***Common Base in Mathematics and Computer Science***
***University of Batna-2***

***1st Year LMD***
***2024/2025***

## Tutorial Series 1
## MACHINE STRUCTURE

---

### *Exercise 1:*

Use truth tables to prove the following equalities:

1- De Morgan's Theorem:
   a- $\overline{A \cdot B} = \overline{A}+\overline{B}$
   b- $\overline{A+B} = \overline{A} \cdot \overline{B}$
2- The laws of Boolean Algebra: Distributivity:
   a- $A + B.C = (A+B) . (A+C)$
   b- $A . (B+C) = A.B + A.C$
   c- $(A+B). (\overline{A} . \overline{B}) = 0$

### *Exercise 2:*

Simplify the following functions using boolean algebra laws:

$F_1= (a.b + \overline{c}) + c.(\overline{a} + \overline{b})$

$F_2= (a.\overline{b} + c) + (a+ \overline{b}).c$

$F_3= (x+y).z + \overline{x}.(\overline{y} + z) + \overline{y}$

$F_4 = (x+ y+z).(\overline{x} + y+z) + x.y + y.z$

### *Exercise 3:*

The function F(A,B,C) with three variables is defined by the following truth table:

| A | B | C | F |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

1- Write the function F in the disjunctive form (first canonical form).
2- Write the function f in the conjunctive form (second canonical form).
3- Write these equations in decimal notation.

### *Exercise 4:*

Convert the following functions to their corresponding canonical form:

$F_1(A,B) = \sum(0,1)$

$F_2(A,B,C) = \prod(0,1,2)$

$F_3(A,B,C) = \sum (0,1,3,4,5)$

## *Exercise 5:*

1) Give the first canonical form of the Boolean functions defined by the following proposals:
   a) **F(A,B,C)= 1** if and only if one of the variables A, B and C takes the value 0.
   b) **F(A,B,C)= 0** if and only if at least two of the variables A, B and C take the value 1.
   *c)* **F(A,B,C)** = $\mathbf{B.C+C+A.\overline{B}}$

2) Give the second canonical form of the boolean functions defined by the following proposals:
   a) **F(A,B,C)= 0** if and only if the variables A, B, and C take the value 1 or 0.
   b) **F(A,B,C)= 1** if and only if at most one of the variables A, B and C takes the value 0.
   **c) F(A,B,C)=** $\mathbf{(A+B).(B+\overline{C})}$

## *Exercise 6:*

Find the complement of the following boolean functions and provide their final simplified functions if possible:

$F_1 = \overline{A}.\overline{B} + A.(\overline{B}+C)$ $\qquad$ $F_2 = A.\overline{B}.(A+C) + \overline{A}.B.\overline{(A+\overline{B}+\overline{C})}$

$F_3 = (A+B.C).(\overline{A}.B+C)$ $\qquad$ $F_4 = (C+D).\overline{A.\overline{C}.D}.(\overline{A}.C+\overline{D})$