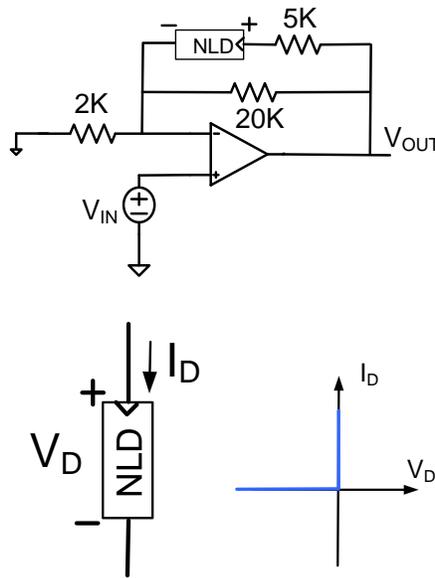


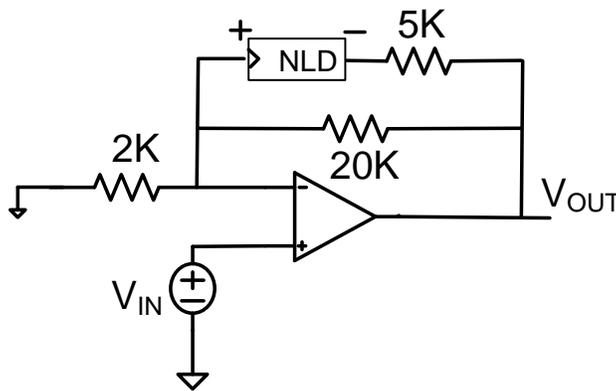
EE 230
 HW 9
 Spring 2010

Problem 1 Determine analytically and plot the transfer characteristics of the following circuit if the Nonlinear Device (NLD) can be modeled with the I-V

characteristics $\begin{cases} I_D = 0 & \text{for } V_D \leq 0 \\ V_D = 0 & \text{for } I_D > 0 \end{cases}$. The transfer characteristics of the NLD are shown below.



Problem 2 Repeat the previous problem if the nonlinear device orientation is reversed as show.

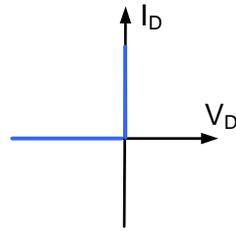
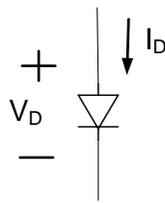
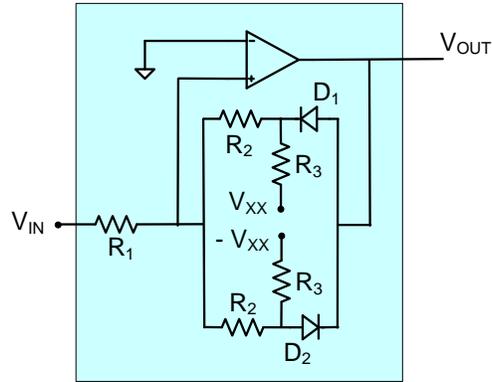


Problem 3

Assume the nonlinear devices, denoted as D_1 and D_2 , can be modeled as shown below.

- a) Obtain an expression for and plot the transfer characteristics of the following comparator

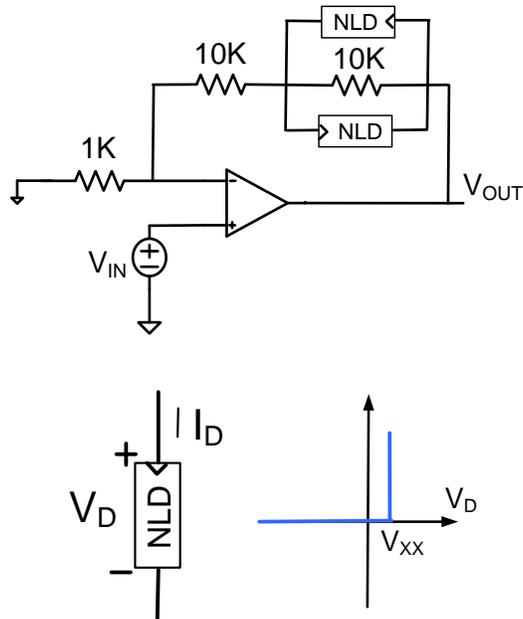
- b) Give an analytical expression for the center and the width of the hysteresis loop.



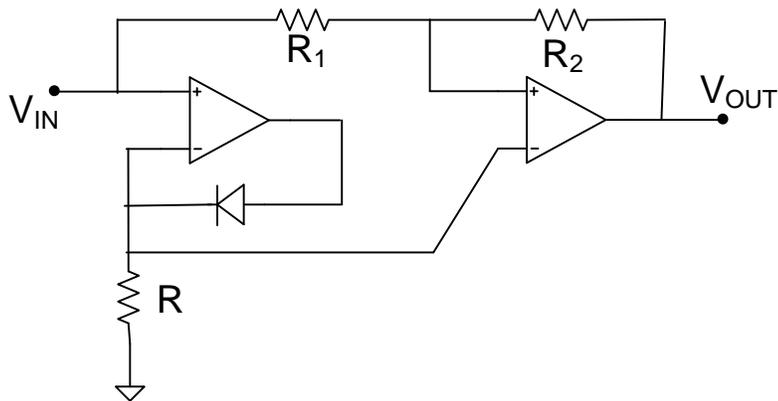
$$I_D = 0 \quad \text{if } V_D \leq 0$$

$$V_D = 0 \quad \text{if } I_D \geq 0$$

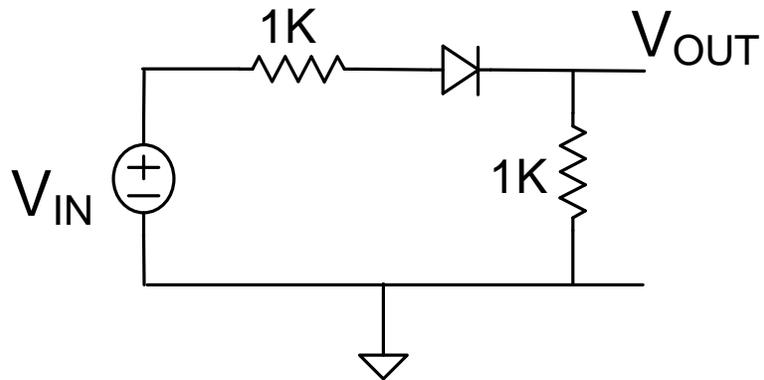
Problem 4 Obtain the transfer characteristics of the following circuit. Include the saturation characteristics of the op amp which is assumed to be biased with $\pm 15\text{V}$ supplies. Assume the NLD is characterized by the transfer characteristics shown below where $V_{XX}=0.6\text{V}$.



Problem 5 Assume the op amps are ideal except for output saturation voltages of $V_{SAT H}=15\text{V}$ and $V_{SAT L}=-15\text{V}$ and the diode can be modeled with a piecewise linear model with $V_{ON}=0.6\text{V}$. If the input is $V_{IN}=2\sin 1000t$, determine an analytical expression for and plot V_{OUT} if $R=1\text{K}$, $R_2=3\text{K}$ and $R_1=1\text{K}$.

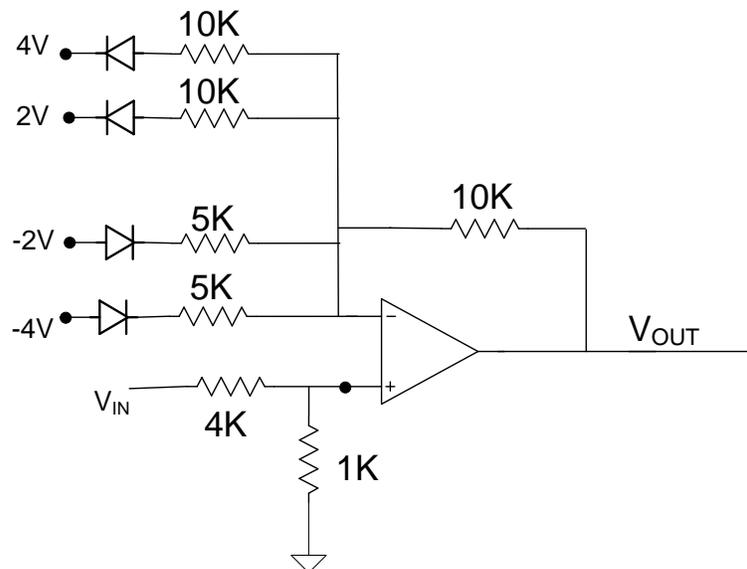


Problem 6 A rectifier circuit is shown below. Obtain the transfer characteristics and the output waveform if $V_{IN}=50\sin 60t$, if $V_{IN}=2\sin 60t$ and if $V_{IN}=0.5\sin 60t$. First solve this problem assuming the diode is ideal and then repeat the problem assuming the diode has an “ON” voltage of $0.6V$. Comment on how effective this circuit is at rectifying the input signal.



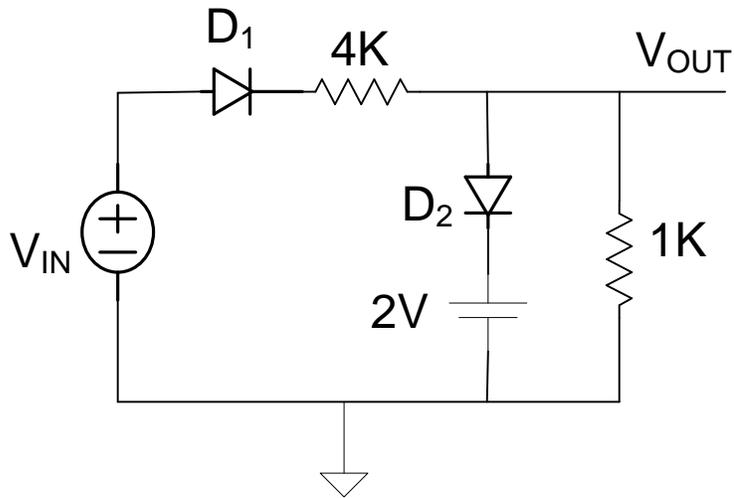
Problem 7 Design an amplifier circuit that has a voltage gain of $+1$ if $V_{IN}<0$ and $+2$ if $V_{IN}>0$. Assume ideal op amps and ideal diodes are available.

Problem 8 Obtain an analytical expression for and plot the transfer characteristics of the following circuit. Assume op amp and diodes are ideal.

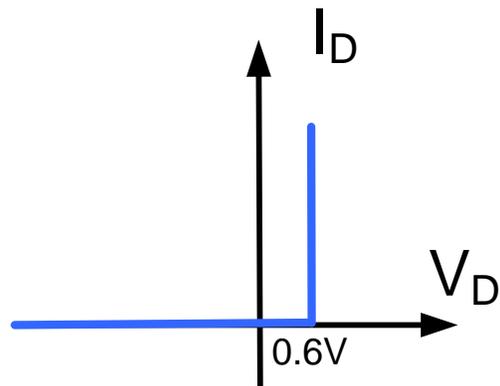


Problem 9 Assume the diodes in the following circuit are ideal.

- Determine V_{OUT} if $V_{IN}=5V$
- Obtain an expression for and plot the transfer characteristics, V_{OUT} vs V_{IN} , for $-20V < V_{IN} < 20V$.



Problem 10 Repeat Problem 9 part b if the diodes are modeled with the piecewise linear model given below



$$I_D = 0 \quad V_D < 0.6V$$

$$V_D = 0.6V \quad I_D > 0$$