**Chapter 5 – Semiconductors Basics**

Q1: What is Bohr's atomic model? A1: Bohr's atomic model states that electrons revolve in fixed orbits around the nucleus, and each orbit corresponds to a specific energy level.

Q2: What is an energy band in solids? A2: An energy band is a range of energy levels in a solid where electrons can exist, separated by gaps where no electron states are allowed.

Q3: Name the three important energy bands in solids. A3: Valence band, Conduction band, and Forbidden band (band gap).

Q4: What is the classification of solids based on energy bands? A4: Solids are classified as conductors, semiconductors, and insulators depending on the width of the band gap.

Q5: What is the band gap of silicon? A5: Approximately 1.1 eV at room temperature.

Q6: What is meant by "energy levels" in an atom? A6: Energy levels are discrete values of energy that an electron in an atom can possess.

Q7: Why is silicon widely used in electronics? A7: Silicon is abundant, has a suitable band gap, and can be easily doped to form p-type and n-type semiconductors.

Q8: What is a semiconductor? A8: A material with conductivity between that of a conductor and an insulator.

Q9: Give two examples of semiconductors. A9: Silicon (Si) and Germanium (Ge).

Q10: What is the band gap of germanium? A10: About 0.7 eV at room temperature.

Q11: What is an intrinsic semiconductor? A11: A pure semiconductor without any impurity atoms.

Q12: What is an extrinsic semiconductor? A12: A semiconductor with impurity atoms added to improve conductivity.

Q13: What is doping? A13: The process of adding impurity atoms to a semiconductor to modify its electrical properties.

Q14: What are the two types of extrinsic semiconductors? A14: n-type and p-type semiconductors.

Q15: What is an n-type semiconductor? A15: A semiconductor doped with pentavalent atoms, where electrons are majority carriers.



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Q16: What is a p-type semiconductor? A16: A semiconductor doped with trivalent atoms, where holes are majority carriers.

Q17: What is a majority carrier? A17: The main charge carrier in a semiconductor (electrons in n-type, holes in p-type).

Q18: What is a minority carrier? A18: The less common charge carrier in a semiconductor (holes in n-type, electrons in p-type).

Q19: What is a hole? A19: The absence of an electron in the valence band, acting like a positive charge.

Q20: Name two pentavalent doping elements. A20: Phosphorus (P) and Arsenic (As).

Q21: Name two trivalent doping elements. A21: Boron (B) and Gallium (Ga).

Q22: What happens to semiconductor conductivity with temperature? A22: Conductivity increases as temperature increases.

Q23: What is electron-hole pair generation? A23: The creation of a free electron and a hole when enough energy is supplied.

Q24: What is recombination? A24: When a free electron fills a hole, neutralizing both charges.

Q25: What is the crystal structure of silicon? A25: Diamond cubic structure.

Q26: What is a covalent bond? A26: A chemical bond where atoms share pairs of electrons.

Q27: How many valence electrons does silicon have? A27: Four valence electrons.

Q28: What is a conduction band? A28: The energy band where electrons are free to move and conduct electricity.

Q29: What is a valence band? A29: The energy band where electrons are bound to atoms.

Q30: What is a forbidden band? A30: The energy gap between the valence band and conduction band.

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**Chapter 6 – Semiconductor Diode**

Q1: What is a semiconductor diode? A1: A two-terminal electronic device made from a pn-junction that allows current to flow in one direction only.

Q2: What is the symbol of a diode? A2: A triangle pointing towards a line, where the triangle represents the anode and the line represents the cathode.


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Q3: What is the anode of a diode? A3: The positive terminal of the diode (p-type side).

Q4: What is the cathode of a diode? A4: The negative terminal of the diode (n-type side).

Q5: What is forward bias? A5: Connecting the anode to the positive and cathode to the negative terminal of a voltage source.

Q6: What is reverse bias? A6: Connecting the anode to the negative and cathode to the positive terminal of a voltage source.

Q7: What happens to the depletion layer in forward bias? A7: It becomes narrower, allowing current to flow.

Q8: What happens to the depletion layer in reverse bias? A8: It becomes wider, preventing current flow.

Q9: What is the cut-in voltage of a silicon diode? A9: Approximately 0.7 volts.

Q10: What is the cut-in voltage of a germanium diode? A10: Approximately 0.3 volts.

Q11: What is reverse saturation current? A11: The small leakage current that flows in reverse bias due to minority carriers.

Q12: What is breakdown voltage? A12: The reverse voltage at which the diode starts conducting heavily.

Q13: Name two types of breakdown in diodes. A13: Zener breakdown and avalanche breakdown.

Q14: What is a rectifier? A14: A circuit that converts AC into DC using diodes.

Q15: What is a half-wave rectifier? A15: A rectifier that allows only one half of the AC cycle to pass.

Q16: What is a full-wave rectifier? A16: A rectifier that allows both halves of the AC cycle to pass.

Q17: What is the difference between a center-tap rectifier and a bridge rectifier? A17: A center-tap rectifier uses two diodes and a center-tapped transformer, while a bridge rectifier uses four diodes without a center tap.

Q18: What is rectifier efficiency? A18: The ratio of DC output power to AC input power.

Q19: What is ripple factor? A19: A measure of the AC component present in the DC output of a rectifier.

Q20: How can ripple be reduced in rectifiers? A20: By using filters such as capacitors or inductors.

Q21: What is a filter in a rectifier circuit? A21: A component that smooths the DC output by reducing ripple.

Q22: What is a Zener diode? A22: A diode designed to operate in reverse breakdown for voltage regulation.


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Q23: What is the application of a Zener diode? A23: Voltage regulation and surge protection.

Q24: What is a clamping circuit? A24: A circuit that shifts the DC level of a signal without changing its shape.

Q25: What is a clipping circuit? A25: A circuit that removes part of a signal above or below a certain voltage level.

Q26: What is a Schottky diode? A26: A diode with a metal-semiconductor junction, having low forward voltage drop and fast switching speed.

Q27: What is the use of a Schottky diode? A27: In high-speed switching and low-voltage applications.

Q28: What is reverse recovery time? A28: The time taken by a diode to switch from conducting in forward bias to blocking in reverse bias.

Q29: What is a light-emitting diode (LED)? A29: A diode that emits light when forward biased.

Q30: Why does a diode conduct in one direction only? A30: Due to the behavior of the depletion layer and potential barrier at the pn-junction.

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**Chapter 7 – Special-Purpose Diodes**

Q1: What is a special-purpose diode? A1: A diode designed for a specific application beyond simple rectification, such as voltage regulation, light emission, or signal detection.

Q2: What is a Zener diode? A2: A diode designed to operate in reverse breakdown to provide a constant voltage output.

Q3: What is the main application of a Zener diode? A3: Voltage regulation and surge protection.

Q4: What is breakdown voltage in a Zener diode? A4: The reverse voltage at which the diode conducts heavily without damage.

Q5: What is an LED? A5: Light Emitting Diode – emits light when forward biased.

Q6: Name three common LED colors. A6: Red, green, and blue.

Q7: What determines the color of light in an LED? A7: The semiconductor material and its energy band gap.

Q8: What is a photodiode? A8: A diode that generates current when exposed to light.

Q9: What is the bias condition for operating a photodiode? A9: Usually operated in reverse bias for better sensitivity.


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Q10: Name two applications of photodiodes. A10: Light detection in cameras and optical communication systems.

Q11: What is a tunnel diode? A11: A diode with very high doping levels, showing negative resistance due to quantum tunneling.

Q12: What is a key application of tunnel diodes? A12: High-speed switching and microwave oscillators.

Q13: What is a varactor diode? A13: A diode used as a variable capacitor by changing the reverse bias voltage.

Q14: Where are varactor diodes used? A14: In tuning circuits of radios and TV receivers.

Q15: What is a Schottky diode? A15: A diode with a metal-semiconductor junction, having a low forward voltage drop.

Q16: What is the forward voltage drop of a Schottky diode? A16: Around 0.2 to 0.3 volts.

Q17: What is an optoisolator? A17: A device that transfers electrical signals using light, providing isolation between circuits.

Q18: Name two components inside an optoisolator. A18: An LED and a phototransistor.

Q19: What is a laser diode? A19: A diode that emits coherent, monochromatic light when forward biased.

Q20: Name two applications of laser diodes. A20: Optical fiber communication and barcode scanners.

Q21: What is a PIN diode? A21: A diode with an intrinsic (undoped) layer between p and n regions, used in high-frequency applications.

Q22: What is the use of a PIN diode? A22: RF switching and photodetection.

Q23: What is an avalanche diode? A23: A diode that operates in avalanche breakdown for high-voltage applications.

Q24: What is a Gunn diode? A24: A diode that generates microwave oscillations using the Gunn effect.

Q25: What is a photoemissive diode? A25: A diode that emits electrons when light falls on its surface.

Q26: What is the main difference between an LED and a photodiode? A26: LED emits light; photodiode detects light.

Q27: Why is a Zener diode connected in reverse bias for regulation? A27: Because it maintains a constant voltage in the breakdown region.


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Q28: What is a transient voltage suppression (TVS) diode? A28: A diode designed to protect circuits from voltage spikes.

Q29: What is the main use of an avalanche diode? A29: Over-voltage protection and microwave generation.

Q30: Name three optoelectronic devices based on diodes. A30: LED, photodiode, and laser diode.


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