

EECS 40, Summer 2005
Instructor: Octavian Florescu
Homework #5

Due Wed. 7/27 at 5PM in 2nd Floor Cory Dropbox
Total Points:

Note: Be sure to put (1) your name and (2) discussion section number on your homework. You will get the graded homework back in your discussion session.

Operational Amplifiers

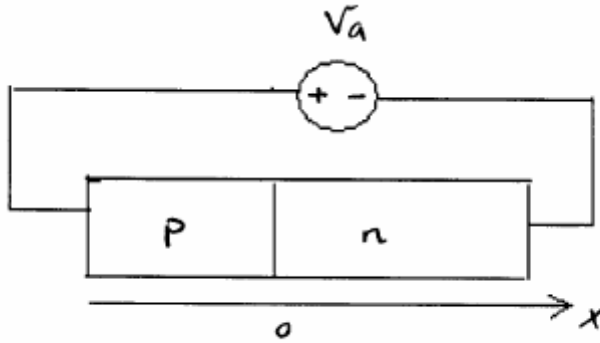
1. Problem 14.11 in the textbook
2. Problem 14.27 in the textbook

Semiconductor Devices

3. A silicon region is doped with acceptors at $N_a = 10^{15} \text{ cm}^{-3}$ and with donors at $N_d = 8 \times 10^{14} \text{ cm}^{-3}$.
 - a. What type is the silicon? (n-type or p-type)
 - b. What electric field must be applied for the magnitude of the drift velocity of the majority carriers to be $4 \times 10^6 \text{ cm/s}$?
4.
 - a. A region of silicon is doped with three impurities. arsenic: 10^{16} cm^{-3} , boron: $1.15 \times 10^{16} \text{ cm}^{-3}$ and phosphorus: $2.5 \times 10^{15} \text{ cm}^{-3}$. Find the electron and hole concentration at the room temperature.
 - b. Given a sheet resistance of $250 \Omega/\text{square}$ in a $11 \mu\text{m}$ thick p-type implanted layer:
 - i. What is the average acceptor concentration in the layer?
 - ii. Sketch the layout for a $2.5 \text{ K}\Omega$ resistor.
5. Given an n-type ion implanted layer with thickness $t = 1 \mu\text{m}$ and average doping concentration $N_d = 10^{17} \text{ cm}^{-3}$, what is the sheet resistance?

pn Junctions and Diodes:

6. Consider a pn junction under equilibrium, $V_a = 0$, with $N_a = 10^{17} \text{ cm}^{-3}$ and $N_d = 10^{14} \text{ cm}^{-3}$.



- What is the value of the built-in potential?
- What is the depletion width?
- Draw the electric field, the electric potential and the charge density plot with respect to x .
- Repeat parts a, b and c for $V_a = -0.5$ V and $V_a = 0.5$ volts. Compare your results.

- Problem 10.6 in the textbook
- Problem 10.8 in the textbook
- Problem 10.32 in the textbook
- Problem 10.33 in the textbook
- Problem 10.35 in the textbook

MOSFET:

- Problem 12.3 in the text book
- Problem 12.5 in the text book
- Problem 12.9 in the text book
- Problem 12.13 in the text book
- Problem 12.17 in the textbook