Digital Electronics Question Bank - (4th Sem EE)

Unit 1: Number Systems and Boolean algebra

1. Convert $(234.625)_{10}$ to binary.
2. Convert $(10111.011)_2$ to decimal.
3. Convert $(5A2.B)_{16}$ to octal.
4. Convert $(673.4)_8$ to hexadecimal.
5. Perform binary addition: 11101 + 10111.
6. Perform binary subtraction: 11001 - 10110.
7. Perform binary multiplication: 1101 *1111
8. Perform binary division: 111100 \ 110.
9. Find the 2's complement of$101101)_2$
10. Subtract (1010) from (1101) using 2's complement.
11. Convert $(42)_{10}$ to Gray code.
12. Convert Gray code (11010) to binary.
13. State and prove the distributive laws of Boolean algebra.
14. Simplify: AB + A'C + BC given AB + C = 1.
15. Simplify: (A + B)(A' + C)(B + C).
16. Implement F(A, B, C) = A'B + AC' using NAND gates only.
17. Implement F(A, B, C) = (A + B')C using NOR gates only.
18. Draw the truth table for a 3-input XOR gate.
19. Explain the concept of Boolean duality.
20. Show how a XOR gate can be made from basic logic gates.
21. Perform the following conversions:

(a) $(3A.2F)_{16}$ to binary

(b) $(573)_8$ to decimal

(c) $(11011.011)_2$ to octal

(d) $(245)_{10}$ to Excess-3 code

22. Perform the following 2's complement arithmetic:

(a) 011010 + 101011

(b) 110010 - 011101

(c) Interpret the results, including overflow conditions.

23. Explain the application of Gray codes in digital systems, particularly in rotary encoders.

24. Design a BCD adder to add two BCD numbers and produce a BCD sum.

25. What is the Hamming code? Explain how it is used for error detection and correction.

26. Explain the difference between weighted and non-weighted codes with examples.

Unit 2: Combinational Logic Circuits

1. Minimize $F(A, B, C, D) = \sum m(0, 1, 4, 5, 9, 11, 12, 15)$ using a K-map.
2. Minimize $F(A, B, C, D) = \pi M(0, 2, 5, 8, 10, 13, 14)$ using a K-map.
3. Use the Quine-McCluskey method to simplify $F(A, B, C, D) = \sum m(0, 1, 3, 7, 8, 9, 11, 15)$.
4. Design a half-subtractor.
5. Design a full-subtractor using two half-subtractors and an OR gate.
6. Design a 4-bit adder-subtractor circuit.
7. Implement a 8-to-1 multiplexer using 4-to-1 multiplexers.
8. Implement a 1-to-16 demultiplexer using 1-to-4 demultiplexers.
9. Design a BCD to Excess-3 code converter.

10. Design a 2-bit magnitude comparator.

11. Explain the working of a parity generator and checker.

12. Design a circuit that detects the binary sequence 1001.

13. Design a decimal to BCD encoder.

14. Design a 4 to 2 encoder.

15. Explain how to expand a decoder.

16. Design a circuit to implement the boolean function, F=AB + CD with the use of gates.

17. Explain the concept of hazards in combinational circuits.

18. Simplify the Boolean expression using Karnaugh maps and implement it using NAND gates:

$$F(A,B,C,D)=\sum m(1,3,5,7,9,11,13,15)$$

19. Simplify the Boolean expression using Quine-McCluskey method:

$$F(A,B,C,D)=\sum m(0,1,3,7,8,9,11,15)$$

20. Implement the following function using a multiplexer:

$$F(A,B,C)=\sum m(1,3,5,6)$$

21. Explain the concept of positive and negative logic.

22. Prove the following Boolean identities:

(a) $A+AB=A+B$

(b) $AB+AC+BC=AB+AC$

23. Design a 4-bit magnitude comparator.

24. Design a BCD-to-binary converter.

25. Design a code converter to convert from Excess-3 to BCD.

26. Describe the operation of a carry-lookahead adder and its advantages.

Unit 3: Sequential Logic Circuits

1. Definitions:

a. Define a sequential circuit. How does it differ from a combinational circuit?

b. Explain the concept of "state" in a sequential circuit.

c. What is the role of a clock signal in synchronous sequential circuits?

2. Latches and Flip-Flops:

a. Explain the operation of an SR latch. What are its limitations?

b. Describe the working principle of a D flip-flop.

c. Compare and contrast JK and T flip-flops.

d. Explain the concept of a master-slave flip-flop and its purpose.

e. Differentiate between level-triggered and edge-triggered flip-flops.

3. State Diagrams and State Tables:

a. What is a state diagram? How is it used to represent the behavior of a sequential circuit?

b. What is a state table? How is it related to a state diagram?

c. Explain the process of converting a state diagram to a state table.

4. Counters:

a. Explain the difference between synchronous and asynchronous counters.

b. Design a modulo-N counter using flip-flops.

c. Describe the operation of a ring counter and a Johnson counter.

d. What are the uses of counters in digital systems?

5. Shift Registers

a. Explain the operation of different types of shift registers (SISO, SIPO, PISO, PIPO).

b. What are the applications of shift registers?

6. Explain the difference between level-triggered and edge-triggered flip-flops.

7. Draw the timing diagram for a JK flip-flop.

8. Convert a D flip-flop to a T flip-flop.

9. Design a 4-bit parallel-in serial-out (PISO) shift register.

10. Design a 4-bit serial-in parallel-out (SIPO) shift register.

11. Design a modulo-10 synchronous counter.

12. Design a 3-bit asynchronous up/down counter.

13. Explain the operation of a twisted ring counter.

14. Draw the state diagram for a modulo-6 counter.

15. Explain the difference between synchronous and asynchronous sequential circuits.

16. Design a sequential circuit to implement a given state table.

17. Explain the concept of propagation delay.

18. Explain the difference between synchronous and ripple counters.

Unit 4 Analog to Digital and Digital to Analog Converters

1. Define Analog-to-Digital (A/D) and Digital-to-Analog (D/A) conversion.

2. Explain the importance of A/D and D/A converters in digital systems.

3. List and define the key parameters of A/D and D/A converters (resolution, accuracy, linearity, settling time, conversion time, etc.).

4. Differentiate between resolution and accuracy in A/D and D/A converters.

5. Explain the concept of quantization error and how it affects the accuracy of A/D conversion.

6. Explain the concept of sampling theorem.

7. What is aliasing, and how can it be prevented in A/D conversion?

8. Explain the purpose of a sample-and-hold circuit in A/D conversion.

9. Describe the advantages and disadvantages of different A/D and D/A converter types.

10. What is the impact of temperature on the performance of A/D and D/A converters?

11. What are the common applications of A/D and D/A converters in real-world systems?

12. Explain the concept of successive approximation in the context of A/D converters.

D/A Converter Types:

1. Explain the working principle of a binary-weighted resistor D/A converter.
2. Describe the advantages and disadvantages of a binary-weighted resistor D/A converter.
3. Explain the working principle of an R-2R ladder D/A converter.
4. Describe the advantages and disadvantages of an R-2R ladder D/A converter.
5. Compare and contrast binary-weighted resistor and R-2R ladder D/A converters.

A/D Converter Types:

1. Explain the working principle of a flash A/D converter.
2. Describe the advantages and disadvantages of a flash A/D converter.
3. Explain the working principle of a successive approximation A/D converter.
4. Describe the advantages and disadvantages of a successive approximation A/D converter.
5. Explain the working principle of a dual-slope A/D converter.
6. Describe the advantages and disadvantages of a dual-slope A/D converter.
7. Compare and contrast flash, successive approximation, and dual-slope A/D converters.
8. What is the difference between a SAR ADC and a flash ADC?