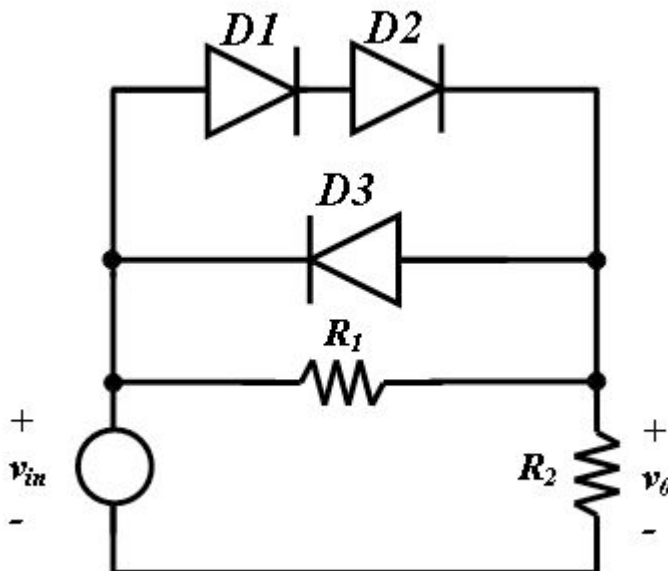


EECS 40, Spring 2007
Prof. Chang-Hasnain**Homework #10**

Due at 6 pm in 240 Cory on Wednesday, 04/18/07
Total Points: 100

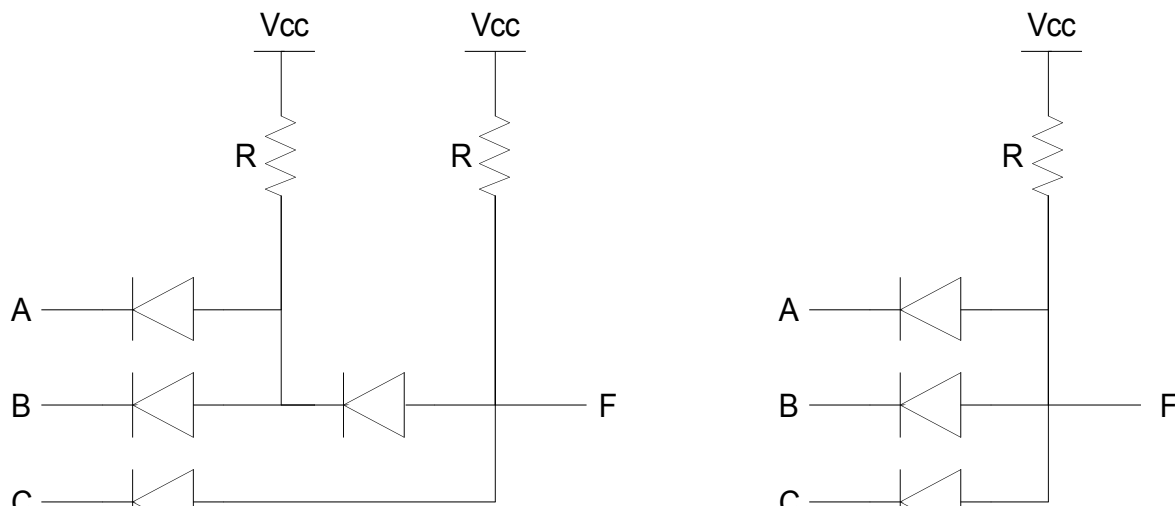
- Put (1) your name and (2) **discussion section number** on your homework.
- You need to put down all the derivation steps to obtain full credits of the problems. Numerical answers alone will at best receive low percentage partial credits.
- No late submission will be accepted expect those with prior approval from Prof. Chang-Hasnain.

1. Hambley, P10.46
2. Hambley, P10.48
3. Hambley, P10.52
4. Hambley, P10.55
5. Hambley, P10.57
6. Hambley, P10.60
7. Consider the following circuit:



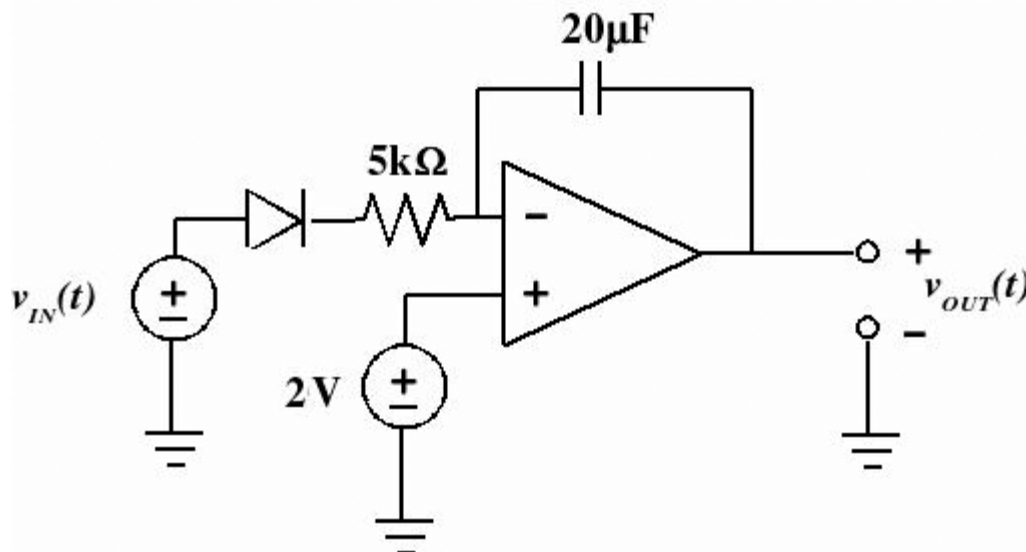
Use the 0.7 model for all the diodes, and let $R_2=2R_1$.
Sketch the voltage transfer characteristic (v_o vs v_{in}) for v_{in} ranging from -5V to +5V

8. Diode Logic: In this problem, we will compare 2 implementations in diode logic of the same logic function.



- (a) What is the logic function performed by these circuits?
- (b) Now let $V_{cc} = 3V$, $R = 100k$, and use the $0.7V$ model for the diodes. When all three inputs are low ($0V$), what is V_{out} (the voltage at F) for each circuit?
- (c) Using the same values, what is the power dissipated in each circuit.
- (d) Which circuit is better, and why?

9. Diode + Op-Amp: Consider the following circuit:



Use the $0.7V$ model for the diode.

- (a) What is $v_{OUT}(t)$ as a function of $v_{IN}(t)$ when the diode is on?
- (b) What is $v_{OUT}(t)$ as a function of $v_{IN}(t)$ when the diode is off?
- (c) For what values of $v_{IN}(t)$ is the diode on?
- (d) Let $v_{IN}(t)$ be a 50 Hz triangle wave with $V_{pp} = 20V$. Suppose the capacitor is initially uncharged. Plot $v_{OUT}(t)$ for $0 < t < 60$ ms.

10. Doping: Identify the majority carrier and find the electron and hole concentrations at room temperature in the following semiconductors:

(a) Silicon doped with phosphorus with a concentration of 10^{15}cm^{-3} .

(b) Silicon doped with both arsenic with a concentration of $5 \times 10^{17}\text{cm}^{-3}$ and boron with a concentration of $5.5 \times 10^{17}\text{cm}^{-3}$.

(c) Silicon doped with three impurities: arsenic with a concentration of 10^{16}cm^{-3} , boron with a concentration of $1.15 \times 10^{16}\text{cm}^{-3}$, and phosphorus with a concentration of $2.5 \times 10^{15}\text{cm}^{-3}$.