ENCS2340 I Section 2 I Fall 2024/2025
Chapter 2
Extra Exercises - 01

1. Simplify each of the following logical expressions to expressions having the indicated number of literals:
   a. $AB + AB + BC + BC$ to a constant
   b. $CD + CBD + BC + BCA$ to 3 literals
   c. $(X + Z + Z)Y + X$ to 2 literals
   d. $ABC + ABC + ABC$ to 3 literals
   e. $XY + YZ + XYZ$ to 3 literal
   f. $(b' + c)(b' + c')$ to 1 literal

2. Use Algebraic manipulations to verify that: (show clearly <u>all steps</u> of your proof)
   a. $(A + B)\ (A\ B) = 0$
   b. $(x + y)(x + y) + xyz + xy + xy\,z = x + y$
   c. $WX\,Z + XW + WXYZ + XWYZ = X$
   d. $C\,D + (A\ B)\,C + (A + B)\,D = A\,BC + AD + BD,$ Hint : Use the concensus theroem

3. Using the following expression for F (<u>as given</u>):

   $F = (AB' + C'D)(DE' + W)$

   Derive the complement F' <u>in the form of a sum of products</u> using each of the following two methods. Verify that the two methods give the same answer.

   i. Applying the DeMorgan's theorem as many times as needed.
   ii. Obtaining the dual of F (i.e. F_{dual}) then complementing every literal in F_{dual}, e.g. $A -> A$ and $A -> A$

4. By applying the DeMorgan's theorem as many times as needed, express the following function F:

   $F = EW' + (AB')(C' + D)$

   a. Using AND and NOT operators only (Express OR expressions as NOT-AND-NOTs)
   b. Using OR and NOT operators only (Express AND expressions as NOT-OR-NOTs)

5. a. Given $F(A,B,C) = (A + B)C$, Determine F as a sum of products ,
   b. Verify that you obtained the correct result using the following two approaches:
      i. Deriving the truth tables for both F and F'
      ii. Algebraically verifying that: $F.F = 0$ **and** $F + F = 1$

6. Obtain the dual of the following expression as given, <u>Do not simplify the result</u>.

   $(AC + BA)(C + AB)$

7. For the following function of 3 variables X, Y, Z (Z is the LSB), and <u>without any expansion or simplification:</u>

$$F(X,Y,Z) = XY' + XZ' + \overline{Z(X+Y')}$$

i. Give the truth table

ii. Draw a complete logic diagram using AND, OR, and NOT gates

8. For the logic diagram opposite:

a. Derive the logic equation for the output F (A, B, C, D) <u>without simplification.</u>

b. F (1, 0, 1, 1) = _____ (0/1)