

## COMBINATIONAL CIRCUITS

A combinational circuit is a digital logic in which the values of the output function(s) are a direct expression of the input values only.

Once we have the expression of the output function(s) the circuit can be built using basic gates.

One way to get to these expressions is to start with a truth table in which we will enter the values of the output function(s) for each of the input combinations ( $n$  input variables –  $2^n$  distinct combinations). Only the input combinations where the output function(s) value is 1 will be considered.

As default situation we want to obtain the most simplified expression for our output function(s). When it comes to functions of 3, 4 variables, the most straightforward way to simplify is using K-maps. Having a simplified expression implies the use of fewer gates for when the function will be implemented as part of the combinational circuit. It means a more efficient circuit (faster), due to the fact that each used gate creates a gate propagation delay.

Sometimes the problem might ask to implement these functions using a MUX, or a ROM, or NAND or NOR gates only. In that case we will not need to simplify our function(s), we might need them in their canonical form (sum of minterms).

In this class we will design the combinational circuit. This means that we are interested in obtaining the expression of the output function(s) in their required form (most simplified or sum of minterms).

The next step of connecting the gates and building the circuit is straightforward.

## INTEGRATED CIRCUITS

Integrated circuit (IC), also called microelectronic circuit, microchip, or chip, represents an assembly of electronic components, fabricated as a single unit. The individual circuit components are generally microscopic in size. The IC we are covering are having specific purposes. Their internal architecture is already established (known), and all that is needed in order to provide it, is the size of the circuit (usually given as the size of the input x the size of the output).

Examples of integrated circuits: Multiplexers, Decoders, Encoders, Adders, ALUs, ROMs, PLAs.