_2 = 1.0 A? Assume μ_r = 1200 and constant.

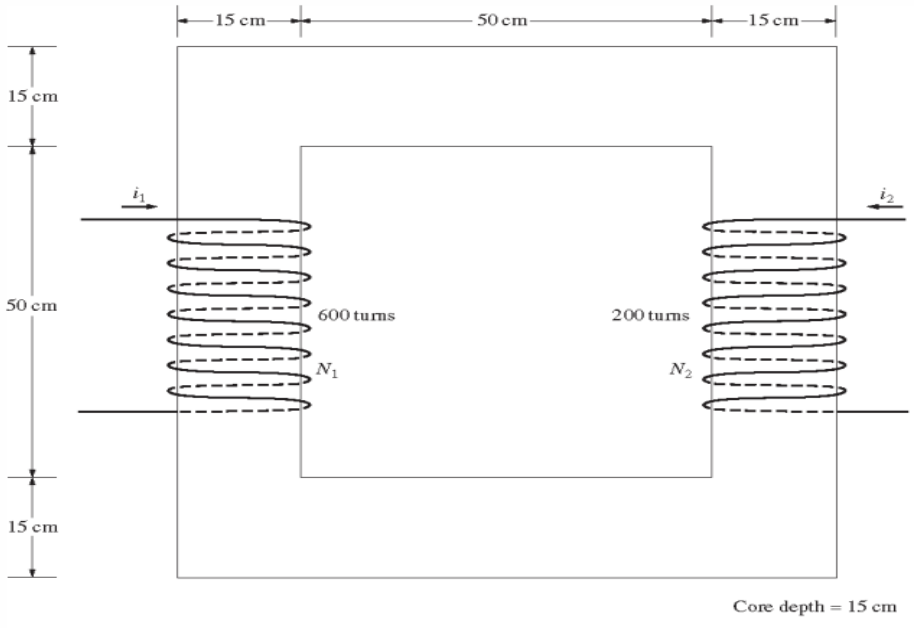

Figure 1.2: The ferromagnetic core with double coil

Question 4: (30)

Figure 1.3 shows a core of a simple DC motor. The magnetization curve for the metal in this core is given by figures 1.4 and 1.5. Assume that the cross-sectional area of each air gap is 18cm^2 and the width of each air gap is 0.05cm. The effective diameter of the rotor core is 4cm.

a. It is desired to build a machine with great flux density while avoiding the excessive saturation in the core. What would be a reasonable flux density for this core?
b. What would be the total flux in the core at this flux density of part a?
c. Maximum possible field current for this machine is 1A. Select a reasonable number of turns of wire to provide the desired flux density while not exceeding the maximum available current.

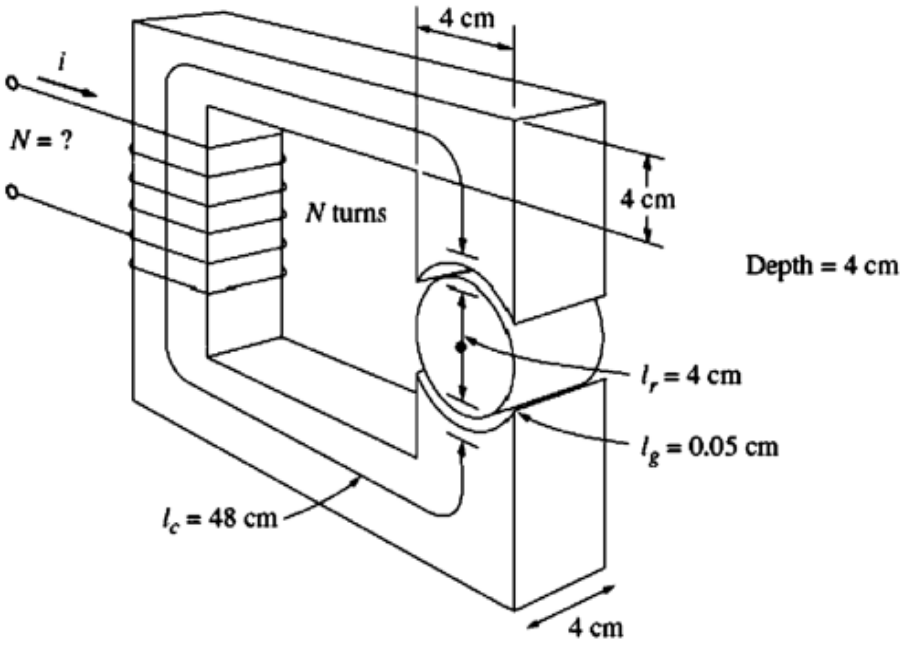

Figure 1.3: The ferromagnetic core

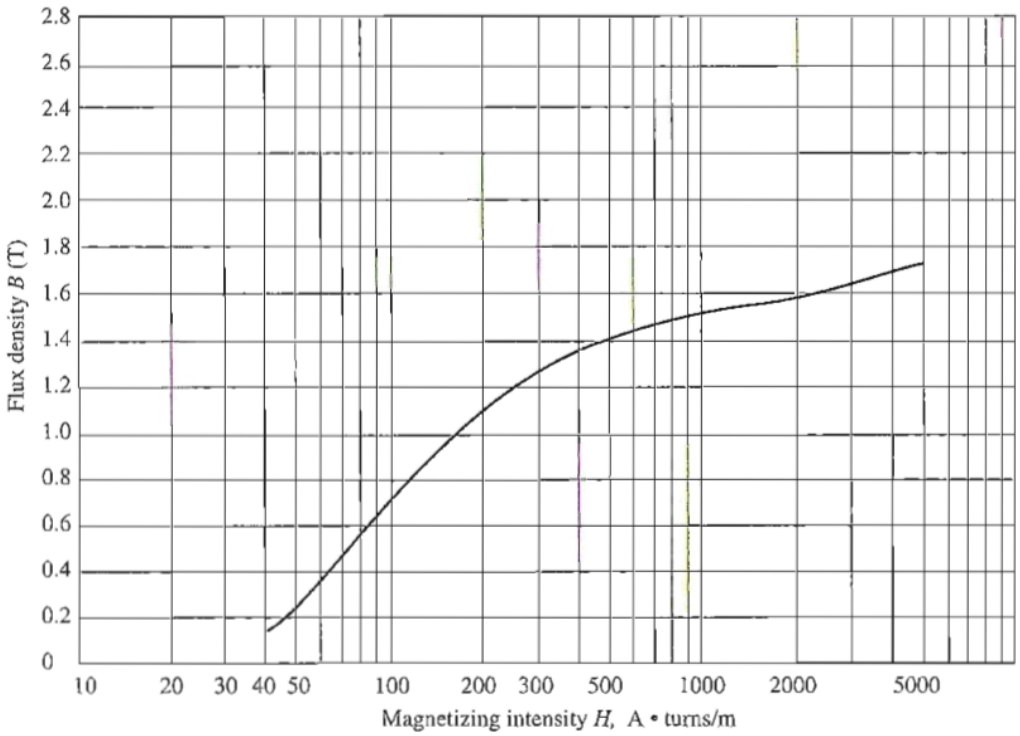

Figure 1.4: A detailed magnetization curve for a typical piece of steel

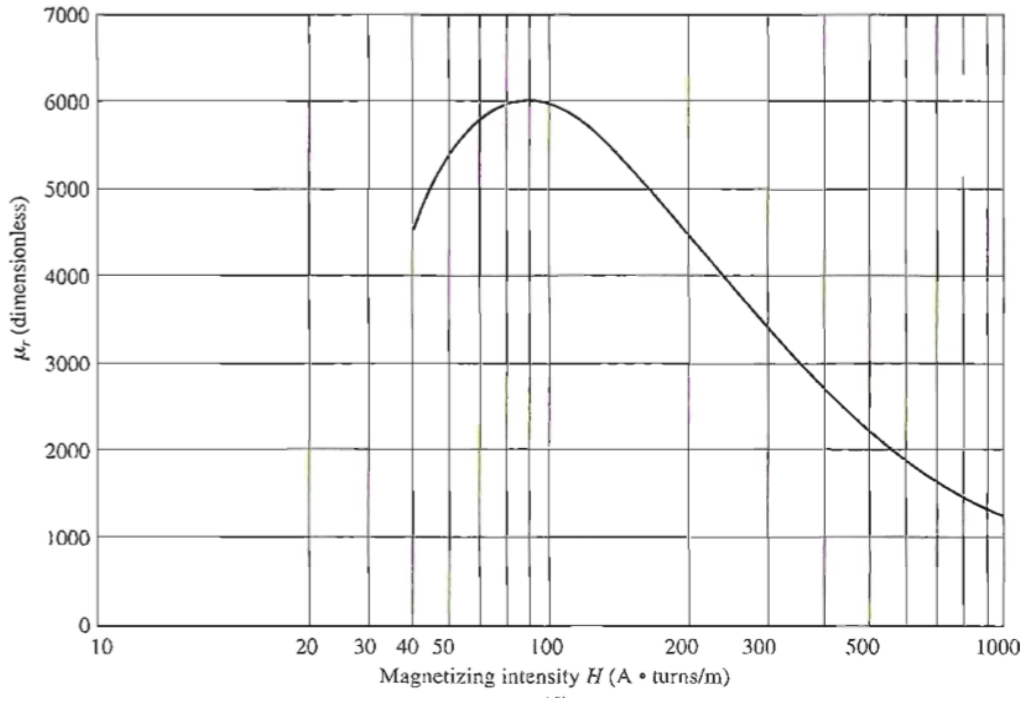

Figure 1.5: A plot of relative permeability μ_r as a function of magnetizing intensity H for a typical piece of steel

Question 5: (20)

The linear machine shown in figure 1.6 has a magnetic flux density of 0.5 T directed into the page, a resistance 0f 0.25 Ω, a bar length l = 1.0 m and a battery voltage of 100V.

a. What is the initial force on the bar at starting? What is the initial current flow?
b. What is the no load steady speed of the bar?
c. If the bar is loaded with a force of 25 N opposite to the direction of motion, what is the new steady-state speed? What is the efficiency of this machine under these circumstances?

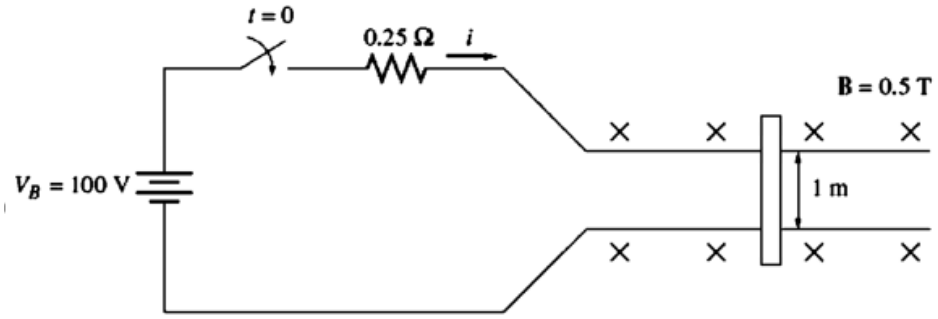

Figure 1.6: The linear machine

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