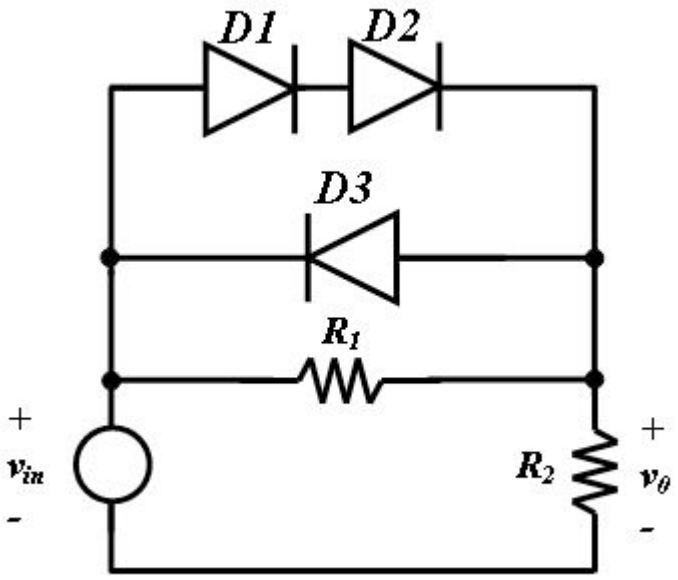
EECS 40/42/100, Spring 2007
Prof. Chang-Hasnain

Homework #10

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

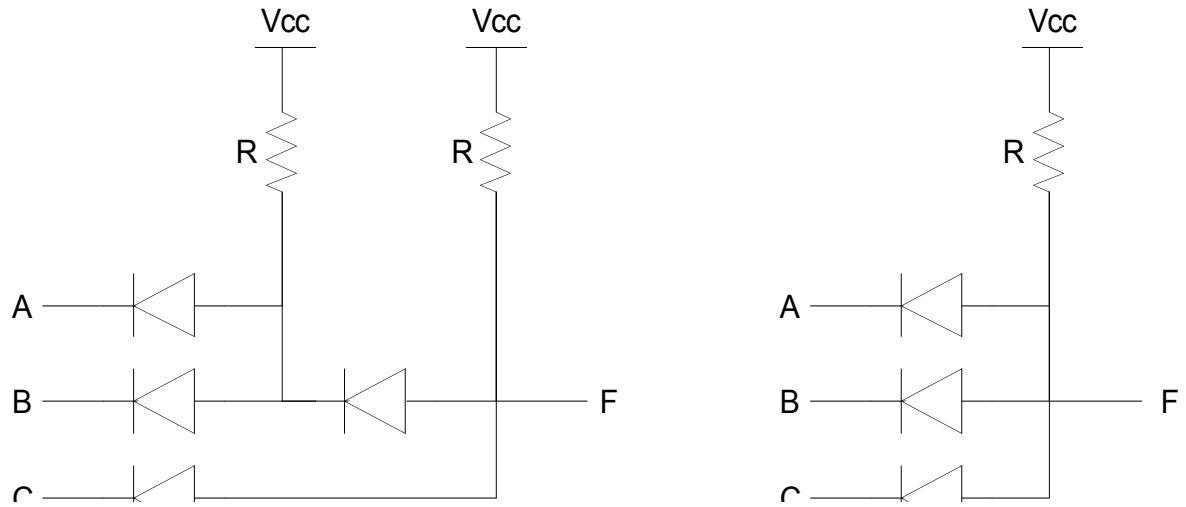
- Put (1) your name and (2) **discussion section number** on your homework.
- You need to put down all the derivation steps to obtain full credits of the problems. Numerical answers alone will at best receive low percentage partial credits.
- No late submission will be accepted expect those with prior 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 (EE40 Only)
7. Hambley, P10.62 (EE100 Only)
8. 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.

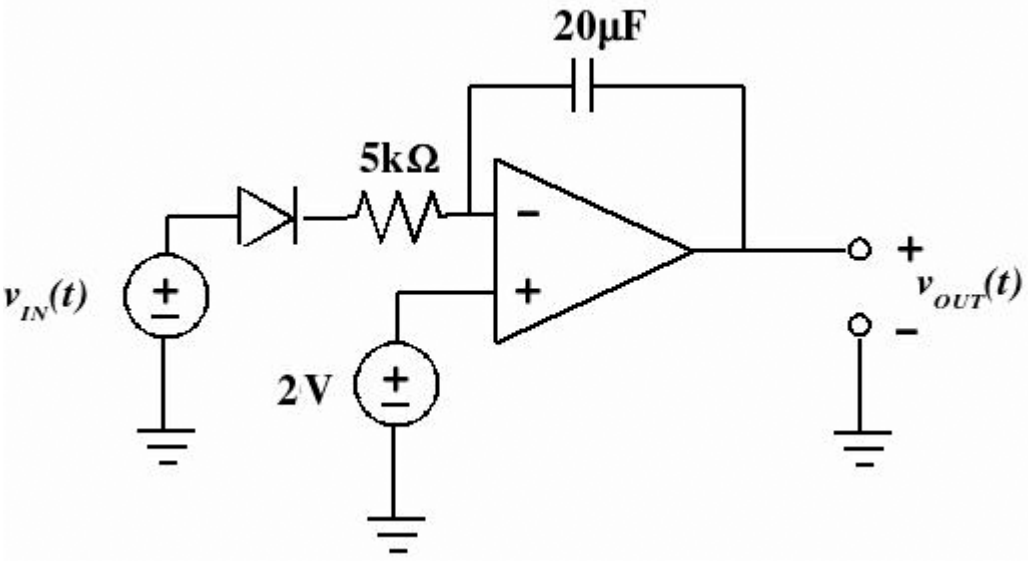
9. Diode Logic: In this problem, we will compare 2 implementations in diode logic of the same logic function.



(a) What is the logic function performed by these circuits?
(b) Now let Vcc = 3V, R = 100k, and use the 0.7V model for the diodes. When all three inputs are low (0V), what is Vout (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?

10. Hambley, P10.64 (EE100 Only)

11. Diode + Op-Amp: (EE40 Only)
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 Vpp = 20V. Suppose the capacitor is initially uncharged. Plot $v_{OUT}(t)$ for $0 < t < 60$ ms.

12. 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 arsenic with a concentration of $5x10^{17}cm^{-3}$ and boron with a concentration of $5.5x10^{17}cm^{-3}$.
(c) Silicon doped with three impurities: arsenic with a concentration of $10^{16}cm^{-3}$, boron with a concentration of $1.15x10^{16}cm^{-3}$, and phosphorus with a concentration of $2.5x10^{15}cm^{-3}$.