

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF ELECTRICAL ENGINEERING

EE 200 DIGITAL LOGIC CIRCUIT DESIGN

EXAMINATION II

December 5, 2007

NAME :				
I.D. # :				
SECTION :	1	3	4	5



PROBLEM #	SCORE	MAXIMUM
1.		40
2.		30
3.		30
TOTAL		100

Q.# 1)

Design a combinational circuit that implements the following Boolean functions:

$$F_1(A, B, C, D) = \sum(0, 2, 8, 9, 10, 11, 13, 15)$$

$$F_2(A, B, C, D) = \Pi(0, 2, 8, 10, 13, 15)$$

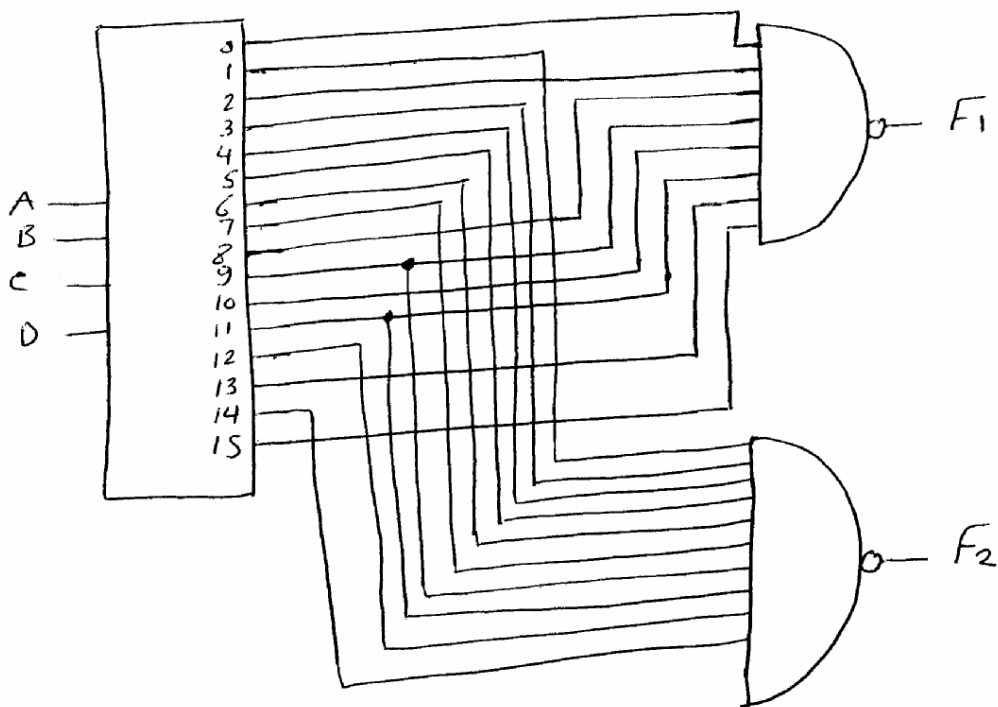
1. using a decoder made with NAND gates and external gates. Determine the type of external gates.
2. Using a PLA with the minimum number of product terms. Determine the size of the PLA and its program table.
3. Draw the logic circuit of the PLA showing the fuse pattern.

1. $F_1 = \sum (0, 2, 8, 9, 10, 11, 13, 15)$

$F_2 = \sum (1, 3, 4, 5, 6, 7, 9, 11, 12, 14)$

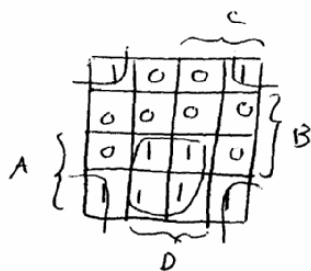
We use 4x16 decoder with NAND gates and two external NAND gates one with 8 inputs and the second with 10 inputs. Alternatively one NAND with 8 inputs and one AND with six inputs.

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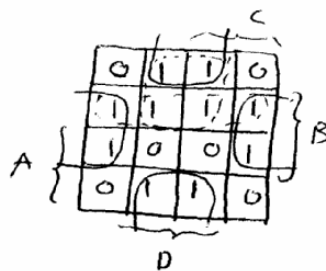
Also F_2 can be obtained from AND gate with inputs coming from $F_2' = \sum (0, 2, 8, 10, 13, 15)$

2.



$$F_1 = AD + B'D' + ABD$$

$$F_1' = A'D + BD'$$



$$F_2 = BD' + B'D + A'D$$

$$= A'B$$

$$F_2' = B'D' + ABD$$

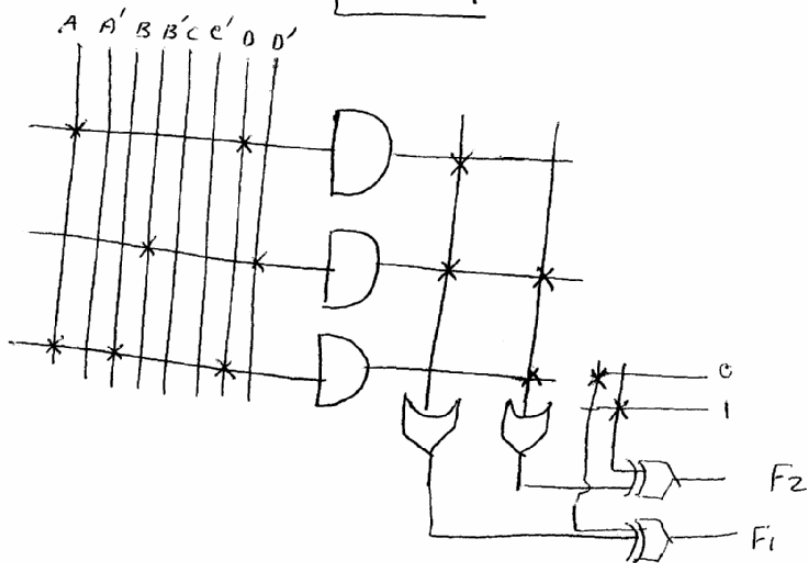
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Using	K
F_1, F_2	5
F_1, F_2'	3
F_1', F_2	3 or 4
F_1', F_2'	4

We use F_1 & F_2'

PLA size is 4x3x2

prod. term		inputs				F_1	F_2'
		A	B	C	D		
1	AD	1	-	-	1	-	
2	B'D'	-	0	-	0	1	
3	ABD	1	1	-	1	-	
		T C					



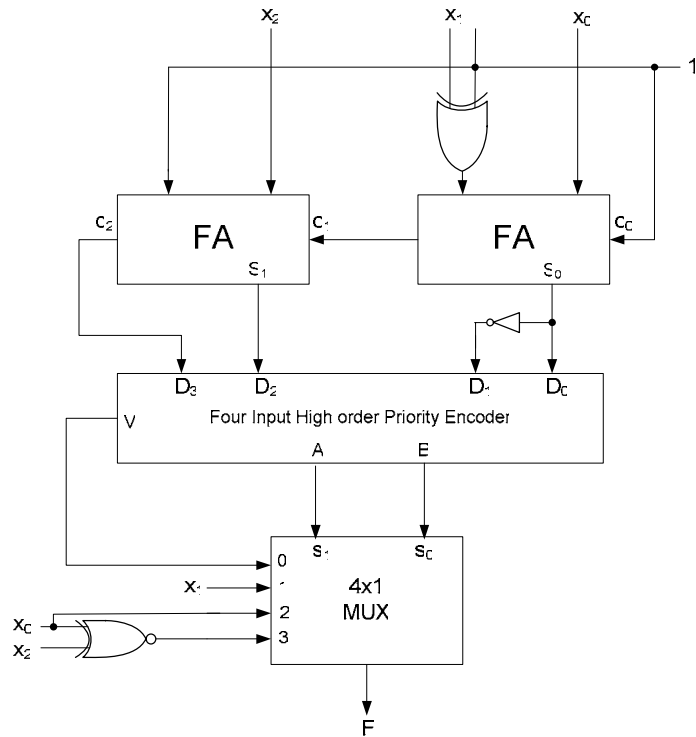
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Q # 2)

In the logic circuit shown below, the inputs are x_2, x_1, x_0 and the final output is F .

- Derive the truth table that describes the operation of this circuit. Show the logic values at $D_0, D_1, D_2, D_3, A, B, V$ and F
- Find out what the output function F represents in terms of the input variables.

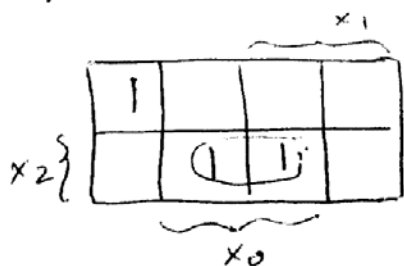
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a.

x_2	x_1	x_0	D_0	D_1	D_2	D_3	A	B	V	F
0	0	0	0	1	0	1	1	1	1	1
0	0	1	1	0	0	1	1	1	1	0
0	1	0	1	0	1	0	1	0	1	0
0	1	1	0	1	0	1	1	1	1	0
1	0	0	0	1	1	1	1	1	1	0
1	0	1	1	0	1	1	1	1	1	0
1	1	0	1	0	0	1	1	1	1	1
1	1	1	0	1	1	1	1	1	1	1

b. $F = \sum (0, 5, 7)$



$$F = x_2 x_0 + x_2' x_1' x_0'$$

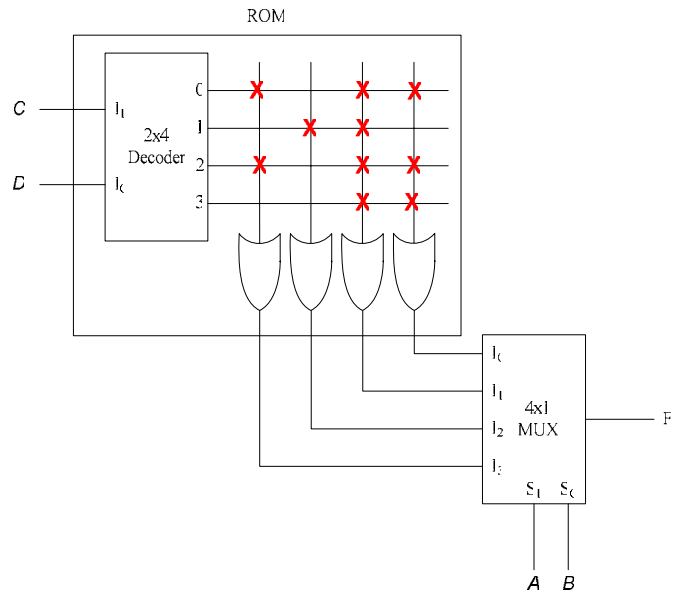
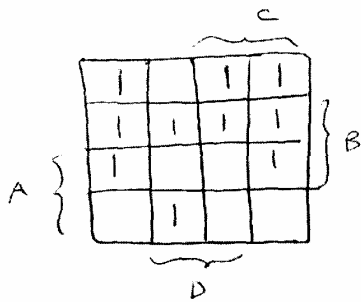
Q # 3)

You would like to build a circuit that implements the function

$$F(A,B,C,D) = A'B + A'C + A'D + BD + AB'C'D$$

Only a 4x4 ROM and a 4x1 MUX are available. Program the ROM in the following circuit to implement the function F .

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$$F = \sum (0, 2, 3, 4, 5, 6, 7, 9, 12, 14)$$

	A'B'	A'B	AB'	AB
	0	1	2	3
c'd'	0	4	8	12
c'd	1	5	9	13
cd'	2	6	10	14
cd	3	7	11	15

(c'd)' | c'd | d'
= c+d'

$$I_0 = c + d'$$

$$I_1 = 1$$

$$I_2 = c'd$$

$$I_3 = d'$$

c	d	I ₀	I ₁	I ₂	I ₃
0	0	1	1	0	1
0	1	0	1	1	0
1	0	1	1	0	1
1	1	1	1	0	0