<https://platform.openai.com/playground/assistants?assistant=asst_rPS5mUCgqzrpR461A7aZbUaP&thread=thread_s6s75M8A9mHyXINVV5BzRJI9>

https://platform.openai.com/playground/assistants?assistant=asst\_rPS5mUCgqzrpR461A7aZbUaP&thread=thread\_s6s75M8A9mHyXINVV5BzRJI9

1. Explain the operations of full-wave rectifier.
2. What does a clipper circuit do?
3. Explain the operations of a clamper circuit.
4. Which periodic table group do acceptor dopants belong to? Name some acceptor dopants.
5. Which chemical bond exists in Silicon crystal lattice? Give details.
6. Explain the forward-bias configuration of a diode.
7. Explain in detail the avalanche breakdown in a diode.
8. How is Zener breakdown different from avalanche breakdown?
9. Is it possible to implement NOT gate using only diode logic?
10. What is transconductance in BJT? Explain with equation.
11. What is transconductance in MOSFET? Explain with equation.
12. Explain the different biasing configuration of BJT.
13. Explain the small signal model of MOSFET.
14. Explain the structure of BJT.
15. Explain the structure of MOSFET.
16. How is the channel formed in MOSFET?
17. What are the operating regions of BJT?
18. What are the different operating regions of MOSFET?
19. In which operating region, the MOSFET can be used as an amplifier?
20. In which operating region, the MOSFET can be used as a switch?
21. Explain the pinch-off voltage in MOSFET.
22. What are intrinsic and extrinsic semiconductors?
23. What are the parameters influencing the gain of a Common source amplifier?
24. What are some possible applications of common drain amplifier configuration?
25. Give a brief comparison of Common source, Common drain and common gate configuration in terms of input resistance, output resistance and gain.
26. Mention some non-ideal effects observed in MOSFET.
27. What is channel length modulation of MOSFET? Explain with equation.
28. Under what conditions is body effect observed in MOSFET?
29. Explain the velocity saturation phenomenon in MOSFET.
30. Explain the conditions for MOSFET to be in saturation.
31. Explain the conditions for BJT to be in forward active region.
32. Explain the reverse breakdown in diode with necessary details.
33. How is a half-wave rectifier different from a full wave rectifier?
34. Explain the structure and operation of a CMOS NOT gate.
35. What are the sources of power dissipation in CMOS circuits? Explain with necessary details.
36. Briefly explain the Deal-Grove model of thermal oxidation.
37. What is lithography in the fabrication of CMOS?
38. How can you calculate the noise margin in CMOS inverter?
39. Define the propagation delay time in CMOS circuits.
40. What is drain induced barrier lowering?

True/False:

1. Anode and cathodes are the 2 terminals of MOSFET.
2. Latch-up is a reliability issue that is classified as a hard error and can cause the integrated circuit to fail permanently.
3. Static power dissipation in CMOS circuits consists mostly of the power dissipation during switching.
4. The small signal model of MOSFET is used to calculate the Q-point of the circuit.
5. Piranha solution or Piranha etch is a mixture of hydrochloric acid and nitric acid. – False
6. An error correction code that can recover from a single device or chip failure requires two ECC chips worth of check-bits. – true (Improving Memory Reliability by Bounding DRAM Faults)
7. Modeling of I/O clock jitter for the Transmitter/Receiver clock topology is a key problem in modeling a new I/O standard. – True (Modeling of DDR5 Signaling from Jitter Sequences to Accurate Bit Error Rate (BER))
8. Decision Feedback Equalization or DFE is employed to counter Inter-Symbol Interference or ISI in communication channels. – True
9. Decision Feedback Equalization or DFE can be used to improve Signal integrity in communication channels. – True (LPDDR5 (6.4 Gbps) 1-tap DFE Optimal Weight Determination)
10. A CMOS inverter consists of 5 MOS devices.
11. BJT works as an amplifier in the cutoff region.
12. MOSFET experiences no leakage current at all.
13. The reverse saturation current in diode is a function of the majority carrier concentration.
14. The 3 terminals of BJT are gate, drain and emitter.
15. In a common emitter amplifier, the input is provided at the collector and output is taken from the gate.
16. Boron is a p-type dopant.
17. In a Silicon lattice structure, the atoms are bound by ionic bonds.
18. In DDR5 design, imperfections in channel routing have no effect on the Signal Integrity margins. – False (DDR5 Electrical Challenges in High-Speed Server Design)
19. Pure semiconductors are very good conductors.
20. Common collector amplifier has very high gain.
21. Silicon is a group IV element.
22. It is possible to implement NOT gate using only diode logic.
23. If phosphorous is in group V of the periodic table, then it must be an acceptor atom.
24. Common drain amplifier is a follower circuit.
25. Channel length modulation becomes prominent in short channel devices.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| Generic | | | | | | | |
|  | 7b | 7b finetuned | 70b | 70b Teacher | Distilled 7b | RAG | GPT-4 |
| 1 |  |  |  |  |  |  |  |
| 2 | - |  |  |  |  | - |  |
| 3 | - | - | ~ |  | - |  |  |
| 4 |  | - |  | ~ |  |  |  |
| 5 |  | ~ |  |  |  |  |  |
| 6 |  |  |  | ~+ |  |  |  |
| 7 |  |  |  |  |  |  |  |
| 8 | - |  |  |  | - |  |  |
| 9 | - | - | - |  | - |  |  |
| 10 | ~ | ~ | ~ | ~+ |  |  |  |
| 11 | ~ | ~ | ~ | ~+ |  |  |  |
| 12 | - | - | ~ | -~+ | - |  |  |
| 13 | ~ | ~ | ~ | ~+ | ~ |  |  |
| 14 | ~ |  |  |  | - |  |  |
| 15 | ~ |  | ~ | ~ |  |  |  |
| 16 |  | ~ | ~ | ~ | ~ |  |  |
| 17 |  | - |  | ~- | - | ~- |  |
| 18 | - | - | ~ | ~- | - | ~- |  |
| 19 | - |  | - | - | - | - |  |
| 20 | - | ~ |  | - | - | - |  |
| 21 | - | - | ~ | ~ | ~ | ~ |  |
| 22 |  |  |  |  | ~ |  |  |
| 23 | - | ~ | ~ |  | -~ | ~ |  |
| 24 |  | - |  | - | - | -~ |  |
| 25 | - | - | ~- | - | ~ | ~- |  |
| 26 | - | - |  |  | ~ |  |  |
| 27 | - | - | - | ~- | - |  |  |
| 28 | - | - | - | ~ | - |  |  |
| 29 | - | - | ~ |  | - |  |  |
| 30 | - | - | ~ | ~ | - |  |  |
| 31 | - | ~ | ~ | +~ | - | ~- |  |
| 32 |  | ~ | ~ | ~+ | ~ |  |  |
| 33 |  |  |  |  |  | - |  |
| 34 | - | - |  |  |  | ~ |  |
| 35 | ~ | ~ |  |  | ~ |  |  |
| 36 | - |  |  |  | ~ |  |  |
| 37 |  |  |  |  |  |  |  |
| 38 | - | ~ | - | ~ | - | - |  |
| 39 | - | - |  | ~ |  |  |  |
| 40 | - | ~ |  | - | ~ |  |  |
| True/False | | | | | | | |
| 1 |  | ~ |  |  |  |  |  |
| 2 | - |  |  |  |  |  |  |
| 3 |  |  |  |  |  | - |  |
| 4 | - |  |  |  | ~ |  |  |
| 5 |  |  | - | - | - |  |  |
| 6 |  | - | - | - | - | - | - |
| 7 |  |  |  |  |  | ~ |  |
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| 9 |  |  | - |  | - |  |  |
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| 13 |  | - | - |  | - |  |  |
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| 19 |  |  |  |  |  |  |  |
| 20 |  | - |  |  |  |  |  |
| 21 | - |  |  | - |  |  |  |
| 22 | - |  |  |  |  |  |  |
| 23 | - | - |  |  | - |  |  |
| 24 | - | - |  |  | - |  |  |
| 25 |  |  |  |  |  |  |  |
|  | 18 | 19 | 21 | 21 | 19 | 17 |  |

I will give you 5 statements, read the statements carefully and decide if they are true or false. Answer ONLY true or false for each statement and NOTHING else. Answer based on your stacked knowledge.

* Got completely wrong

~ Partially correct/somewhat correct/could be better

~+ somewhere in between Partially correct/somewhat correct/could be better and golden answer

~- wrong to Partially correct/somewhat correct

+ Good answer

++ very good answer

Blank = correct answer

I am giving you 10 questions the answers to these 10 questions. Read the answers carefully evaluate the accuracy of the answers independently. Then based on 7-point likert scale rate the answers. Score the answers separately for accuracy and quality.

Define the 7-point likert scale as: Strongly agree - 7 points Agree - 6 points Somewhat agree - 5 points Neither agree nor disagree - 4 points Somewhat disagree -3 points Disagree - 2 points Strong disagree 1 point

Print the questions when you are answering and then put scores for accuracy and quality.

Reasoning/Optimization:

1. A n-type MOSFET (nmos) is operating in saturation. The gate to source voltage VGS is kept constant at 1V. The threshold voltage is also constant at 0.4 V. The carrier mobility of the MOSFET and the oxide parameters are constant. The channel length of the nmos (L) is fixed at 90 nm and the width (W) of the nmos Is 1 um. The aspect ratio is the nmos is calculated as W/L. I want to increase the drain current of the nmos by 3 times.
   1. Should I increase or decrease the width of the nmos?
   2. Based on the answer you just provided, calculate the new width of the nmos to increase the drain current by 3 times.
2. An electronic circuit has a voltage source of 10 V, 1 Silicon diode, and 2 resistances: Rs = 10 kohm and RL = 2 kohm. All the components are connected in series. There is a voltage drop of 0.7 V across the Silicon diode. The output voltage is measured across RL. Consider the voltage drop across the diode and both Rs and RL when calculating the total current through the circuit.
   1. Calculate the total current through the circuit.
   2. Based on the total current you just calculated, what is the value of the output voltage?
3. An electronic circuit has a voltage source of 10 V, 2 resistances: Rs = 8 kohm and RL = 2 kohm. All the components are connected in series. The output voltage is measured across RL.
   1. Calculate the output voltage.
   2. Based on the answer you just provided, the source voltage stays at 10 V and load resistance remains unchanged at 2 kohm. If I want to increase the output voltage by 2 times, we need to decrease the value of Rs. Calculate the new value of the Rs such that the new output voltage value is 2 times the present output voltage value calculated in the previous part.
4. There are 3 currents in BJT: base current IB, collector current IC and emitter current IE. The relationship between IC and IB is: IC = beta \* IB. For this case, beta = 100. If beta is constant and I want to get increase IC by 2 times, how much should I increase value of IB? Answer based on only the given information.
5. There are 2 resistances resistance 1 = 1 kohm and resistance 2 = 2 kohm connected in parallel with each other.
   1. Calculate the parallel equivalent resistance.
   2. Based on the answer you just provided, If I want the parallel equivalent resistance to be 0.5 kohm while keeping resistance 2 constant, what should be the new value of resistance 1?

The following problems test your comprehension of domain specific knowledge and your ability to apply reasoning and optimize designs based on given specifications.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Ground** | **7B** | **7B-LoRA** | **70B** | **70B-LoRA** | **Student** | **RAG** |
| **1a** | **Increase** | Increase | Increase | Increase | Increase | Increase | decrease |
| **1b** | **3 um** | 3 um | 3 um | 3 um | 3 um | 3 um | 330 nm |
| **2a** | **0.775 mA** | 1.28 A | 1.395 A | 5.58 mA | 5.58 mA | .06 A | x |
| **2b** | **1.55 V** | 0.83 V | 0.647 V | 11.16 V | 8.6 V | .7 V | x |
| **3a** | **2 V** | 5 V | 0.625 V | 2 V | 2 V | 5 V | 6 V |
| **3b** | **3 kohm** | 10 kohm | 13 kohm | 8 kohm | 4 kohm | 4 kohm | x |
| **4** | **2** | 2 | 2 | 2 | 2 | 2 | 2 |
| **5a** | **0.66 kohm** | 0.5 kohm | 3 kohm | 666.67 ohm | 2/3 kohm | 0.5 khm | x |
| **5b** | **.667 kohm** | 0.25 kohm | 1 kohm | 666.67 ohm | 0.5 kohm | 1.6 kohm | x |