Homework Assignment 2 (Due 10/1)

Instructions: Answer the following questions based on the concepts discussed in class. Be sure to show all work where applicable. Please do not write your solutions on the question PDF

Problem 1: What are the different types of materials used in electronics? What are their charge carrier densities?

Problem 2: Why is silicon used in electronics?

Problem 3: Draw the atomic models of the p-type and n-type semiconductors.

Problem 4:

- What is this electronic device?
- Draw the I-V characteristics and explain what the threshold voltage is.

Problem 5: Write the ideal diode equation and explain each quantity in the equation.

- A silicon diode is connected in a circuit with a 5V power supply and a series resistor of 1kΩ. Draw the circuit. The saturation current of the diode is $I_s = 10^{-12}$. Use the diode equation to calculate the current through the diode when the voltage across it is 0.7V.

$n = 1$

$\frac{kt}{q} = 26mV$

- Find the voltage across the diode when the current through it is 1mA.

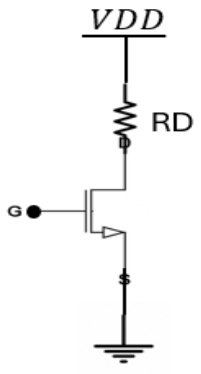
Problem 6: What is a MOSFET? What is a p-channel and n-channel MOSFET? Draw their side view and label each segment.

- A n-channel MOSFET is used in a circuit with a drain resistor RD=1kΩ and a supply voltage VDD=10V. The MOSFET has the following parameters:

V_{th}=2V

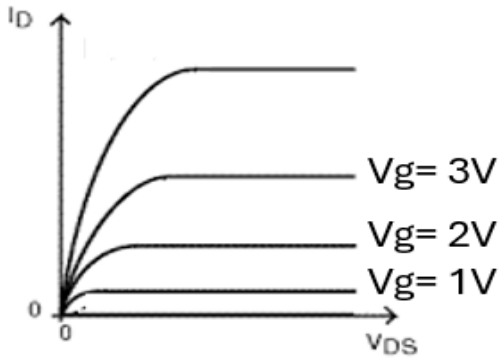
$\frac{\mu_n . C_{ox} . Z}{2L}$=0.5 $\frac{mA}{V^2}$

If VGS=4V, assuming the MOSFET is in the saturation region, calculate the current and voltage across the resistor.



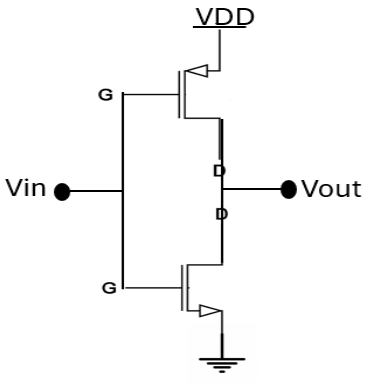
Problem 7: Draw the circuit symbol of p-channel and n-channel MOSFET.

Problem 8:



In the shown plot, draw curves for Vg<Vth. What is the state of the N-channel MOSFET?

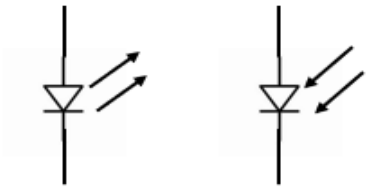
Problem 9: Fill up the table.



Vin	Vout
0	
VDD	

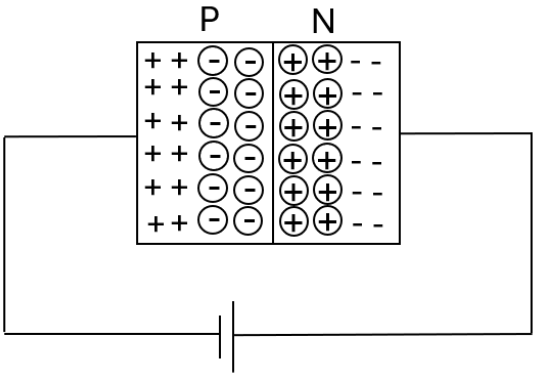
- What is this electronic device? Where can you use such a device?

Problem 10: What are these electronic component symbols?



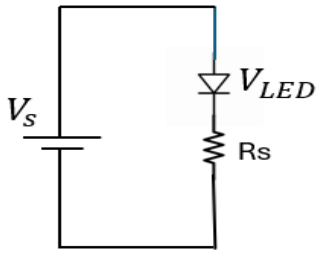
Problem 11: Define direct and indirect semiconductors that are used for optoelectronics.

Problem 12: If you shine light, show where the electron-hole pair will be generated. Draw a circuit to show the current flow direction.



Problem 13: How can you design a white-light LED?

Problem 14: Write the equation for circuit below if Vs=3.3V, VLED=2V. What value of Rs will give you 10mA of current.



Problem 15: Can you use the bottom photodetector to sense the light from the LED?