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**Week 6 Quiz ANSWERS: Device Fabrication and PN Diodes I**

**ECE 305: Semiconductor Devices**

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

- 1) Ion implantation is a technique to do what?
  - a) **Dope a semiconductor.**
  - b) Deposit an insulating layer on a semiconductor.
  - c) Deposit a metallic layer on a semiconductor.
  - d) Deposit an insulating layer on an insulator.
  - e) Deposit a metallic layer on an insulator.
  
- 2) What is "lithography" used for in semiconductor manufacturing?
  - a) To dope semiconductors.
  - b) To deposit amorphous films on semiconductors.
  - c) To deposit polycrystalline films on semiconductors.
  - d) To grow crystalline films on semiconductors.
  - e) **To produce patterns in the films deposited on semiconductors.**
  
- 3) What is the most common insulator used in silicon manufacturing?
  - a)  $\text{Si}_3\text{N}_4$
  - b)  $\text{Al}_2\text{O}_3$ .
  - c)  **$\text{SiO}_2$ . \*\*\* These days, it is being replaced by so-called hi-K materials for the gate oxide of transistors, but  $\text{SiO}_2$  is used in many other places in IC manufacturing.**
  - d)  $\text{HfO}_2$ .
  - e)  $\text{Ta}_2\text{O}_5$ .
  
- 4) Which of the following statements is true about the magnitude of the electric field in the transition region of an NP junction?
  - a) It is constant in space.
  - b) It increases linearly from the N side to the P-side.
  - c) It decreases linearly from the N side to the P-side..
  - d) **It first increases linearly, reaches a peak at the junction, then decreases linearly.**
  - e) It increases quadratically from the N side to the P-side.

- 5) Which of the following is true about the electron density in the transition region  $-x_n < x < x_p$  of an NP junction?
- It is less than  $n_i$  everywhere.
  - It is zero everywhere.
  - It is much less than the doping density over most of the transition region.**
  - It varies with space as  $\exp(-x / L_n)$ .
  - It varies with space as  $\cosh(x / L_n)$ .
- 6) The built-in potential of an NP junction is roughly equal to what in magnitude?
- The thermal voltage,  $k_B T / q$ .
  - $3k_B T / 2q$ .
  - 110 V.
  - The bandgap of the semiconductor in eV.**
  - The electron affinity of the semiconductor in eV.
- 7) What happens if we insert an intrinsic (undoped) layer between the N and P layers of an NP junction?
- The built-in potential decreases by about a factor of 2.
  - The built-in potential increases by about a factor of 2..
  - The built-in potential becomes zero.
  - The built-in potential becomes  $k_B T / q$ .
  - The built-in potential does not change.** \*\*\* It only depends on the two ends - not on what is in between.