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Week 13 Quiz ANSWERS: Nonideal MOS
ECE 305: Semiconductor Devices
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Answer the **multiple choice questions** below by choosing the **one, best answer**.

- 1) The flatband voltage of a modern Si transistor is not zero. What is the main reason?
 - a) Charge in the oxide.
 - b) Charge at the gate-oxide interface.
 - c) Charge at the oxide-silicon interface.
 - d) **The gate electrode to Si workfunction difference.**
 - e) Non-uniform doping in the semiconductor.

- 2) Assume that there is sheet charge (C/cm^2) located in the oxide. At what location does it have the greatest effect on the threshold voltage?
 - a) At the metal-oxide interface.
 - b) **At the oxide-semiconductor interface.**
 - c) One Debye length away from the oxide-semiconductor interface.
 - d) In the middle of the oxide, halfway between the metal and semiconductor.
 - e) The effect is independent of the location of the charge sheet.

- 3) What effect do sodium ions in the oxide have on a MOS-C?
 - a) They change the electron affinity of the oxide.
 - b) They change the workfunction of the oxide.
 - c) They etch the oxide away.
 - d) **They lead to a shift in the threshold voltage whose magnitude changes over time.**
 - e) They increase the conductivity (i.e. reduce the resistivity) of the oxide.

- 4) Which surface orientation produces the largest fixed charge at the oxide-silicon interface?
 - a) (100).
 - b) (001).
 - c) (110).
 - d) (011).
 - e) **(111).**

- 5) What effect do interfacial traps have on an MOS-C?
 - a) They increase the oxide capacitance.
 - b) They decrease the oxide capacitance.
 - c) They increase the inversion capacitance.

- d) They decrease the inversion capacitance.
 - e) They distort the transition from accumulation to inversion.**
- 6) How does exposure to radiation (e.g. x-rays, energetic electrons, protons, etc.) affect MOS devices?
- a) It changes the metal workfunction.
 - b) It introduces traps in the oxide and at the oxide-silicon interface.**
 - c) It changes the doping near the semiconductor surface.
 - d) It changes the electron affinity of the semiconductor.
 - e) It changes the electron affinity of the oxide.
- 7) What does the term “negative bias instability” refer to?
- a) The triggering of an MOS device into an unstable oscillation under the right bias conditions.
 - b) A shift of threshold voltage in the negative direction after the application of a large, negative bias on the gate.**
 - c) A shift of the threshold voltage in the negative direction after the application of a large, positive bias on the gate.
 - d) A shift of the threshold voltage in the positive direction after the application of a large, positive bias on the gate.
 - e) A shift of the threshold voltage in the positive direction after the application of a large, negative bias on the gate.