COMBINATIONAL LOGIC DESIGN / ANALYSIS

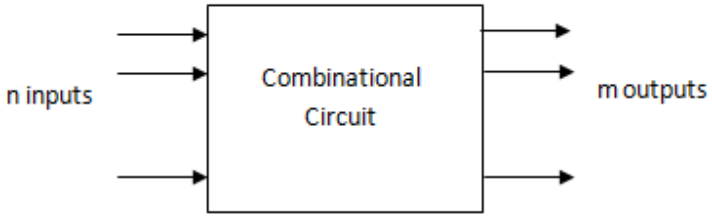
In general, logic circuits can be classified as:

1. Combinational logic circuits
2. Sequential logic circuits

COMBINATIONAL LOGIC CIRCUITS

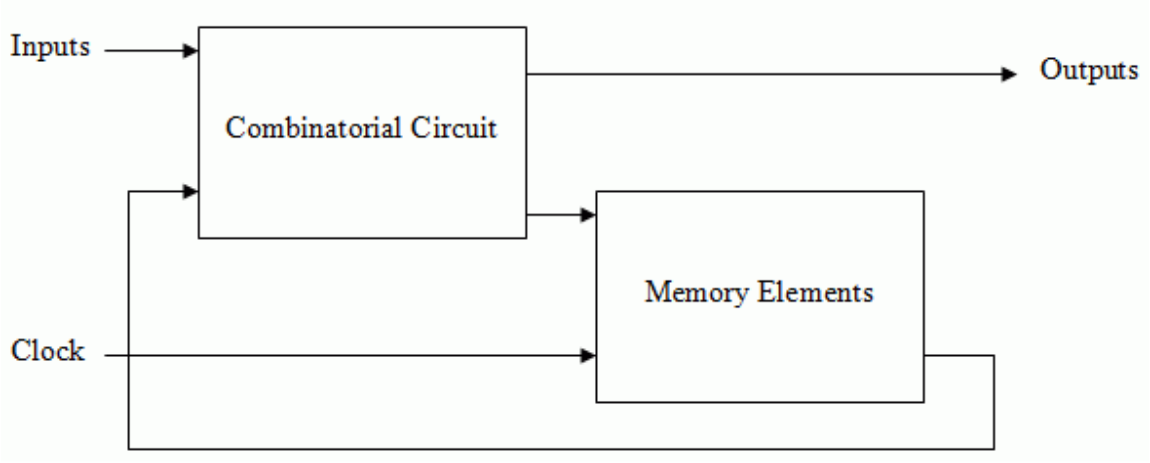
The circuit consists of logic gates whose outputs are functions of current inputs only. That is, output values are determined by the values of current inputs.

This type of circuits do not contain memory elements.



SEQUENTIAL LOGIC CIRCUITS

The circuit consists of memory elements (flip-flops) in addition to logic gates. The outputs are functions of current inputs and some of previous output values.



DESIGN PROCEDURE OF COMBINATIONAL LOGIC CIRCUITS

The design procedure for a combinational logic circuit starts with the problem specification and comprises the following steps:

1. Determine the required number of inputs and outputs from the specifications.
2. Assign letter symbols for inputs and outputs.
3. Derive the truth table for each of the outputs based on their relationships to the inputs.
4. Simplify the Boolean expression for each output. Use Karnaugh Map or Boolean algebra.
5. Draw the logic diagram of the simplified Boolean expression.

ADDERS

Half-Adder: a combinational circuit that performs the addition of two bits and produces the corresponding output(s). It has two inputs and two outputs.

Full-Adder: a combinational circuit that performs the addition of three bits and produces the corresponding output(s). It has three inputs and two outputs.

SUBTRACTORS

Half-Subtractor: a combinational circuit that performs the subtraction of two bits and produces the corresponding output(s). It has two inputs and two outputs.

Full-Subtractor: a combinational circuit that performs the subtraction of three bits and produces the corresponding output(s). It has three inputs and two outputs.

BINARY ADDER and SUBTRACTOR

Binary Parallel Adder: is a combinational circuit that produces the sum of two binary numbers using ***n*** full-adders in parallel.

Ex: Consider the addition of two 4-bit binary numbers, ***A*** and ***B***.

Binary Parallel Adder / Subtractor: Design a 4-bit parallel adder/subtractor with an *add/sub* control input.

When add/sub = 1 => parallel subtractor
When add/sub = 0 => parallel adder