

**EECS 40, Fall 2007**  
**Prof. Chang-Hasnain**

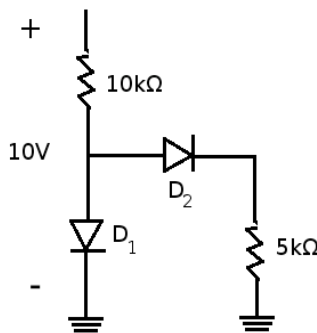
**Homework #8**

Due at 5 pm in 240 Cory on Thursday, 11/15/07  
 Total Points: 100

- Put (1) your name and (2) discussion section number on your homework.
- You need to put down all the derivation steps to obtain full credits of the problems. Numerical answers alone will at best receive low percentage partial credits.
- No late submission will be accepted except those with prior approval from Prof. Chang-Hasnain.
- Problems of this HW are from Hambley 4<sup>th</sup> Edition

**Large Signal Modeling of Diodes**

1. (Load Line Analysis) P10.24 (10 points)
2. (DC Models Diode) (12 points)

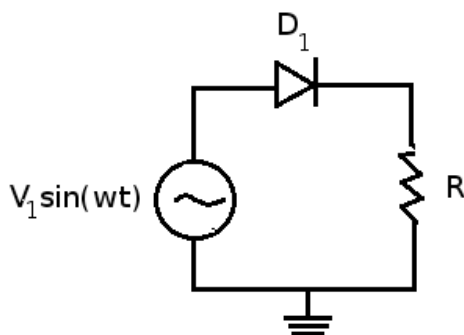


For the circuit on the left, calculate the currents and voltages of each diode

(a) assuming ideal diodes. (6 pts)

(b) assuming the constant voltage drop model (0.6 V) (6pts)

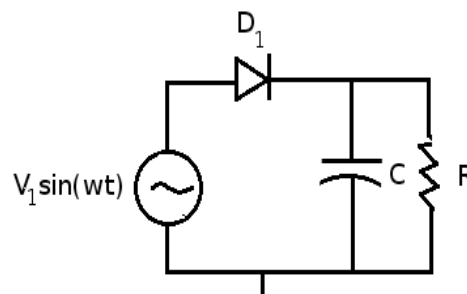
3. (Rectifier Circuits)



You have a device which requires DC voltage. However, you only have an AC voltage source. You try to design a rectifier circuit. In this question, you may assume the diode to be ideal. (27 pts)

(a) Your first approach is the circuit on the left. sketch the voltage at the diode and at the resistor as a function of time. There are two problems associated with this circuit. What are these? (4 pts)

(b) To improve on these problems, you come up with the following circuit. Sketch the voltage drop at the resistor qualitatively (you do not need the actual values to do that). (5pts)



(c) Still considering the circuit on the right, assume now  $R=1k\Omega$ ,  $C=100\mu F$ , and  $f=60\text{Hz}$ . Calculate the approximate lowest value of the voltage drop at the resistor as a function of  $V_1$ , and briefly comment on why your approximation holds. (6pts)

(d) Assume now you want to assure that the voltage drop across the resistor is never lower than 0.9, what value for  $C$  do you need to choose if  $R$  and  $f$  are fixed. (6pts)

(e) You now use a diode-bridge full-wave rectifier. Draw the configuration with the smoothing capacitor and the load resistor at the output. (3 pts)

(f) Repeat problem (d) with the configuration found in (e). (3 pts)

4. (Clipper Circuits) – 14 pts

You have a sinusoidal input voltage adhering to  $5V \sin(\omega t)$ .

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(a) Design a clipper circuit using diodes (assume the constant voltage drop model with 0.6V) and Zener diodes (ideal) that clips voltages above 4V, and also clips the signal during half of the time during which the input is negative. (8 pts)

(b) Explain the functionality of the designed circuit. Discuss voltage drops and currents of the diodes in the different phases of operation. (6 pts)

5. (Clamp Circuits) P10.76 (12 pts)

### **Small Signal Modeling of Diodes**

6. P10.78 (6 pts)

7. P10.79 (6 pts)

8. P10.80 (6 pts)

9. P10.83 (7 pts)