EE 203 Name _____
Exam 2
Spring 2006

Instructions: There are 10 questions on this exam that are worth 2 pts each and 5 problems worth 16 points each. Answer all questions and solve all problems. All work should be included on the exam itself. Attach additional sheets only if you run out of space on a problem. Students may bring 4 pages of notes to the exam. Calculators are permitted but can not be shared.

Unless stated to the contrary, assume all diodes are ideal and all MOS transistors are from a process with $\mu_n C_{OX}=100\mu A/V^2$, $\mu_p C_{OX}=33\mu A/V^2$, $V_{Tn}=1V$, and $V_{Tp}= -1V$.

Questions:

1. In what year was the pn junction first introduced?

2. If an op amp has a slew rate of 0.5V/μsec and supply voltages of ±15V, what is the shortest time required for the op amp to make a transition from +15V to -15V?

3. What is a typical value for I_S in the diode equation?

4. What is a typical value for C_{OX} in a 0.5μ CMOS process?

5. What is the ratio between the mobility of electrons to the mobility of holes?

6. The terms MOS stand for Metal , Oxide and Semiconductor respectively. In most MOS transistors made today, one of these three terms is no longer descriptive of how the device is made. Which term is no longer descriptive?

7. What are the dominant carriers in n-doped silicon?

8. What is the major benefit of using a "precision rectifier" rather than a simple diode/resistor rectifier?

9. Reverse breakdown is avoided in most applications but one class of diodes are usually operated in the reverse breakdown mode. Which class of diodes are these?

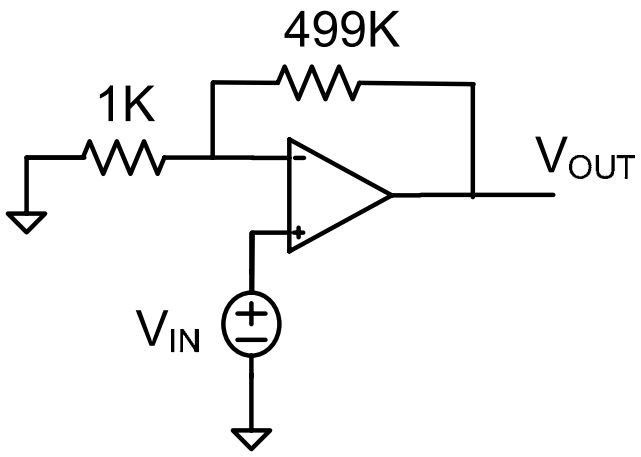
10. There are three identified regions of operation for the MOSFET. Most digital circuits ideally operate in two of these three regions. Which regions are these?

Problem 1
The amplifier shown is biased with ±18V power supplies

a) If the op amp is ideal except for an input offset voltage of 3mV and if the input is 0.01sin50000t, what is the desired output and what is the actual output?

b) If the op amp is ideal except for a slew rate of 1V/μsec and if the input is $V_m$sin10000t, what is the maximum value of Vm that can be applied without having slew rate distortion at the output?

c) (Extra Credit) If the input is .01sin50000t and if the Op Amp has a GB of 1MHz, what is the sinusoidal steady state output voltage?



Problem 2

Determine the variables indicated. Assume the diodes are ideal.

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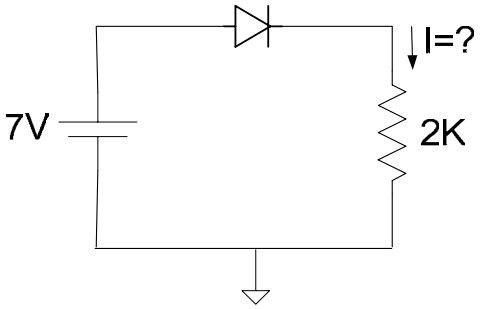

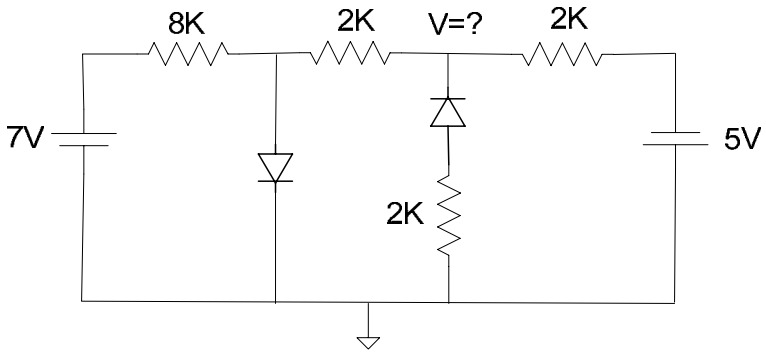

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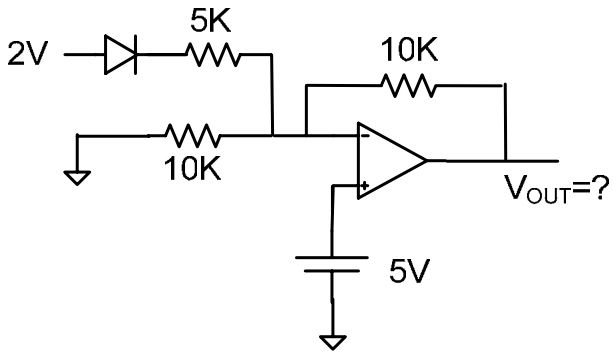
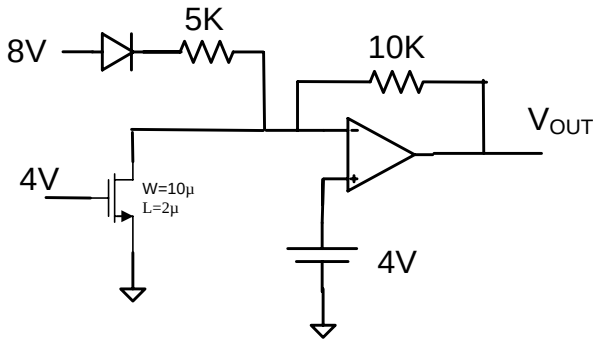
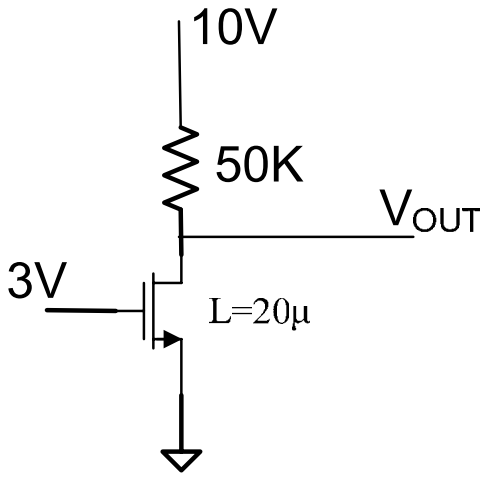




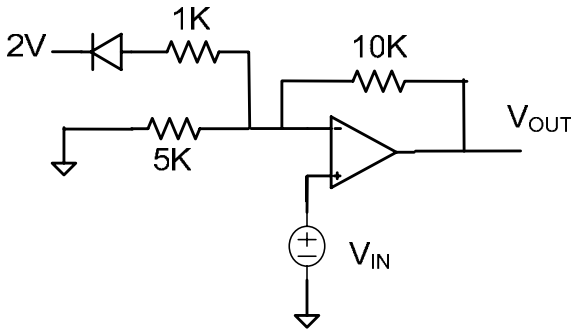
Problem 3

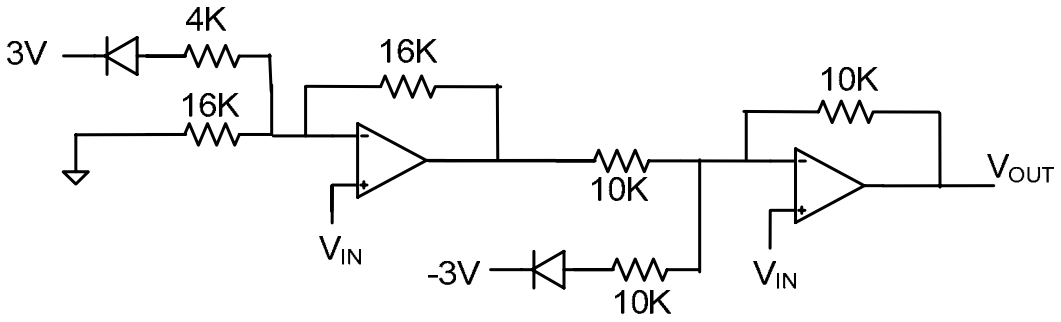
Determine the width W so that the output voltage of the circuit shown in 5V.



Problem 4

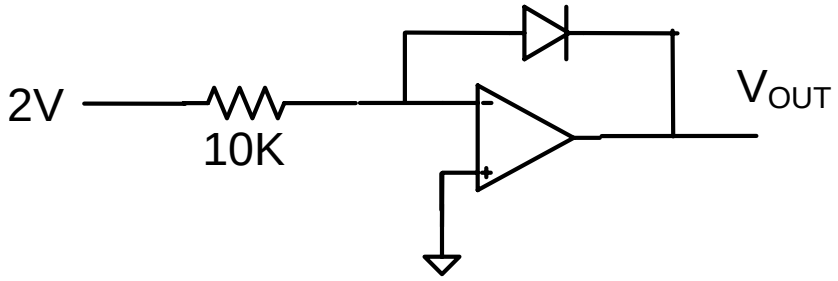
Obtain an expression for and plot the transfer characteristics of the following circuits. Assume the diodes are ideal.



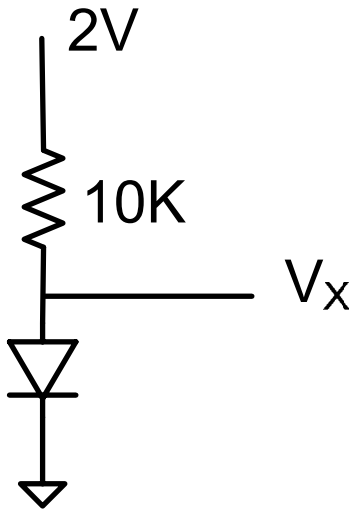


Problem 5

Accurately determine the output voltage for the circuit shown. Assume the diode is operating at 25°C and the parameter I_S for the diode at this temperature is 10^{-14}A.



Problem 6 (extra credit)
If the voltage V_X for the circuit shown was measured to be 0.65V at T = 25C, what would be the voltage at the same temperature if two additional identical diodes are placed in parallel with the diode (with anodes connected to anodes and cathodes connected to cathodes).



Problem 7 (extra credit) Obtain an expression for and plot the transfer characteristics for the following circuit.

(double extra credit) Obtain an expression for and plot the transfer characteristics for the following circuit if RF=7.5K