Assignment: Semiconductor Devices

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1. What is the difference between conductor, semi-conductor, and insulator?

Ans: The level of conductivity is different in the above classifications. Conductor let energy of any form to flow thru it. Insulator won't let anything to flow thru it. But Semiconductor is partially conductor. By tuning the property, we can let the semi-conductor to conduct/non-conduct

2. Which semiconductor material used mostly for IC design and why?

Silicon is the mostly used material and the reason is available abundantly in the nature and has higher melting point than other semiconductors

3. What is the difference between Silicon and Germanium?

Atomic # is 32 for Ge and 14 for Si. Valence electrons are far from nucleus Is the Ge meaning less force of attractions than Si. So can valance electrons escapes freely. Si withstand high melting point than Ge.

4. What is the difference between intrinsic and extrinsic semiconductor?

Holes and # electrons are same in intrinsic and differs in the extrinsic semiconductor materials.

5. What is doping?

Adding impurity in the semiconductor to induce the change in the level of conductions is called Doping.

What are the different types of trivalent and pentavalent impurity materials?

Pentavalent Impurities → Arsenic, Antimony, etc.

Trivalent Impurities → Aluminum, Boron, etc.

6. What is the difference between drift and diffusion?

Flow of current induced the electric field at the gate called drift current and diffution current is due to PN junction collision due to change in carrier concentrations.

7. What is PN junction?

PN Junction is the area where P and N material meets.

How it behaves without any external bias voltage?

This state is called Zero Bias and PN diffuse happens.

8. What is built-in potential of a P-N junction?

Theoretically for Si it is 0.7V

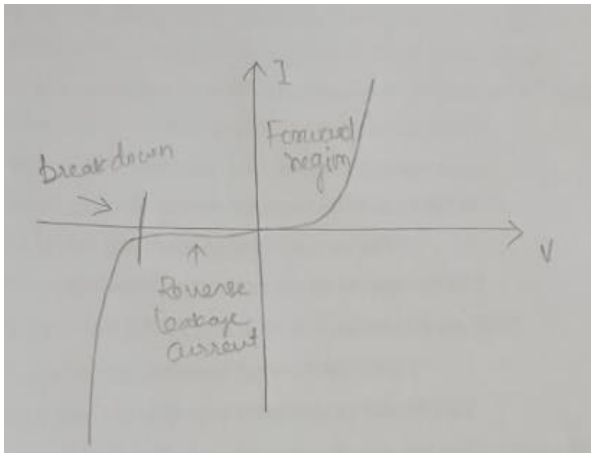
9. What is the PN Junction behavior at forward bias as well as reverse bias?

PN junction (diode) allows current to flow from one direction to another. Forward bias putting voltage to let current to flow but reverse bias is putting in opposite directions.

10. What is reverse saturation current of a PN junction diode? Is the reverse current in the diode caused by minority carrier diffusion towards depletion region.

11. What is junction or diffusion capacitance of a reverse biased PN junction? At reverse biased conditions, no current flows. At the period, both n and p regions start act as electrodes and depletion region between them act as di-electric. This situation is called diffusion cap at reverse biased PN junction.

si12. Draw the V-I characteristics of PN junction diode.



13. What is BJT and how it is different from the diode? BJT is the current controlled 3 terminal device where Diode is 2 terminal voltage-controlled device. BJT is 2 diodes config; 1 in forward and 1 in reverse biased.

14. What is the difference between NPN and PNP BJT? These types based on the doping types of three terminals.

NPN → two semiconductor junctions that have thin p-doped anode region

PNP → two semiconductor junction that have thin n-doped cathode region

15. What are the working principles of BJT?

Three terminal Base, Collector and Emitter is current controlled device which have emitter-base as one forward biased and collector-base as reverse biased conditions.

16. Draw the input and output characteristics of BJT

17. What is MOSFET and how it is different from BJT? Mosfet is metal oxide sem field effect transistor with gate/S/D terminals. It is voltage-controlled device. But BJT is current controlled. Mosfet used in high power applications while BJTs used inly in low current applications.

18. What are the different types of MOSFET? P and n channel mosfets

19. What are the different terminals of MOSFET?

Gate, Source, Drain and Bulk.

20. What is the difference between P-channel and N-channel MOSFET? P channel device S/D made of p type and n channel S/D made of n-type.

21. Why MOSFET is suitable for IC design?

Due to its greater switching speed, high scalability, less power consumptions

22. Define the working principle of MOSFET?

Voltage applied at the gate induce electric field. Results in formation channel between S and D and let current flows. Controlling Gate voltage, we can control Drain Current.

23. What are three different regions of operation of a MOSFET?

Cut-off, Linear and Saturations

24. Draw the Id-Vgs and Id-Vgs characteristic curve for MOSFET.

25. What are the different intrinsic capacitances associated with MOSFET? Intrinsic cap is the gate capacitance based on Width, Length and Oxide thickness.