DIGITAL ELECTRONICS CIRCUIT(BCA 103)

DEPARTMENT OF COMPUTER SCIENCE

PROGRAMME: BCA

CENTRAL UNIVERSITY OF ODISHA

KORAPUT

- Logic circuits for digital systems may be combinational or sequential.
- A combinational circuit consists of logic gates whose outputs at any time are determined from only the present combination of inputs.
- A combinational circuit performs an operation that can be specified logically by a set of Boolean functions.
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Combinational Circuit

- In this output depends only upon present input.
- There is no feedback between input and output.
- Elementary building blocks: Logic gates
- Combinational circuits don’t have capability to store any state.
- These circuits do not have any memory element.
- This is time independent.
- As combinational circuits don’t have clock, they don’t require triggering.

Sequential Circuit

- In this output depends upon present as well as past input.
- There exists a feedback path between input and output.
- Elementary building blocks: Flip-flops
- Sequential circuits have capability to store any state or to retain earlier state.
- These circuits have memory element.
- This is time dependent.
- As sequential circuits are clock dependent they need triggering.

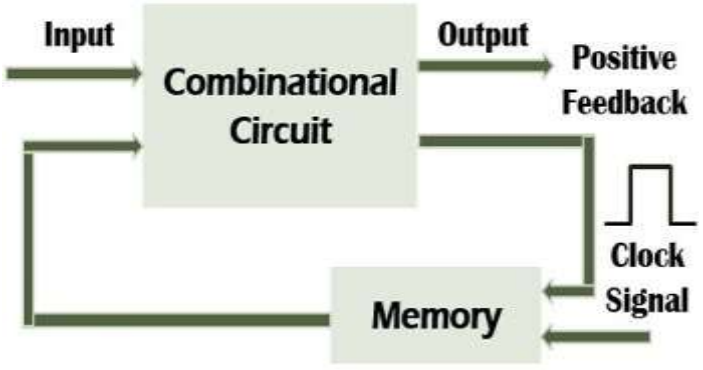
Combinational Circuit

- It is designed easy.
- Speed is fast.
- Used for arithmetic as well as boolean operations.
- **Examples –** Encoder, Decoder, Multiplexer, Demultiplexer.

Combinational Circuit

Sequential Circuit

- It is designed tough as compared to combinational circuits.
- Speed is slow.
- Mainly used for storing data.
- **Examples** – Flip-flops, Counters.



Sequential Circuit

- The *n* input binary variables come from an external source; the *m* output variables are produced by the internal combinational logic circuit and go to an external destination.
- For *n* input variables, there are 2^n possible combinations of the binary inputs.
- For each possible input combination, there is one possible value for each output variable.
- Thus, a combinational circuit can be specified with a truth table that lists the output values for each combination of input variables.
- A combinational circuit also can be described by *m* Boolean functions, one for each output variable.
- Each output function is expressed in terms of the *n* input variables.

- In many applications, the source and destination are storage registers.
- If the registers are included with the combinational gates, then the total circuit must be considered to be a sequential circuit.

- Among the various arithmetic operations, the most basic arithmetic operation is the addition of two binary digits.
- This simple addition consists of four possible elementary operations.
- When both augend and addend bits are equal to 1, the binary sum consists of two digits.
- The higher significant bit of this result is called a *carry*. When the augend and addend numbers contain more significant digits, the carry obtained from the addition of two bits is added to the next higher order pair of significant bits.

Augend	Addend	
0	0	0
0	1	1
1	0	1
1	1	10

Half Adder

- A combinational circuit that performs the addition of two bits is called a *half adder*.
- The input variables designate the augend and addend bits; the output variables produce the sum and carry.
- We assign symbols *x* and *y* to the two inputs and *S* (for sum) and *C* (for carry) to the outputs.
- The *C* output is 1 only when both inputs are 1.
- The *S* output represents the least significant bit of the sum.

x	y		C	S
0	0		0	**0**
0	1		0	**1**
1	0		0	**1**
1	1		1	**0**

S = x'y + xy'
C = xy

- The logic diagram of the half adder implemented in sum of products .
- It can be also implemented with an exclusive-OR and an AND gate.
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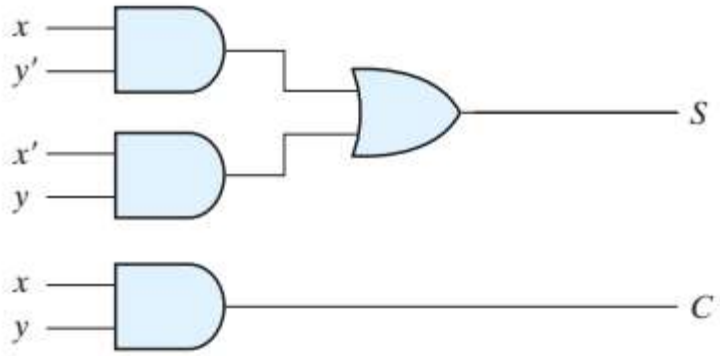
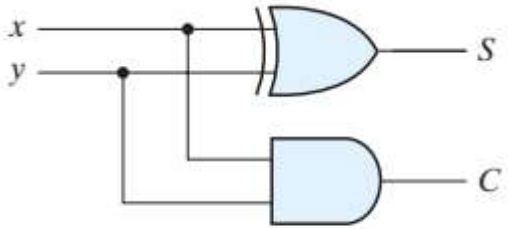


(a) $S = xy' + x'y$
$C = xy$



(b) $S = x \oplus y$
$C = xy$