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YEAR	SEM
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**CS8351**

## DIGITAL PRINCIPLES AND SYSTEM DESIGN

### UNIT II COMBINATIONAL LOGIC

#### 2.1 Combinational circuits and Analysis procedure

Version: 1.XX



## Combinational Circuits

The digital system consists of two types of circuits, namely

- Combinational circuits
- Sequential circuits

### Combinational circuits

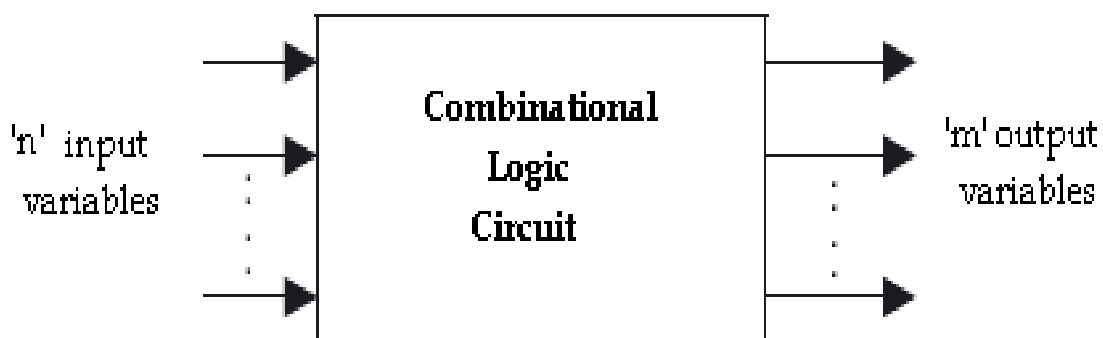
Combinational circuit consists of logic gates whose output at any time is determined from the present combination of inputs. The logic gate is the most basic building block of combinational logic. The logical function performed by a combinational circuit is fully defined by a set of Boolean expressions.

### Sequential circuits

Sequential logic circuit comprises both logic gates and the state of storage elements such as flip-flops. As a consequence, the output of a sequential circuit depends not only on present value of inputs but also on the past state of inputs.

- A combinational circuit consists of input variables, logic gates, and output variables.
- The logic gates accept signals from inputs and output signals are generated according to the logic circuits employed in it.
- Binary information from the given data transforms to desired output data in this process.
- Both input and output are obviously the binary signals, *i.e.*, both the input and output signals are of two possible states, logic 1 and logic 0.
- **Combinational Circuits** (CC) are **circuits** made up of different types of logic gates.
- A logic gate is a basic building block of any electronic **circuit**. The output of the **combinational circuit** depends on the values at the input at any given time.
- The **circuits** do not make use of any memory or storage device.
- Combinational logic is used in computer circuits to perform Boolean algebra on input signals and on stored data.
- Practical computer circuits normally contain a mixture of combinational and sequential logic.

- For example, the part of an arithmetic logic unit, or ALU, that does mathematical calculations is constructed using combinational logic.
- Other circuits used in computers, such as half adders, full adders, halfsubtractors, fullsubtractors, multiplexers, demultiplexers, encoders and decoders are also made by using combinational logic.



### **Block diagram of a combinational logic circuit**

For  $n$  number of input variables to a combinational circuit,  $2^n$  possible combinations of binary input states are possible.

For each possible combination, there is one and only one possible output combination.

A combinational logic circuit can be described by  $m$  Boolean functions and each output can be expressed in terms of  $n$  input variables.

## Analysis Procedure

Analysis of a digital circuit results a Boolean function, a truth table and sometimes an explanations of circuits also.

The steps involved in analysis procedure are listed below:

To obtain the Boolean function of the given digital circuit.

- Designate the output of selected gates with suitable alphanumeric symbols.
- Find the output expression of each selected gate which is connected to input variables.
- Find the output expression for the gates which are connected to input variables.
- Repeat this process until the final output is obtained.
- Convert the final output in terms of input variables.

To obtain the truth table directly from the given digital circuit:

- List all the binary combinations of input variables.
- Designate the output of selected gates.
- Find the truth table of designated gates which are connected to input variables.
- Find the truth table of designated gates which are connected to the previous gates.
- Continue this process till the final truth table is obtained.

