ECE 320 Recitation: Wednesday 29 February 2010
Homework
Intro to DC Machines

1. Problem 1.9 on page 58 in the textbook.

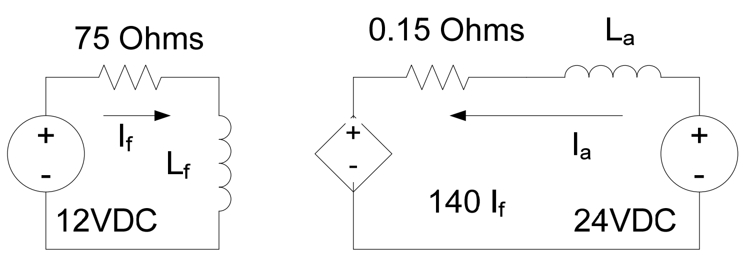
2. Problem 1.10 on page 58 in the textbook.

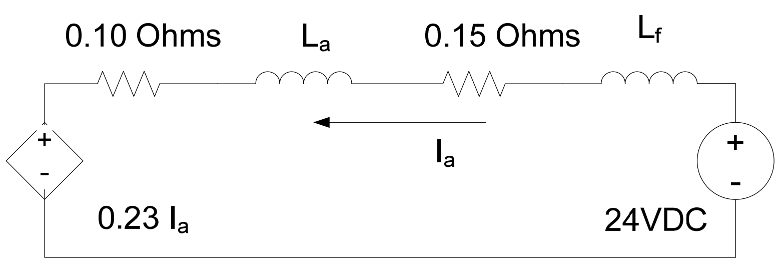
3. Problem 1.21 on page 63 of the textbook.

4. Identify the following parts of a DC machine. Your choice of method to identify them.

Armature	Field	Stator	Rotor
Leads	Terminals	Brushes	Field Poles
Field windings	Field magnets	Frame	End caps
Commutator	Armature winding	Teeth	Slots
Bearings	Shaft		

5. For the two circuits below, find the energy efficiency. The inputs are the independent sources; the outputs are the dependent sources.





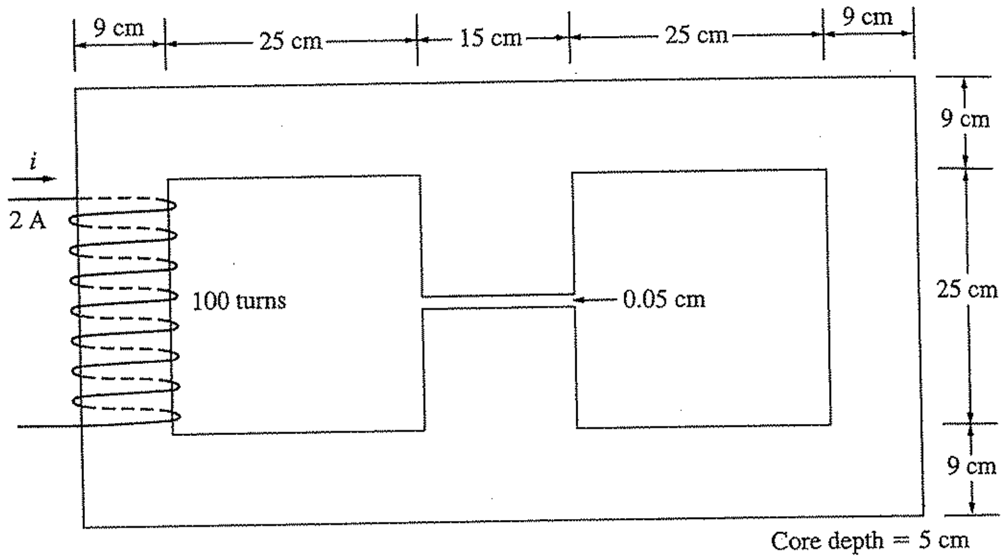


FIGURE P1–5
The core of Problem 1–8.

1–9. A wire is shown in Figure P1–6 that is carrying 2.0 A in the presence of a magnetic field. Calculate the magnitude and direction of the force induced on the wire.

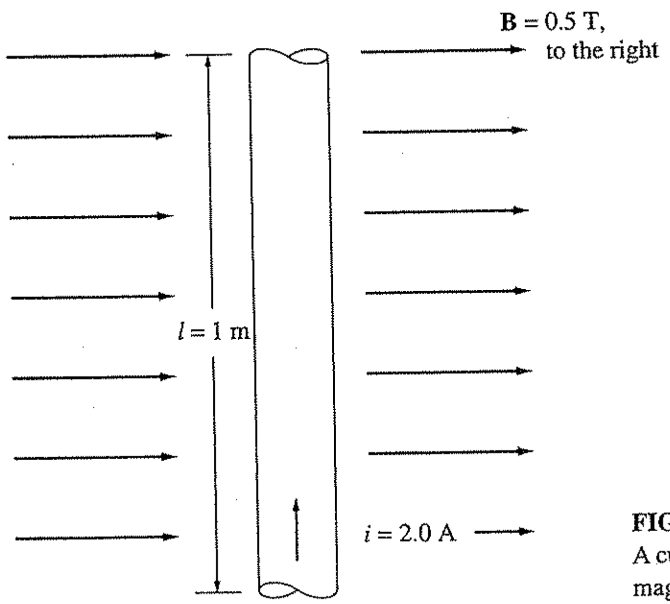


FIGURE P1–6
A current-carrying wire in a magnetic field (Problem 1–9).

1–10. A wire is shown in Figure P1–7 that is moving in the presence of a magnetic field. With the information given in the figure, determine the magnitude and direction of the induced voltage in the wire.

1–11. Repeat Problem 1–10 for the wire in Figure P1–8.

1–12. The core shown in Figure P1–4 is made of a steel whose magnetization curve is shown in Figure P1–9. Repeat Problem 1–7, but this time do *not* assume a constant value of μ_r. How much flux is produced in the core by the currents specified? What is the relative permeability of this core under these conditions? Was the assumption (*c*) Assume that the switch shown in the figure is now closed, and calculate the current **I**, the power factor, and the real, reactive, and apparent power being supplied by the source.

(*d*) How much real, reactive, and apparent power is being consumed by each load with the switch closed?

(*e*) What happened to the current flowing from the source when the switch closed? Why?

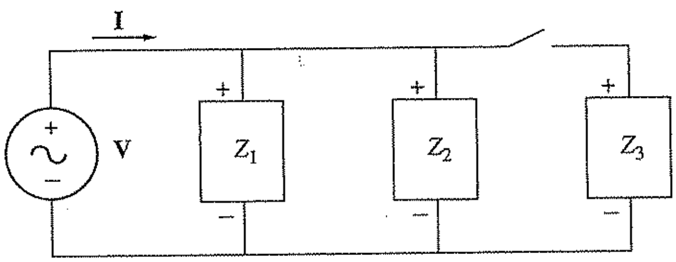


FIGURE P1–14
The circuit of Problem 1–19.

1–20. Demonstrate that Equation (1–59) can be derived from Equation (1–58) using simple trigonometric identities.

$$p(t) = v(t)i(t) = 2VI \cos \omega t \cos(\omega t - \theta) \quad (1\text{–}58)$$

$$p(t) = VI \cos \theta\ (1 + \cos 2\omega t) + VI \sin \theta \sin 2\omega t \quad (1\text{–}59)$$

Hint: The following identities will be useful:

$$\cos \alpha \cos \beta = \frac{1}{2}[\cos(\alpha - \beta) + \cos(\alpha + \beta)]$$

$$\cos(\alpha - \beta) = \cos \alpha \cos \beta + \sin \alpha \sin \beta$$

1–21. A linear machine shown in Figure P1–15 has a magnetic flux density of 0.5 T directed into the page, a resistance of 0.25 Ω, a bar length l = 1.0 m, and a battery voltage of 100 V.

(*a*) What is the initial force on the bar at starting? What is the initial current flow?

(*b*) What is the no-load steady-state 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 the machine under these circumstances?

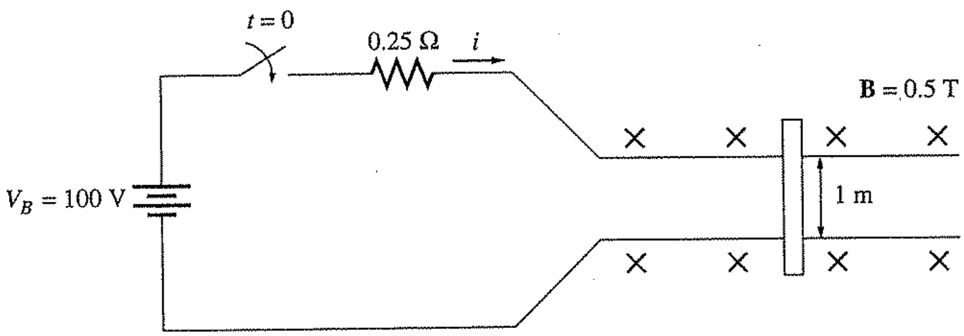


FIGURE P1–15
The linear machine in Problem 1–21.