

Tutorial Works Series N° 4

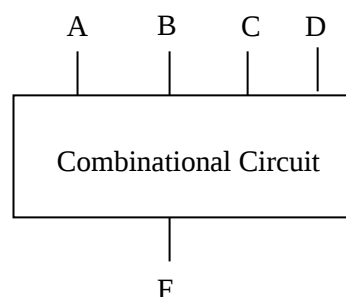
Exercise 01: (Final exam 2023/2024)

We want to design a combinational circuit with four inputs, A, B, C, D, and one output, F. This circuit operates as follows:

- $F=1$ if and only if the decimal number of AB is equal to or greater than the decimal number of CD;
- otherwise, $F=0$.

Examples :

- If ABCD=1001 then $F=1$ ($10 \geq 01$)
- If ABCD=0111 then $F=0$ ($01 < 11$)



1. Establish the truth table corresponding to this circuit.
2. Determine the simplified logical expression of F using the Karnaugh map.

Exercise 02:

1. Design a combinational circuit that performs the multiplication of 1 bit by 1 bit.
2. Design a 2-bit by 2-bit multiplier by following the same steps as those in the first question ($A=A_1A_0$ and $B=B_1B_0$, $P=AB = P_3P_2P_1P_0$).

Indication:

			$A_1 A_0$
			x $B_1 B_0$
		R_1	$A_1 \times B_0$
			$A_0 \times B_0$
R_2	$A_1 \times B_1$		$A_0 \times B_1$
R_2	$R_1 + A_1 \times B_1$	$A_0 \times B_1 + A_1 \times B_0$	$A_0 \times B_0$
P_3	P_2	P_1	P_0

Exercise 03:

Consider a logical function represented by the following form:

$F(A, B, C, D) = \sum(0, 4, 8, 9, 11, 9, 12, 13, 14, 15)$

1. Design F with a 16x1 multiplexer and without logic gates.
2. Design F with an 8x1 multiplexer and logic gates.
3. Design F with a 4 x 16 decoder and without logic gates.
4. Design F with a 3 x 8 decoder and logic gates (if they exist).

Exercise 04:

Perform the following functions using only (1x2), (2x4), and (3x8) decoders and logic gates:

- $F(A, B, C) = \sum(0, 4, 5, 7)$
- $F(A, B, C, D) = \sum(1, 5, 7, 12, 15)$

Additional exercises:

Exercise 05:

Design a combinatorial circuit of the “Majority” function of three variables A, B, and C (the majority of the input values are 1s).

Examples:

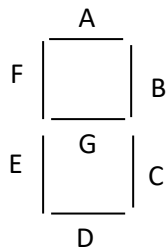
If ABC=001 then F=0

If ABC=110 then F=1

Exercise 06:

7-segment displays are digital displays made up of segments that can be lit or not to display a decimal number: 0, 1, 2, ..., 9 or letters for hexadecimal: a, b, c, d, e, f.

We associate each segment with a letter in the following way:



Design the logic equations and the logic diagram of the circuit allowing this type of display to be controlled.

Exercise 07:

Consider the following logical function:

$$F(A,B,C,D) = \overline{B}\overline{C}\overline{D} + \overline{A}B\overline{D} + B\overline{C}\overline{D} + \overline{A}\overline{B}C + \overline{B}\overline{C}\overline{D}$$

1. Design a combinational circuit that performs this function using a multiplexer (16x1).
2. Design a combinational circuit that performs this function using a multiplexer (8x1).
3. Design a combinational circuit that performs this function using a decoder (4x16).