TUTORIAL 4a

1. Determine the correct number of *Variable*, *Literal* and *Term* for the following Boolean Expression.

$$F = ABC + \overline{A}B + \overline{C}\,\overline{D} + A\overline{B}C\overline{E}$$

   A. *Variable* = 4, *Literal* = 4 and *Term* = 11
   B. *Variable* = 5, *Literal* = 7 and *Term* = 4
   C. *Variable* = 4, *Literal* = 11 and *Term* = 5
   D. *Variable* = 5, *Literal* = 5 and *Term* = 11

2. Which of the following Boolean Expressions needs to be applied DeMorgan's Theorem?

   i. $F = ABC + \overline{C}\,\overline{D} + A\overline{B}C\overline{E}$

   iii. $F = ABC + \overline{A}B + \overline{\overline{C}\,\overline{D}} + A\overline{B}C\overline{E}$

   ii. $F = (\overline{A + C}).(\overline{A}B + A\overline{B} + C\overline{E})$

   iv. $F = (\overline{\overline{A + C}}).(\overline{A}B + C\overline{E})$

   A. i and ii
   B. ii and iii
   C. iii and iv
   D. ii, iii and iv

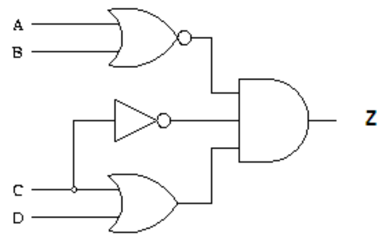
3. If you are converting a non-standard Products of Sum (POS) to a standard POS form of Boolean Expression, what is the step involved?
   A. Add 1 in the Boolean Expression and use rule $A + 1 = 1$
   B. Add 1 in the Boolean Expression and use rule $A + \overline{A} = 1$
   C. Add 0 in the Boolean Expression and use rule $A.0 = 0$
   D. Add 0 in the Boolean Expression and use rule $A.\overline{A} = 0$

4. Determine how to write Products of Sum (POS) term in the following truth table.

A	B	C	Output, F
0	0	1	0
1	0	0	1

   A. Look at output F=0 and write the term as $\overline{A} + \overline{B} + C$
   B. Look at output F=0 and write the term as $A + B + \overline{C}$
   C. Look at output F=1 and write the term as $\overline{A}.\overline{B}.C$
   D. Look at output F=1 and write the term as $A.B.\overline{C}$

5. Write Boolean Expression for Z in the following circuit diagram:



A. $Z = (\overline{A} + \overline{B}).(C + D).\overline{C}$

B. $Z = \overline{A}.\overline{B} + C.D + \overline{C}$

C. $Z = \overline{(A + B)}.(C + D).\overline{C}$

D. $Z = \overline{A.B} + C.D + \overline{C}$

6. Write the following Sigma and PI representation into their correct Boolean Expression.

$$Z = \sum\nolimits_{ABCD}(\ 10\ ) \text{ and } Y = \prod\nolimits_{ABCD}(\ 10\ )$$

A. $Z = A\overline{B}C\overline{D}$ and $Y = A + \overline{B} + C + \overline{D}$

B. $Z = A\overline{B}C\overline{D}$ and $Y = \overline{A} + B + \overline{C} + D$

C. $Z = \overline{A}B\overline{C}D$ and $Y = A + \overline{B} + C + \overline{D}$

D. $Z = \overline{A}B\overline{C}D$ and $Y = \overline{A} + B + \overline{C} + D$

7. Which of the following statement of K-Map is **FALSE**?
   A. The adjacent cells in K-Map can only differ by only one variable value
   B. In a K-Map with 4 variables, the top-most and the bottom-most cells are adjacent
   C. The number of cells in a K-Map is equivalent to the total number of possible input variable combinations
   D. K-Map can be used for expressions with infinite number of variables

8. If $X = \overline{A\,\overline{B} + \overline{\overline{C}\,E}}$ then X is also equals to

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

B. $CE\,(\overline{A} + B)$

C. $(A + \overline{B})(C + D)$

D. $\overline{A}\,\overline{B}\,C\,D$

9. Which of the following is **TRUE**

A. $A\overline{C} + (BD)(A\overline{C}) = A\overline{C}$

B. $(A + C)\overline{(A + C)} = 1$

C. $\overline{X\,\overline{Y\,\overline{Z}}} = \overline{X} + \overline{Y} + Z$

D. $BD + \overline{\overline{BD}}\,E = BD + E$

10. Referring to circuit simplification, which of the following statement is **FALSE** about "simpler circuit"?

A. less gates

B. less input to a gate

C. less number of outputs

D. lower cost

11. A circuit with three variables A, B and C, has an expression of $X = A\overline{C} + \overline{B}C$. Which of the following is the standard Sum of Products (SOP) for the expression?

A. $(A + B + C)(A + \bar{B} + C)$

B. $AB\bar{C} + ABC + A\bar{B}C + A\bar{B}C$

C. $(A + B + \bar{C})(A + \bar{B} + C)$

D. $A\bar{B}\bar{C} + AB\bar{C} + \bar{A}\bar{B}C + A\bar{B}C$

12. The simplification of the following K-Map will produce

AB \ CD	00	01	11	10
00	1	1	X	1
01	1	1	X	X
11	X	X	X	X
10	1	1	X	1

A. $\bar{C}(\bar{A}+D)+\bar{B}D$

B. $BD + A\bar{D} + \bar{A}C$

C. $AB\bar{C} + D(A + \bar{B})$

D. 1

13. Determine the Product of Sums of a circuit if it's Sum of Products is $X = \sum_{ABC}(1,3,4,5,7)$

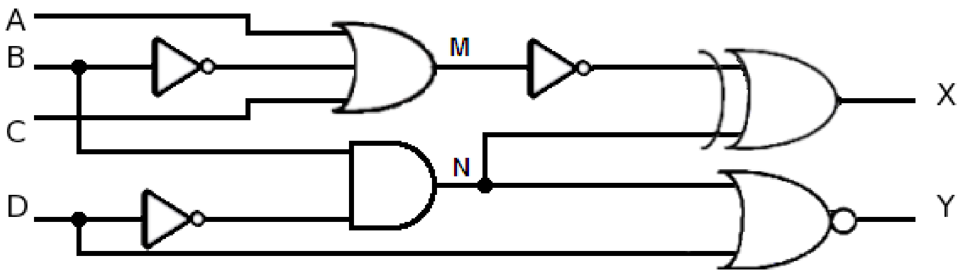
A. $X = A\overline{B} + C$

B. $X = \prod_{ABC}(1,3,4,5,7)$

C. $X = (A+\bar{B}+C)(A+\bar{B}+\bar{C})(\bar{A}+\bar{B}+C)(A+\bar{B}+C)(\bar{A}+B+C)(A+B+C)$

D. $X = (A+B+C)(A+\bar{B}+C)(\bar{A}+\bar{B}+C)$

Question14



a) Write Boolean expression for M, N, X and Y in terms of variables A, B, C and D.

b) Construct the truth table for the given logic circuit, include M and N in your truth table.

Question 15

a) Simplify the following Boolean expression using DeMorgan's law and Boolean rules.

$$Y = \overline{\overline{(AB\bar{C} + A\bar{B})}.\overline{(ABC + \bar{A}\bar{B} + B)}}$$

b) You are given a truth table as follows:

Input				Output
A	B	C	D	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

i. Write the standard Boolean equation for SOP and the Sigma ($\sum$) representation.
ii. Write the standard Boolean equation for POS and the Pi ($\prod$) representation.
iii. Construct the K-Map.
iv. From the K-Map:
   a. Get the minimize form for SOP.
   b. Get the minimize form for POS.
v. Between the minimize SOP in iv(a) and POS in iv(b), which is more cost effective in the circuit implementation. Comment your answer.