CE/CZ1005 Digital Logic Tutorial 4

Combinational Logic

1. Given the following truth table, determine:
   a. The canonical sum-of-minterms expression
   b. The minimum cost sum-of-products (SOP) expression from (a) using algebraic manipulation.
   c. The canonical product-of-maxterms expression
   d. The minimum cost product-of-sums (POS) expression from (c) using algebraic manipulation.
   e. The NAND gate only implementation of the minimum cost SOP expression.
   f. The NOR gate only implementation of the minimum cost POS expression.
   g. That the two expressions in (b) and (d) are identical using algebraic manipulation.

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

Karnaugh maps

2. Simplify the following expressions using Karnaugh map:

   (a) X = AB'D' + A'BC'D + A'BCD + A'B'D'

   (b) Y = (P+Q'+R+S')(P+Q'+R'+S')(P'+Q'+R+S')(P'+Q'+R'+S')

3. Simplify the Boolean function F together with the don't care condition d, using the K-map method. Give your answer in SOP.

   F(A, B, C, D) = Σ m (0, 5, 6, 8, 14)

   d (A, B, C, D) = Σ m (2, 7, 15)

4. Repeat Question 3. Give your answer in POS.

Answers

1.

a. F_{SOP} = A'B'C + A'BC + AB'C' + ABC' + ABC

b. F = AB + A'C + AC'

c. F_{POS} = (A+B+C).(A+B'+C).(A'+B+C')

d. F = (A+C).(A'+B+C')

e. F = ((AB)'. (A'C)'. (AC')')'

f. F = ((A+C)' + (A'+B+C')')'

2. (a) X = B'D' + A'BD

   (b) Y = Q' + S'

3. (a) F = BC + A'BD + B'C'D'

   (b) F = (A'+D')(B+D')(B+C')(B'+C+D)