Chapter 3: Digital Systems and Logic Design

Short Question from the Chapter "Digital Systems and Logic Design":

EXERCISE Short Question with Answers

1. Define a Boolean function and give an example.

Ans: A Boolean function is a function that gives output in **binary form (0 or 1)** depending on the values of input variables.
Example: **F(A, B) = A + B** (OR function) → output is 1 if at least one input is 1.

2. What is the significance of the truth table in digital logic?

Ans: A truth table shows **all possible input combinations** and their corresponding output for a logic circuit or Boolean function.
It is important because it helps us **analyze, design, and verify** digital systems easily.

3. Explain the difference between analog and digital signals.

Ans:

- **Analog signals:** Continuous signals that can take infinite values (e.g., sound waves, thermometer).
- **Digital signals:** Discrete signals that use only **0s and 1s** (e.g., computer data, digital clocks).

4. Describe the function of a NOT gate with its truth table.

Ans: A NOT gate inverts the input. If the input is **1**, output becomes **0**; if input is **0**, output becomes **1**.

Truth Table:

Input (A)	Output (A′)
0	1
1	0

5. What is the purpose of a Karnaugh map in simplifying Boolean expressions?

Ans: A **Karnaugh map (K-map)** is a diagram used to **simplify Boolean expressions** by grouping 1s together.
It reduces **complex logic circuits** into simpler forms, saving cost and improving efficiency in digital design.

Additional MCQs with Answers

Topic 1: Analog and Digital Systems

Q1. What is the main limitation of analog signals?
Ans. Analog signals are easily affected by noise and distortion, which reduces accuracy. This makes them less reliable for data storage and transmission.

Q2. Why are digital systems preferred over analog systems?
Ans. Digital systems are more accurate, less affected by noise, and easier to process, store, and transmit.

Q3. What is quantization in digital systems?
Ans. Quantization is the process of converting continuous analog values into discrete digital values.

Q4. Give one real-life example of digital systems.
Ans. Mobile phones use digital systems for communication, storage, and processing.

Q5. What is the difference between discrete and continuous signals?
Ans. Discrete signals have separate values (like 0,1), while continuous signals change smoothly over time.

Topic 2: Logic Gates

Q1. What is the function of an AND gate?
Ans. An AND gate outputs **1 only when all inputs are 1**; otherwise, the output is 0.

Q2. Why is a NOT gate called an inverter?
Ans. Because it reverses the input: if input = 1, output = 0, and if input = 0, output = 1.

Q3. Which gate is called a universal gate?
Ans. NAND and NOR gates are called universal gates because any logic circuit can be made using only them.

Q4. What is the truth table of an OR gate?
Ans. OR gate outputs 1 if **any input is 1**, and 0 only when all inputs are 0.

Q5. Give one real-life use of logic gates.
Ans. Logic gates are used in digital circuits like calculators and computer processors.

Topic 3: Boolean Algebra

Q1. Who introduced Boolean algebra?
Ans. Boolean algebra was introduced by **George Boole** in the mid-19th century.

Q2. What are the basic operations of Boolean algebra?
Ans. The basic operations are **AND, OR, and NOT**.

Q3. Write one law of Boolean algebra.
Ans. Idempotent Law: A + A = A and A × A = A.

Q4. Why is Boolean algebra important in digital logic?
Ans. It helps in analyzing and simplifying digital circuits.

Q5. What is the complement of a Boolean variable?
Ans. Complement means the opposite value: if A = 1, A’ = 0; if A = 0, A’ = 1.

Topic 4: Truth Tables

Q1. What is a truth table?
Ans. A truth table is a table that shows all possible input values and their corresponding output for a logic function.

Q2. How many rows will a truth table have for 3 inputs?
Ans. A truth table with 3 inputs will have $2^3 = 8$ rows.

Q3. Why are truth tables important in digital design?
Ans. They help verify the working of a logic circuit for all possible inputs.

Q4. Can we use truth tables for Boolean simplification?
Ans. Yes, truth tables provide a clear way to analyze and simplify Boolean functions.

Q5. Give an example of a logic gate and its truth table.
Ans. NOT gate: Input 0 → Output 1; Input 1 → Output 0.

Topic 5: Karnaugh Maps (K-Map)

Q1. What is a Karnaugh map?
Ans. A Karnaugh map is a diagram used to simplify Boolean expressions easily.

Q2. What is the minimum group size in K-Map?
Ans. The minimum group size is **2 cells** (1 cell is also allowed if no grouping possible).

Q3. What is the largest group size in a 4-variable K-map?
Ans. The largest group size is **16 cells** (covering the whole map).

Q4. Why are K-Maps used instead of Boolean algebra?
Ans. Because they are a faster and simpler method for minimization of logic expressions.

Q5. What are don't-care conditions in K-map?
Ans. Don't-care conditions represent inputs that never occur; they can be treated as 0 or 1 for simplification.
