Course: Digital Engineering **Semester:** 1st term 2025/2026.	**Lecturers:** Dr. Osama Elnahas, Dr. Dina Abdelhafiz, Dr. Bassant Tolba, Dr. Radwa Rady **Assistant:** Eng. Rania Helal, Eng. Assma, Eng. Israa Mohsen, Eng. Hazem, Eng. Belal,
Tutorial 4: Minterms and Maxterms	

- **In Boolean algebra, a function can be expressed in two main canonical forms:**

  - Sum of Products (SOP): Logical OR of minterms where the function equals 1.

  - Product of Sums (POS): Logical AND of maxterms where the function equals 0.

- **A minterm represents one combination producing logic 1, while a maxterm represents one combination producing logic 0.**

Question 1: For the given truth table with three variables A, B, and C, and an example function F:
Given truth table for F(A, B, C):

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

Answer the following:
(a) Express the function F in Sum of Products (SOP) form.
(b) Express the function F in Product of Sums (POS) form.

Question2: Convert the following Boolean functions from a canonical sum-of-products form to a standard simplified product-of-sums form and vice versa.

a) $F(x,y,z) = \Sigma(0,2,4,5)$

b) $F(x,y,z) = \Sigma(1,2,3,7)$

c) $F(x,y,z) = \Pi(1,3,4)$

Question3: Complete the following questions:

1. In Boolean algebra, a minterm is defined as ---------
2. A + B + C is a -------term in a Boolean expression with variables A, B, and C.
3. A' · B ·C' is a -------term in a Boolean expression with variables A, B, and C.
4. If a Boolean function F(A,B,C) is represented as the sum of minterms Σm(1, 3, 5), does it imply that F is ---- for input combinations 1, 3, and 5.
5. If a Boolean function F(A,B,C) is represented as the sum of minterms ΠM(0,2,4), does it imply that F is ---- for input combinations 1, 3, 5, 6, and 7, and imply that F is ---- for input combinations 0, 2 and 4.
6. A · B and A' · B' are examples that represent --- terms for variables A and B?
7. -------is A sum term that produces a logic 0 for exactly one combination of inputs.
8. Write a function that represents an example of a sum of minterms?
9. The maxterm M2 for variables A and B is --------
10. The expression F(A,B,C) =ΠM(0,2,4) imply that F is --- for input combinations -----.
11. For a Boolean function with two variables A and B, which minterm corresponds to the combination A = 0, B = 1?

Question 4: Simplify the following questions:

Q1. $F = x(\bar{x} + y) + x$

Q2. $F = \overline{(x + y)}\,(\bar{x} + \bar{y})$

Q3. $F = A.B.C + \bar{A} + A.\bar{B}.C$

Q4. $F = A.\bar{B} + \overline{(\bar{A} + \bar{B} + C\bar{C})}$