PROBLEM SET #4

Issued: Friday, September 14, 2018

Due: Friday, September 21, 2018, 12:00 noon via **Gradescope**.

1. Sedra & Smith, Problem 2.116

2. Sedra & Smith, Problem 2.118

3. Sedra & Smith, Problem 2.122

4. A diode is doped with $N_A = 10^{19}/cm^3$ on the *p*-type side and $N_D = 10^{18}/cm^3$ on the *n*-type side.

(a) What is the depletion-layer width w_d?

(b) What are the values of x_p and x_n?

(c) What is the value of the built-in potential of the junction?

(d) What is the value of E_{MAX}?

5. A diode has $I_S = 10^{-17}A$ and $n = 1$.

(a) What is the diode voltage if the diode current is $100\mu A$?

(b) What is the diode voltage if the diode current is $10\mu A$?

(c) What is the diode current for $v_D = 0$?

(d) What is the diode current for $v_D = -0.06V$?

(e) What is the diode current for $v_D = -4V$?

6. What is the zero-bias junction capacitance per cm^2 for a diode with $N_A = 10^{15}/cm^3$ on the *p*-type side and $N_D = 10^{20}/cm^3$ on the *n*-type side? What is the diode capacitance with a $5V$ reverse bias if the diode area is $0.01cm^2$?

7. Calculate the worst-case output voltage for the circuit in Figure PS4.1 if $V_{os} = 1mV$, $I_{B+} = 100nA$, and $I_{B-} = 95nA$. What would the ideal output voltage be? What is the total error in this circuit? Is there a better choice for the value of R_1? If so, what is the value?

8. The op amp in the circuit of Figure PS4.2 has an open-loop gain of 10,000, an offset voltage of $1mV$, and an input-bias current of $100nA$.

(a) What would be the output voltage for an ideal op amp?

(b) What is the actual output voltage for the worst-case polarity of offset voltage?

(c) What is the percentage error in the output voltage compared to the ideal output voltage?

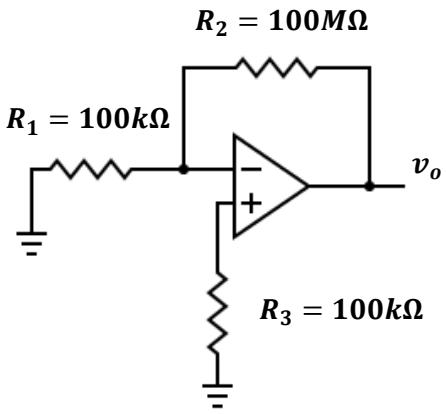

Figure PS4.1

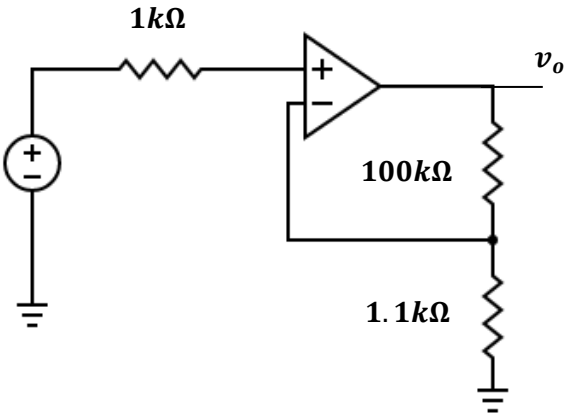

Figure PS4.2