6.334 Power Electronics
Spring 2007

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science

6.334 Power Electronics — Issued: February 9, 2007
Problem Set 1 — Due: February 16, 2007

Reading: KSV Chapter 3

Problem 1.1 KSV Problem 3.2.

Problem 1.2

Figure 1.1 shows a circuit model for the utility supplying one phase of an ac induction motor. The motor system parameters are Rs = 0.08 Ω, Lls = 1 mH, Lm = 40 mH, Llr = 1 mH, Rr = 0.1 Ω, and Rx = 33 Ω.

If the utility voltage is 170·cos(377t), what is the current into the motor?

At what power factor is the motor operating?

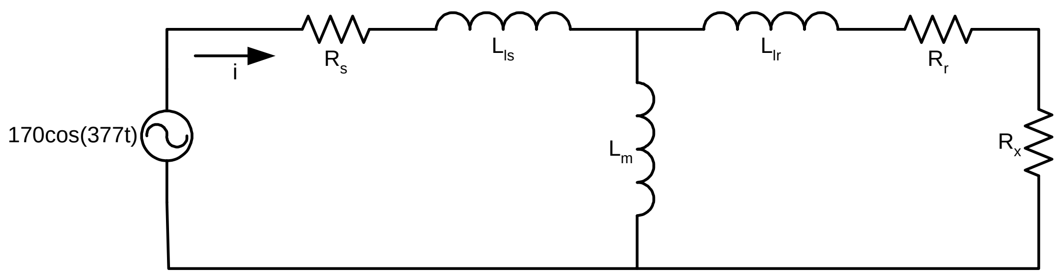

Figure 1.1 A Circuit model for one phase of an induction motor being driven by the utility.

Problem 1.3

Figure 1.2 shows a half-wave rectifier driven by a sinusoidal *current* source supplying a capacitively-filtered output. (Such a configuration is sometimes found in resonant dc-dc converters.) Determine the power factor seen by the current source, assuming that the diodes act ideally and capacitance C_f is large enough such that the output voltage has small ripple ($v_D \approx V_D$).

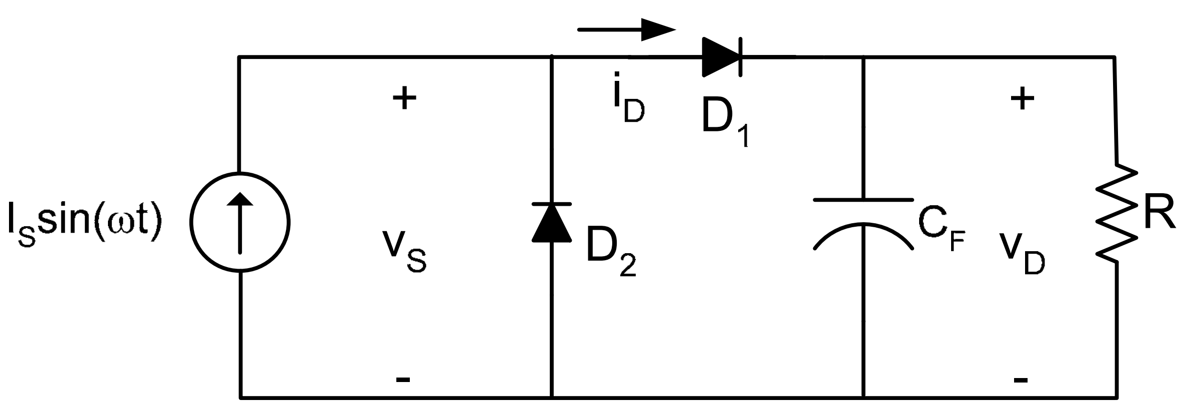

Figure 1.2 A half-wave rectifier driven from a sinusoidal current source.

Problem 1.4

Consider the half-wave rectifier circuit shown in KSV Fig. 3.9(a). What would the load regulation characteristic of this circuit be if it were driven with a *square wave* having peak voltage V_s and period $2\pi/\omega$, instead of a sine wave? Plot the resulting load regulation curve. (Note that this situation occurs in some types of isolated dc/dc power converters.)

Problem 1.5

Consider the magnetic stimulator circuit from the previous homework, repeated below as Fig. 1.3. Using any time-domain simulation tool you want (e.g. PSPICE, PSIM, etc.), simulate the circuit for 1 ms after the switch is closed. Assume that V_c = 950 V when switch S is closed. Note that links for acquiring some time-domain simulators are available on the 6.334 web page.

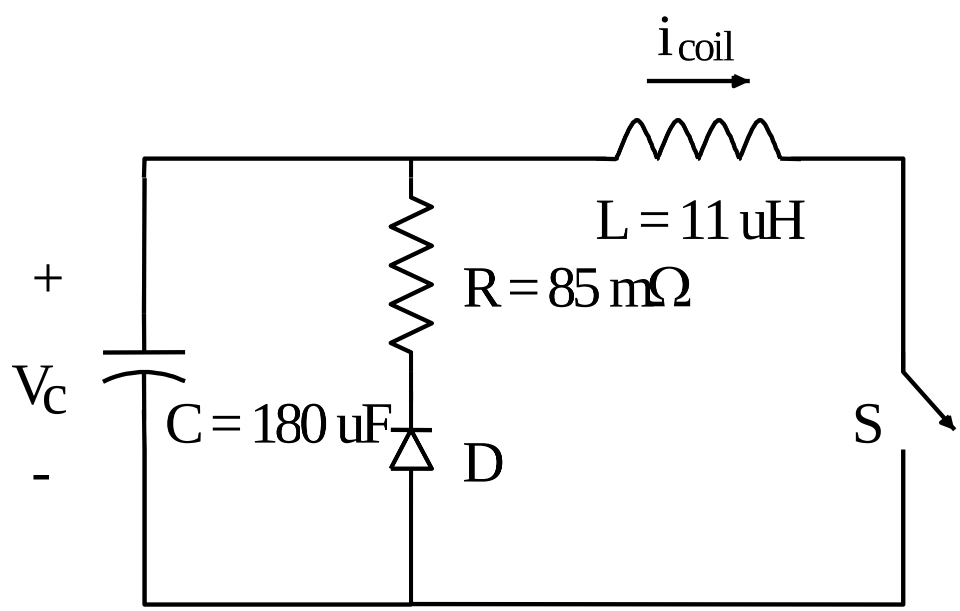

Figure 1.3 **Schematic of the magnetic stimulator circuit to be simulated. The capacitor voltage Vc is precharged to 950 V when the switch S is closed.**