Combinational Logic

Module 4

Introduction

- Logic circuits for digital systems may be combinational or sequential.
- A combinational circuit consists of logic gates whose **outputs** at any time are determined directly from the **present combination of inputs without regard to previous inputs**.
- A combinational circuit performs a specific information-processing operation fully specified logically by a set of Boolean functions.

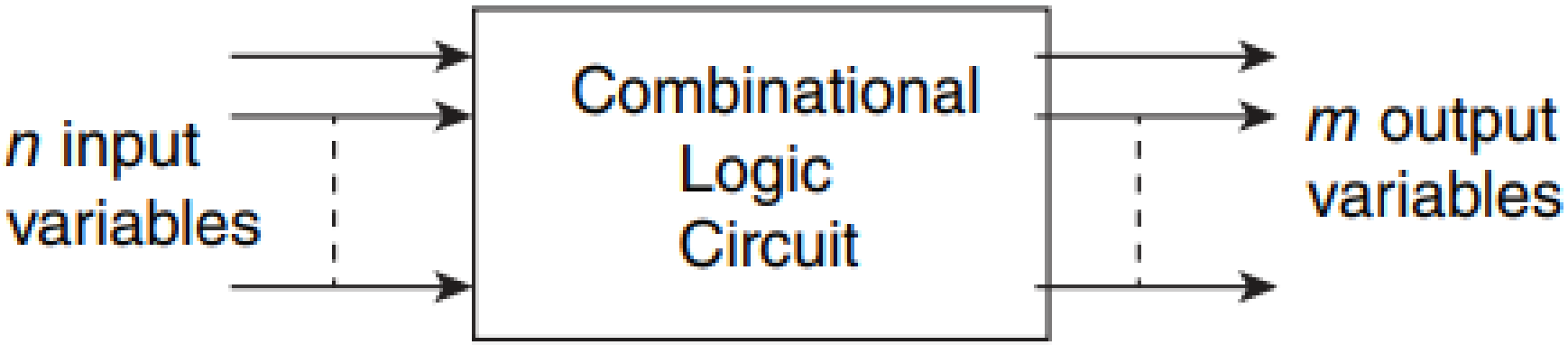
Introduction

- Sequential circuits employ **memory elements** (binary cells) in addition to logic gates. Their **outputs** are a function of the **inputs** and the **state of the memory elements**.
- The state of memory elements, in turn, is a function of **previous inputs**. As a consequence, the **outputs of a sequential circuit** depend not only on **present inputs, but also on past inputs**, and the circuit behavior must be specified by a time sequence of inputs and internal states.

Combinational Circuit

- A combinational circuit consists of **input variables, logic gates, and output variables**. The **logic gates** accept **signals** from the **inputs** and generate signals to the **outputs**. This process transforms binary information from the given input data to the required output data. Obviously, both **input** and **output** data are represented by **binary signals**, i.e., they exist in two possible values, one representing logic-1 and the other logic-0.

Block diagram of a combinational circuit



Combinational Circuit

- For n input variables, there are 2^n possible combinations of binary input values.
- For **each possible input combination**, there is **one and only one possible output combination**.
- A combinational circuit can be described by m Boolean functions, one for each output variable. Each output function is expressed in terms of the n input variables.

Design Procedure

- The design of combinational circuits starts from the verbal outline of the problem and ends in a **logic circuit diagram**, or a set of **Boolean functions** from which the logic diagram can be easily obtained.

1. The problem is stated.
2. The number of available input variables and required output variables is determined.
3. The input and output variables are assigned letter symbols.

Design Procedure

4. The truth table that defines the required relationships between inputs and outputs is derived.
5. The simplified Boolean function for each output is obtained.
6. The logic diagram is drawn.

Example 1:

- Design a combinational logic circuit with three inputs , the output is at logic 1 when more than one inputs are at logic 1.
- Solution:
- Assume A, B, C are inputs and Y is output.
- Construct the truth table.
- K-map simplification or algebraic manipulation.
- Draw the logic diagram based on the simplified function.

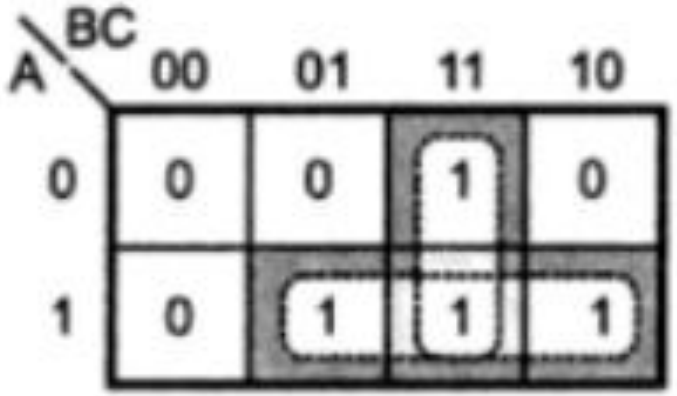
Solution:

- Construct the truth table based on the specified problem.

Truth table

Inputs			Output
A	B	C	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

K-map Simplification



Boolean Expression

$Y=AC + BC + AB$

Logic diagram is drawn