ECE 3040 Microelectronic Circuits Quiz 1
May 25, 2005

Professor Leach   Name⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽

Instructions. Print your name in the space above. The quiz is closed-book, closed-notes, and closed calculator. **Honor Code Statement:** *I have neither given nor received help on this quiz.* Initials ⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽

1. Mathematically, how does one define the condition of electrical neutrality in a semi-conductor? Define the symbols in the equation or equations.

2. What physical property of atoms distinguishes semiconductors from conductors and insulators?

3. (a) How does the resistance of a wire vary with its area S? (b) Prove that the resistance of two wires in parallel, one with area S_1 and the other with area S_2, is equivalent to a single wire of area $S_1 + S_2$.

4. When an electric field is applied to a conductor, a force is exerted on the free electrons. How are the average acceleration and average velocity of the electrons related to the electric field?

5. What is the symbol for and the units of current density?

6. What is the voltage across a pn junction called? Explain briefly what generates this voltage and what limits the value of the voltage.

7. (a) In a graded n-type semiconductor rod, $n_1 > n_2$. What is the direction of the electric field? (b) In a graded p-type semiconductor rod, $p_1 < p_2$. What is the direction of the electric field? (c) What is the direction of the electric field in the depletion region of a pn junction?

8. (a) When an external battery is connected to a pn junction, how does the width of the depletion region vary with battery voltage? (b) Explain why the width of the depletion region can never be reduced to zero.