

EE 2000 Logic Circuit Design
Semester A 2014

Tutorial 6

1. (i) Draw the truth table for a half adder.
(ii) Design a half adder using NOR gates only.

Ans:

(i)

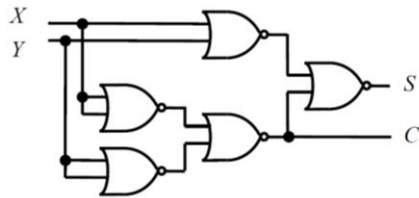
X	Y	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

(ii)

Expresses C and S in POS form:

$$C = XY = [X' + Y']'$$

$$S = (X+Y)(X'+Y') = [(X+Y)' + (X'+Y')']'$$



2. With the following functions, design a circuit with a 3-to-8-line decoder and external gates.

$$F_1(x, y, z) = x'y'z' + xz$$

$$F_2(x, y, z) = xy'z' + x'z$$

Ans:

$$F_1(x, y, z) = x'y'z' + xz$$

$$= x'y'z' + x(y + y')z$$

$$= x'y'z' + xyz + xy'z$$

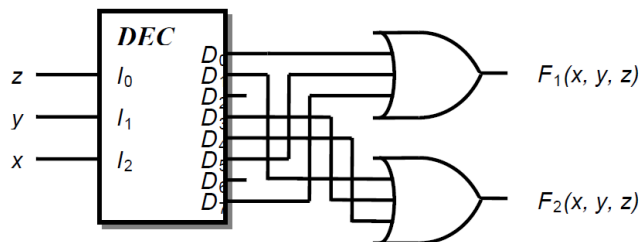
$$= \Sigma m(0, 5, 7)$$

$$F_2(x, y, z) = xy'z' + x'z$$

$$= xy'z' + x'(y + y')z$$

$$= xy'z' + x'y'z + x'y'z$$

$$= \Sigma m(1, 3, 4)$$

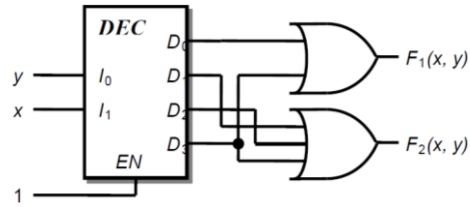


3. With the following functions, design a circuit with a 2-to-4-line decoder with enable input and external NAND gates.

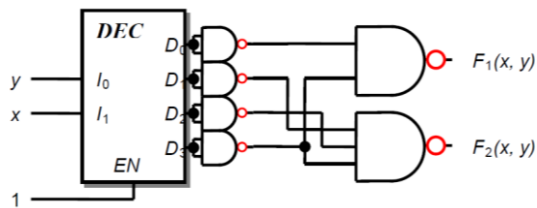
$$F_1(x, y) = \sum m(0, 3)$$

$$F_2(x, y) = \sum m(1, 2, 3)$$

Ans:

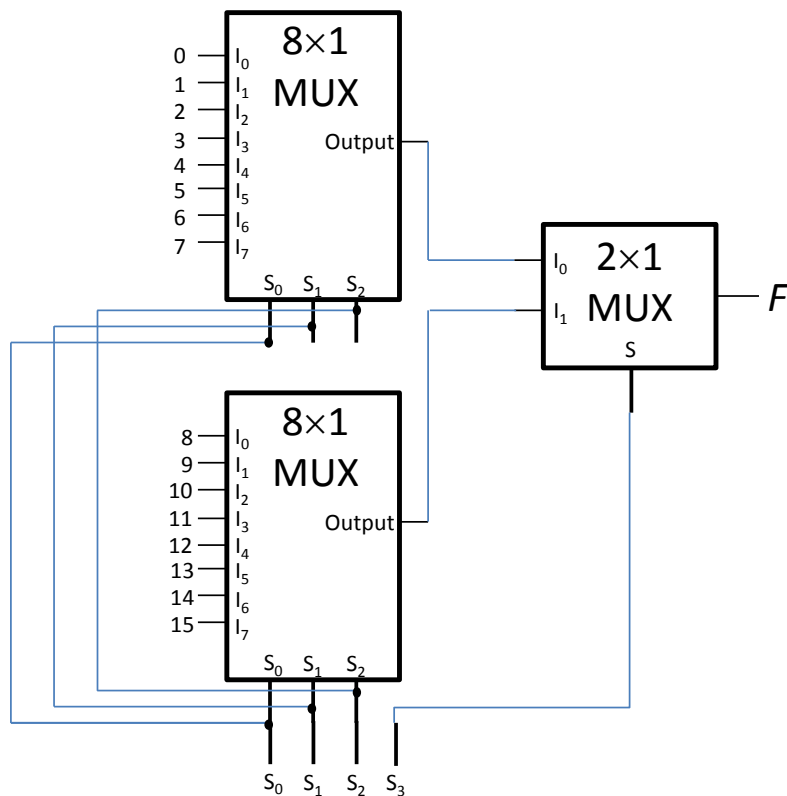


Then,



4. Construct a 16×1 MUX with two 8×1 and one 2×1 MUXs.

Ans:



5. Implement the following Boolean function with a 4×1 MUX and external gates. Connect inputs A and B to the selection lines and inputs C and D to the data input lines of the MUX.

$$F(A,B,C,D) = \sum m(1,3,4,11,12,13,14,15)$$

Ans:

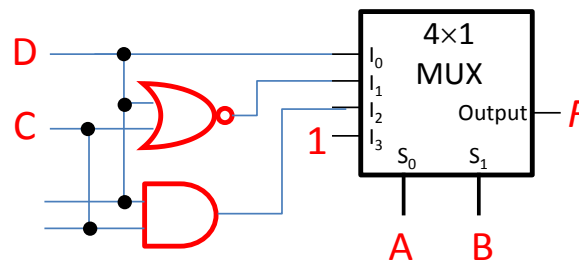
From $F(A,B,C,D) = \sum m(1,3,4,11,12,13,14,15)$, create a K-map without grouping.

CD

AB	00	01	11	10	
00		1	1		→ $F = D$
01	1				→ $F = C'D' = (C+D)'$
11	1	1	1	1	→ $F = 1$
10			1		→ $F = CD$

Choose AB as selection variables

Therefore,



6. Construct the PLA diagram with the minimum number of product terms for the following functions.

$$A(x,y,z) = \sum m(1,2,4,6)$$

$$B(x,y,z) = \sum m(0,1,6,7)$$

$$C(x,y,z) = \sum m(2,6)$$

$$D(x,y,z) = \sum m(1,2,3,5,7)$$

Ans:

Find all complements for functions A, B, C, D.

		yz			
		00	01	11	10
x	0	0	1	0	1
	1	1	0	0	1

$$A = xz' + yz' + x'y'z$$

$$A' = xz + yz + x'y'z'$$

		yz			
		00	01	11	10
x	0	1	1	0	0
	1	0	0	1	1

$$B = xy + x'y'$$

$$B' = xy' + x'y$$

		yz			
		00	01	11	10
x	0	0	0	0	1
	1	0	0	0	1

$$C = yz'$$

$$C' = y' + z$$

		yz			
		00	01	11	10
x	0	0	1	1	1
	1	0	1	1	0

$$D = x'y + z$$

$$D' = xz' + y'z'$$

Choose the combination to provide minimum product terms. Then create a PLA assignment table.

Product terms	Inputs	Outputs
1. yz'	- 1 0	1 - 1 -
2. xz'	1 - 0	1 - - -

3. $x'y'z$	0 0 1	1 - - -
4. xy'	1 0 -	- 1 - -
5. $x'y$	0 1 -	- 1 - 1
6. z	- - 1	- - - 1
		A B' C D

Based on the above PLA table, then complete the PLA diagram.

