NAME:_____   **PUID:** _____

Week 8 Quiz: Deviations from Ideal and Small Signal Model
ECE 305: Semiconductor Devices
Mark Lundstrom, Purdue University, Spring 2015

Answer the **multiple choice questions** below by choosing the **one, best answer**.

1)   Which of the following is true about "impact ionization"?
   a) It is the cause of avalanche breakdown.
   b) It can be initiated by either electrons or holes.
   c) It generates both electrons and holes.
   d) All of the above.
   e) None of the above.

2)   What effect does quantum mechanical tunneling have on a PN junction?
   a) It can lead to reverse breakdown at low voltages (-5 < V < 0).
   b) It can lead to reverse breakdown at high voltages (V < -15).
   c) It can lead to current "roll-off" at high voltages.
   d) It can increase the series resistance of a diode.
   e) It is the most common cause for n = 2 currents at low forward bias.

3)   Why does the reverse bias current increase as the square root of voltage in a Si diode?
   a) Because of quantum mechanical tunneling.
   b) Because of impact ionization.
   c) Because of recombination in the transition region.
   d) Because of generation in the transition region.
   e) Because of series resistance.

4)   What is the primary reason for the strong temperature dependence of the forward biased current in an N+P junction?
   a) The D_n term in J_0 .
   b) The L_n term in J_0 .
   c) The N_A term in J_0 .
   d) The n_i^2 term in J_0 .
   e) None of the above

5) Which of the following is true about the small signal model of a PN junction?
   a) It consists of a resistor in series with a capacitor.
   b) It consists of a resistor in parallel with a capacitor.
   c) It consists of a resistor in series with an inductor.
   d) It consists of a resistor in parallel with an inductor.
   e) It consists of a resistor in parallel with a capacitor in parallel with an inductor.

6) Which of the following is true about the resistor in the small signal model of a diode?
   a) It has a very large value in reverse bias and a very small value in forward bias.
   b) It is equal to $\left(dI_D/dV_A \right)^{-1}$.
   c) In forward bias, it is very close to $\left(k_B T/q \right)/I_D$.
   d) All of the above.
   e) None of the above.

7) Which of the following is true of the <u>junction</u> capacitance?
   a) It is proportional to $1/\sqrt{V_{bi}-V_A}$.
   b) It is proportional to $\sqrt{V_{bi}-V_A}$.
   c) It is proportional to $1/\left(V_{bi}-V_A \right)$
   d) It is proportional to $\left(V_{bi}-V_A \right)$.
   e) It is proportional to $\exp\left(qV_A/k_B T \right)$.

8) Which of the following is true of the <u>diffusion</u> capacitance?
   a) It is proportional to $1/\sqrt{V_{bi}-V_A}$.
   b) It is proportional to $\sqrt{V_{bi}-V_A}$.
   c) It is proportional to $1/\left(V_{bi}-V_A \right)$
   d) It is proportional to $\left(V_{bi}-V_A \right)$.
   e) It is proportional to $\exp\left(qV_A/k_B T \right)$.

9) What is $\Delta n = \left(n_i^2/N_A \right)\left(e^{qV_A/k_B T} - 1 \right)$ called?
   a) The Einstein relation .
   b) The Caughey-Thomas relation.
   c) The second law of thermodynamics.
   d) Moore's Law
   e) The Law of the Junction.