Tutorial 1

1. Simplify the following Boolean expressions to a minimum number of literals

   a) xyz' + x'yz + xyz + x'yz' b) (A + B)' (A' + B')'

   c) x⊕y⊕xy d) [(A+AB') (A+A'B')]+[(CD+C'D')+(C⊕D)]

2. Find the complement of the following expressions

   a) (x' + y + z')(x + y')(x + z) b) (A 'B + CD)E' + E

3. Implement the Boolean function F = xy+x'y'+y'z with

   a) AND, OR, and inverter gates

   b) NAND and inverter gates

   c) NOR and inverter gates

4. Express the complement of the following functions in sum of minterrns form
   a) $F(A, B, C, D)=\Sigma(3, 5, 9, 11, 15)$ (b) $F(x, y, z) = \Pi(2,4,5,7)$

5. Draw the logic diagram corresponding to the following Boolean expressions without simplifying them:
(a) $BC + AB + ACD$ (b) (A + B)(C + D)(A ' + B + D)

6. Simplify each of the following expressions by applying the theorems. State the theorems used

a) (A′ + B′ + C)(A′+ B′ + C)′ b) AB(C′ + D) + B(C′ + D)
c) AB + (C′ + D)(AB)′ d) (A′BF + CD′)(A′BF + CEG)
(e) A′ (B + C)(D′F + F)′ + (D′F + F) (f) A′BC′ + BC′D + A′CD + B′CD + A′BD

7. (a) Reduce to minimum sum of products (three terms):

(X + W)(Y⊕ Z) + XW′

(b) Reduce to minimum sum of products (four terms):

(A ⊕ BC)+ BD + ACD

(c) Reduce to minimum product of sums (three terms):

(A′ + C′ + D′) (A′ + B + C′) (A + B + D) (A + C + D)

8. Simplify the following expression to a sum of two terms and then factor the result to obtain a product of sums

ab′d′f′ + b′cegh′ + abd′f + acd′e + b′ce

9. An assembly line has 3 fail safe sensors and one emergency shutdown switch. The line should keep moving unless any of the following conditions arise:
   (i) If the emergency switch is pressed
   (ii) If the sensor1 and sensor2 are activated at the same time.
   (iii) If sensor 2 and sensor3 are activated at the same time.
   (iv) If all the sensors are activated at the same time

   Give a Boolean expression for above case?

10. In a 6 variable K-map, how many literals will the grouping of 4 adjacent cells will result. Generalize the solution for **N** variable k-map and for grouping of **K** adjacent cells

11. Y = A'C + AC'B' and you are given that A=C=1 will never occur (don't cares). Simplify Y?

12. Give the minterms of the expression F=y'z'+x'y'+x'z' and express it in canonical form?

13. Show that following two gates realize same function. State the theorems used