

Unit 4

Combinational Logic Circuits

Lecture 1

Combinational Logic

- In digital circuit theory, combinational logic is a type of digital logic which is implemented by Boolean circuits, where the output is a pure function of the present input only.
- This is in contrast to sequential logic, in which the output depends not only on the present input but also on the history of the input.
- In other words, sequential logic has memory while combinational logic does not.

Combinational Circuit

- These are the circuit gates employing combinational logic.
- A combinational circuit consists of n input variables, logic gates, and m output variables.
- The logic gates accept signals from the inputs and generate signals to the outputs.
- 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.

A block diagram of a combinational circuit is shown in Fig:

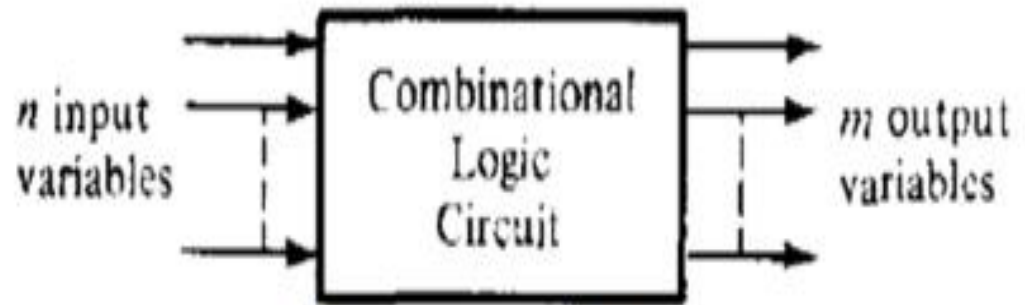


Fig: Block diagram of combinational circuit

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.
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.

Adders

- Digital computers perform a variety of information-processing tasks.
- Among the basic functions encountered are the various arithmetic operations.
- The most basic arithmetic operation, no doubt, is the addition of two binary digits.

Half-Adder

- A combinational circuit that performs the addition of two bits is called a half-adder.
- Circuit needs two inputs and two outputs.
- The input variables designate the augend (x) and addend (y) bits; the output variables produce the sum (S) and carry (C).
- Now we formulate a Truth table to exactly identify the function of half-adder.

| x | y | C | S |
|-----|-----|-----|-----|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 0 |

The simplified Boolean functions for the two outputs can be obtained directly from the truth table. The simplified sum of products expressions are:

$$S = x'y + xy'$$

$$C = xy$$