Exercise Five - P2

23- Draw the logic diagram of 2-to-4 line decoder using :-

(1) NOR gates . active high decoder

(2) NAND gates. active low decoder

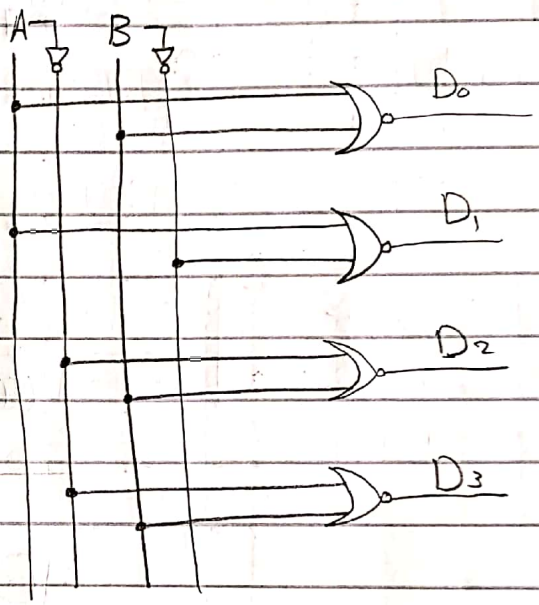
A	B	D_0	D_1	D_2	D_3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

$D_0 = A'B' = [(A'B')']' = (A+B)'$

$D_1 = A'B = [(A'B)']' = (A+B')'$

$D_2 = AB' = [(AB')']' = (A'+B)'$

$D_3 = AB = [(AB)']' = (A'+B')'$



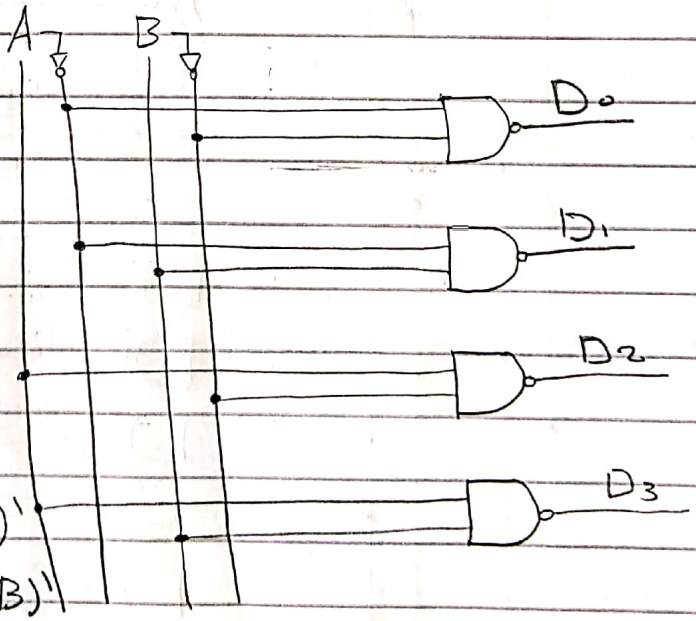
A	B	D_0	D_1	D_2	D_3
0	0	0	1	1	1
0	1	1	0	1	1
1	0	1	1	0	1
1	1	1	1	1	0

$D_0 = A+B = [(A+B)']' = (A'B')'$

$D_1 = A+B' = [(A+B')']' = (A'B)'$

$D_2 = A'+B = [(A'+B)']' = (AB')'$

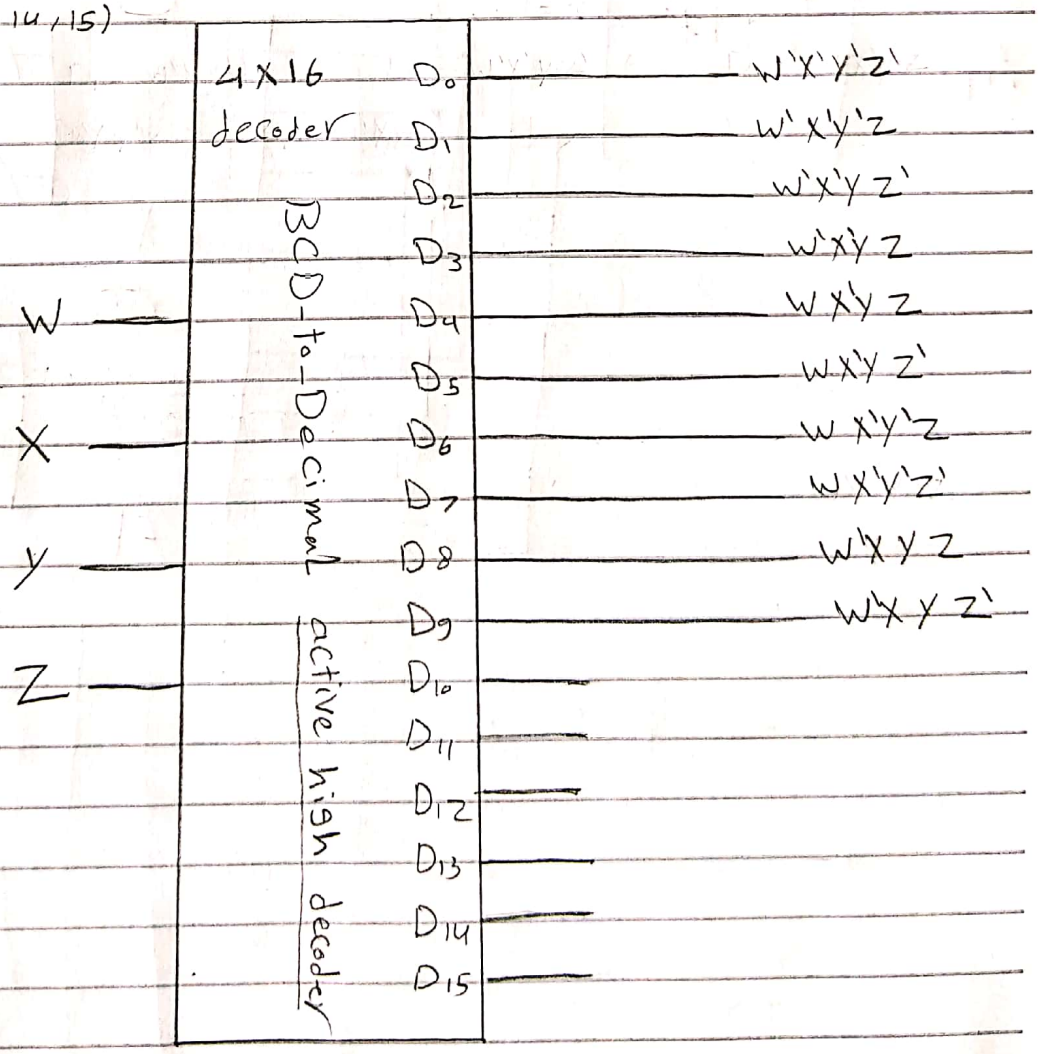
$D_3 = A'+B' = [(A'+B')']' = (AB)'$



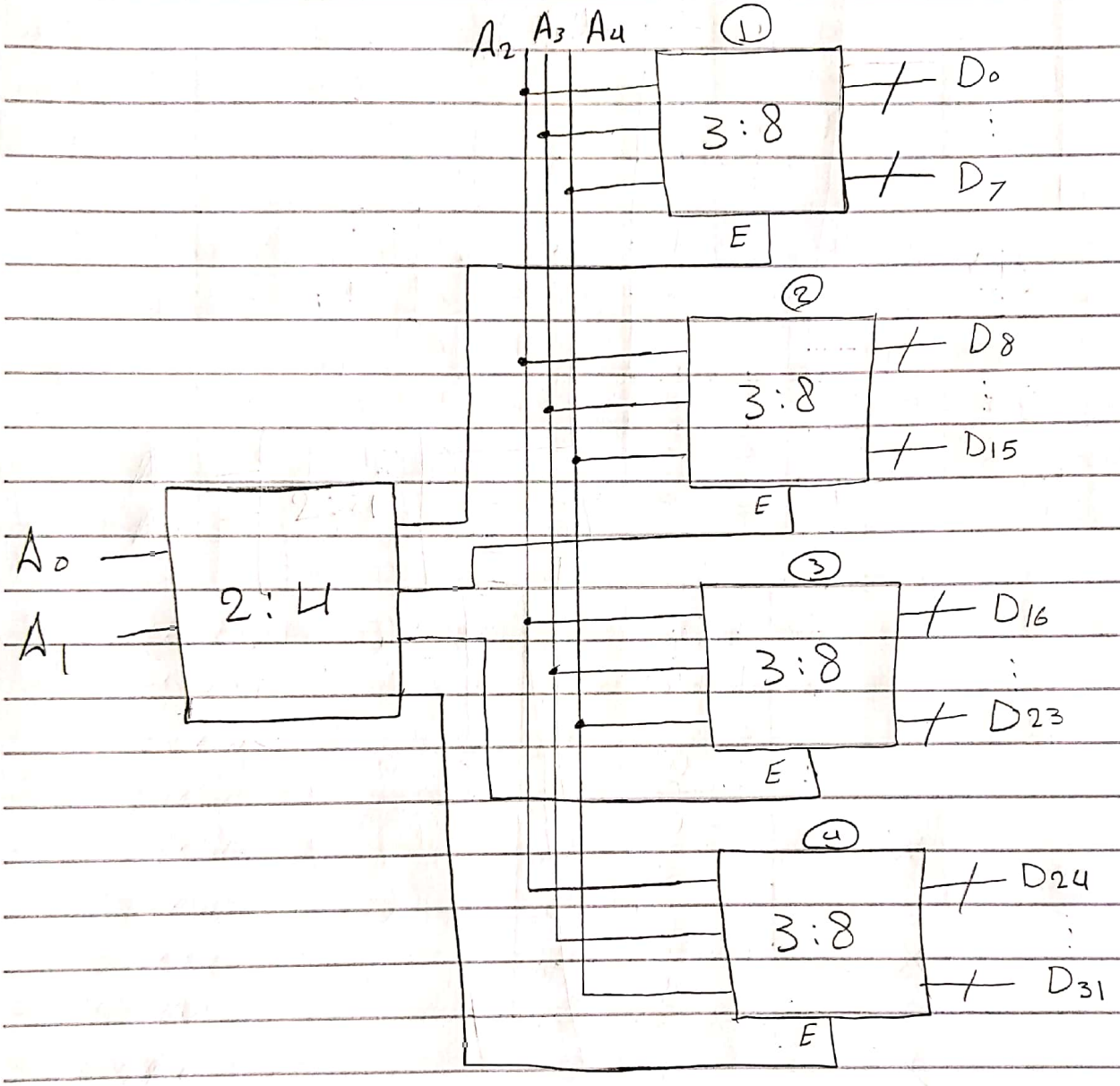
24- Design a BCD-to-Decimal decoder using the unused Combinations of the BCD code as don't-care conditions:-

Dec	BCD	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9
0	0000	1	0	0	0	0	0	0	0	0	0
1	0001	0	1	0	0	0	0	0	0	0	0
2	0010	0	0	1	0	0	0	0	0	0	0
3	0011	0	0	0	1	0	0	0	0	0	0
4	0100	0	0	0	0	1	0	0	0	0	0
5	0101	0	0	0	0	0	1	0	0	0	0
6	0110	0	0	0	0	0	0	1	0	0	0
7	0111	0	0	0	0	0	0	0	1	0	0
8	1000	0	0	0	0	0	0	0	0	1	0
9	1001	0	0	0	0	0	0	0	0	0	1

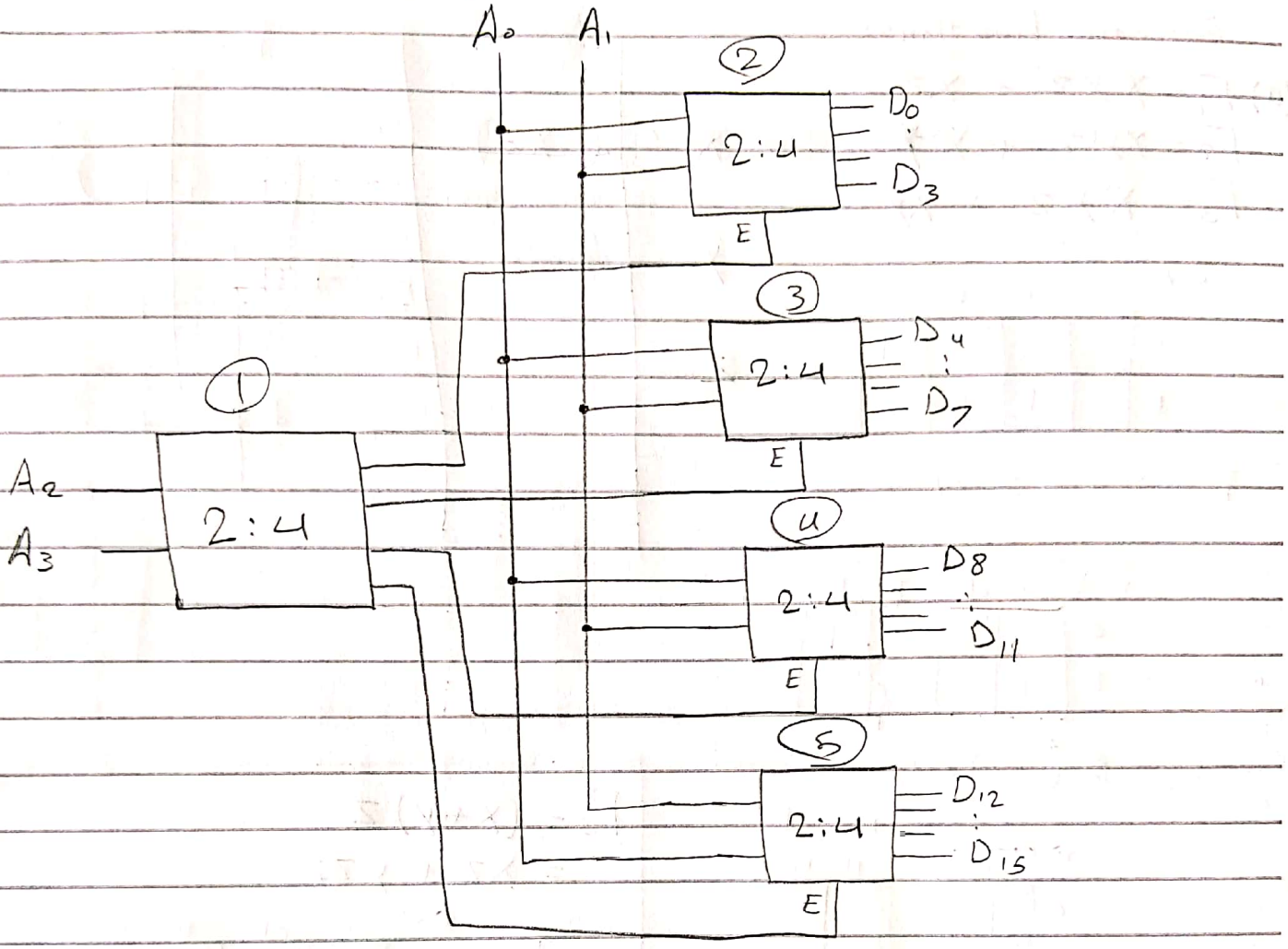
$d = \sum(10, 11, 12, 13, 14, 15)$



25- Construct a 5-to-32-line decoder with four 3-to-8-line decoders with enable and a 2-to-4-line decoder. Use block diagrams for the components:-



26- Construct a 4-to-16-line decoder with five 2-to-4 line decoders with enable:

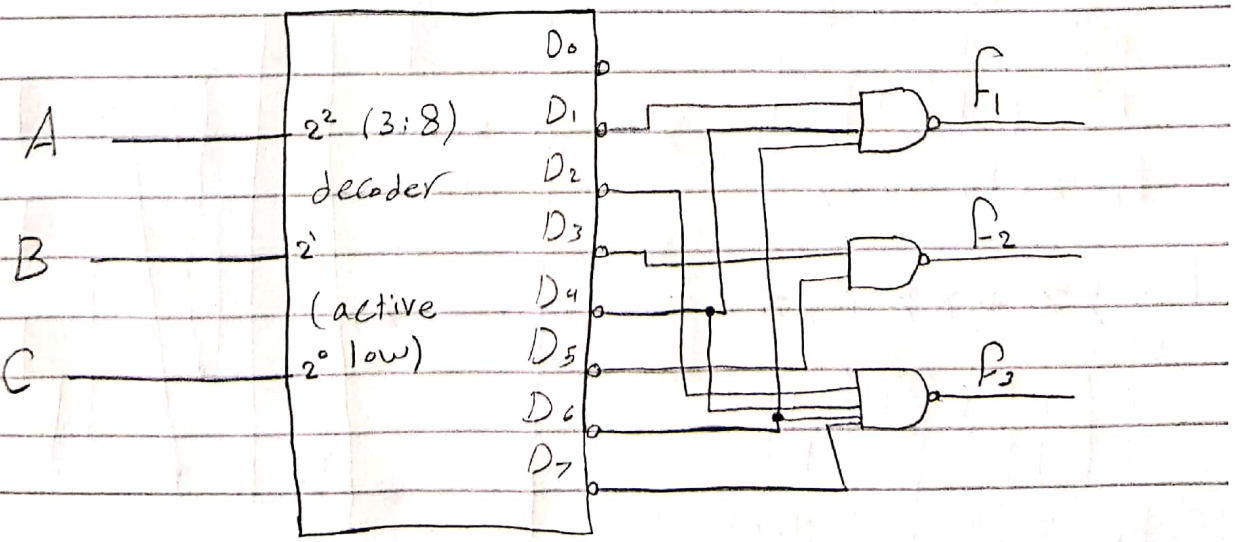


27- A combinational circuit is specified by the following three Boolean functions: $F_1 = \Sigma(1,4,6)$

$F_2 = \Sigma(3,5)$

$F_3 = \Sigma(2,4,6,7)$

Implement the circuit with a decoder constructed with NAND gates:-

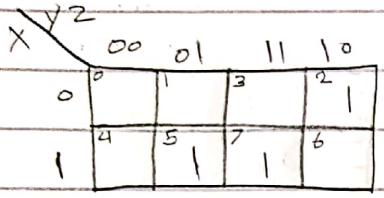


28- Using a decoder and external gates, design the Combinational circuit defined by the following three Boolean functions:

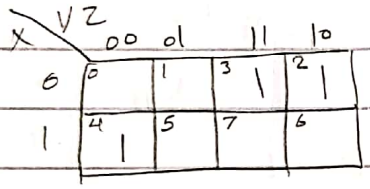
(a) $F_1 = x'y'z' + xz$

$F_2 = xy'z' + x'y$

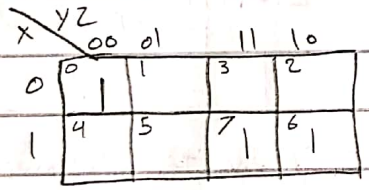
$F_3 = x'y'z' + xy$



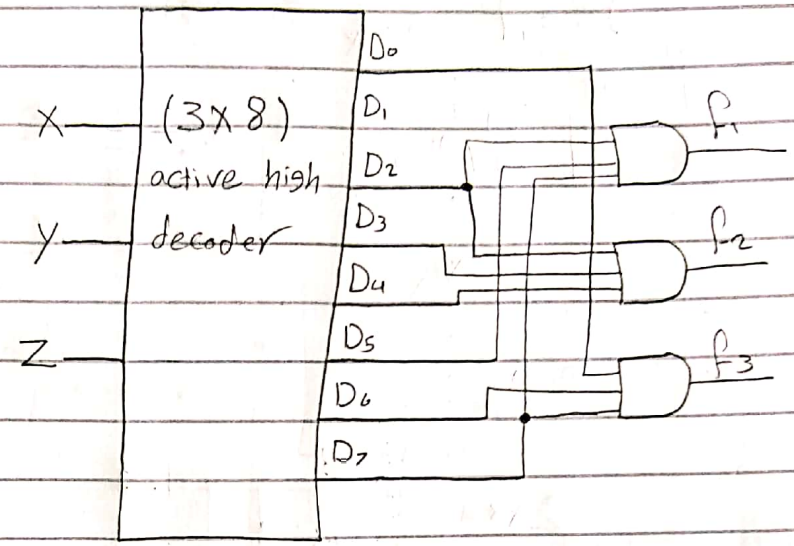
$f_1 = \Sigma(2, 5, 7)$



$f_2 = \Sigma(2, 3, 4)$

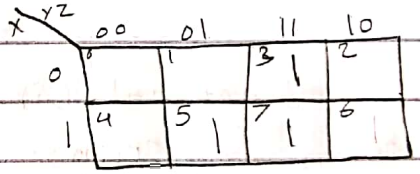


$f_3 = \Sigma(0, 6, 7)$



$F_3 = (x+y)z$

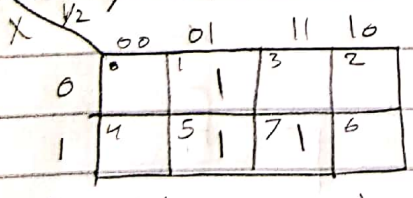
$= xz + yz$



$F_3 = \Sigma(3, 5, 7)$

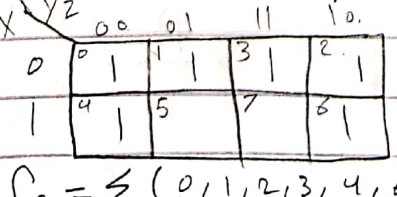
(b) $F_1 = (y' + x)z$

$= y'z + xz$

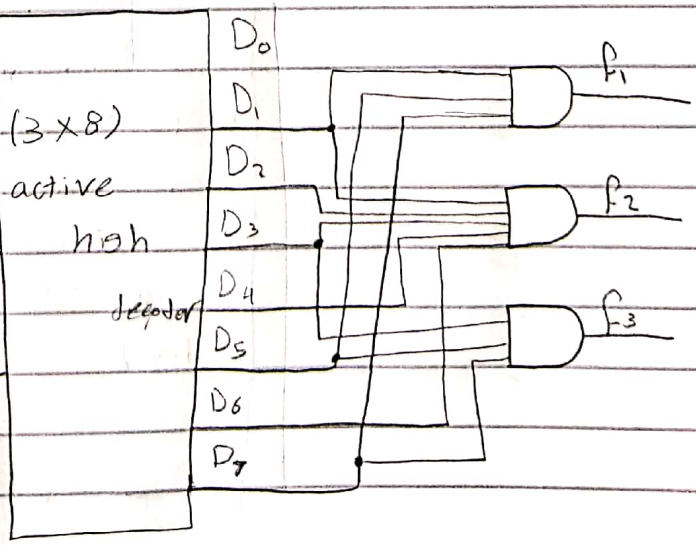


$f_1 = \Sigma(1, 5, 7)$

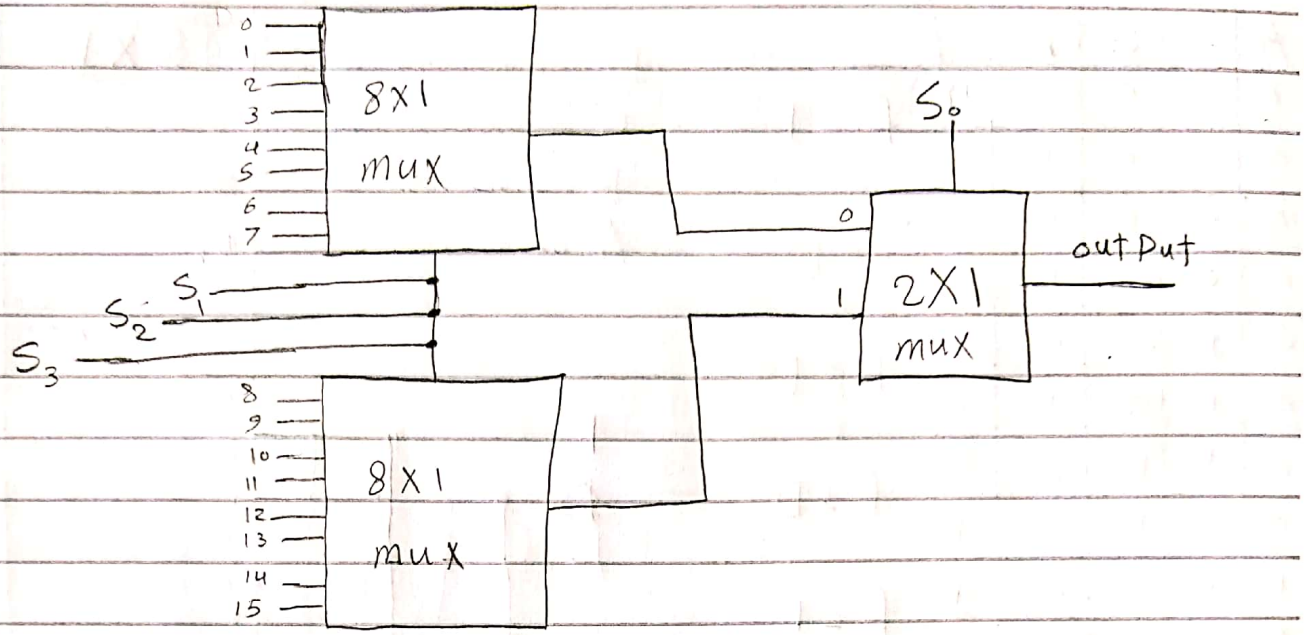
$f_2 = y'z' + x'y + yz'$



$f_2 = \Sigma(0, 1, 2, 3, 4, 6)$



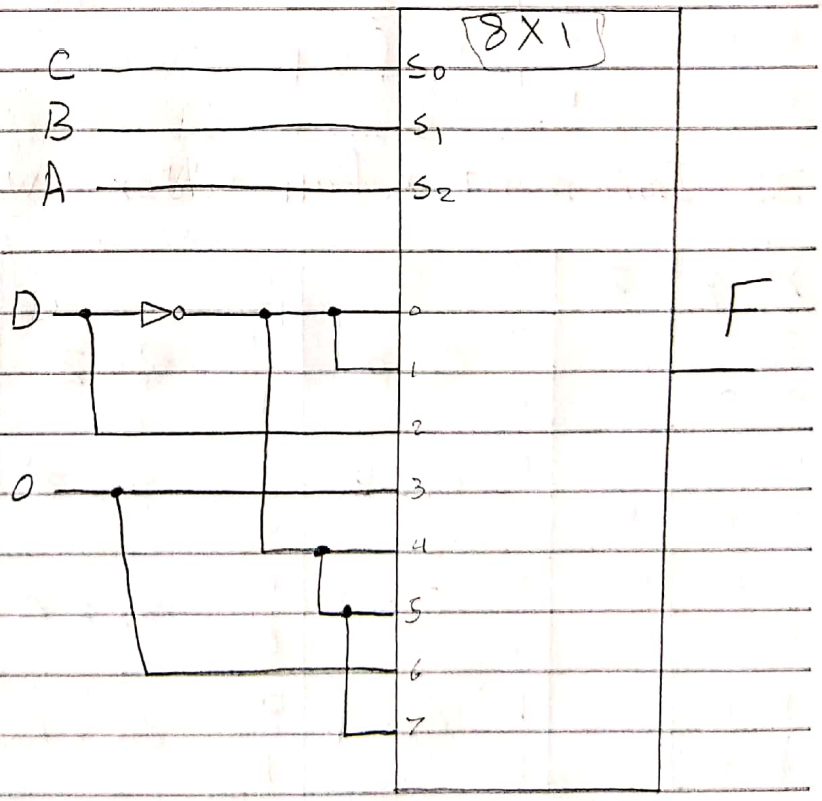
31- Construct a 16X1 multiplexer with two 8X1 and one 2X1 multiplexers. Using block diagrams.



32- Implement the following Boolean function with a multiplexer:

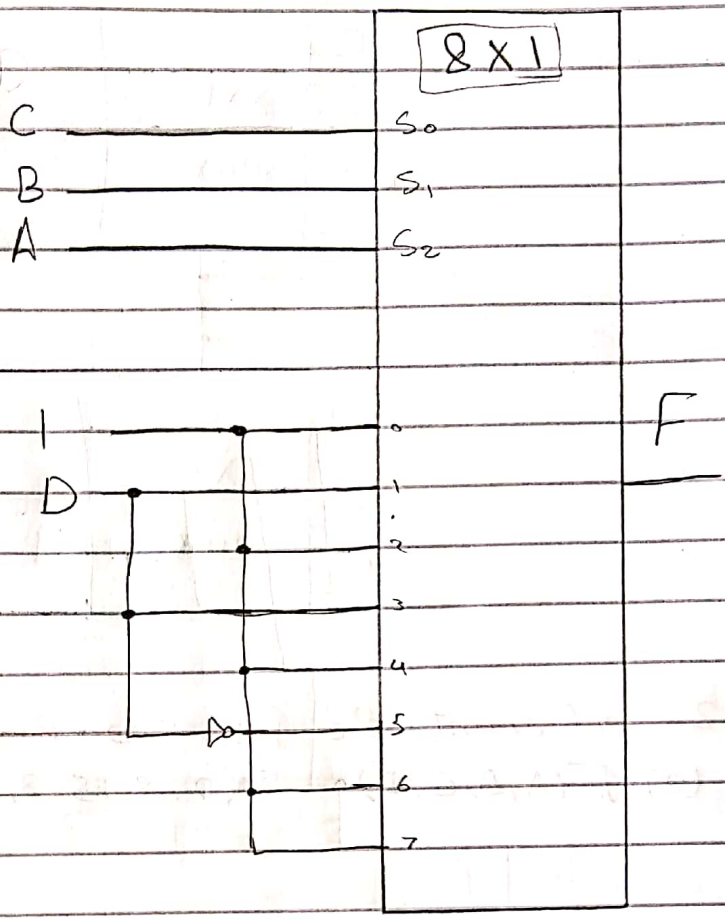
(a) $F(A,B,C,D) = \Sigma m(0,2,5,8,10,14)$ $n-1 = 3$ (3 → Select lines) $mux = 2^3 = 8X1$

A	B	C	D	F	
0	0	0	0	1	$f = D'$
0	0	0	1	0	
0	0	1	0	1	$f = D'$
0	0	1	1	0	
0	1	0	0	0	$f = D$
0	1	0	1	1	
0	1	1	0	0	$f = 0$
0	1	1	1	0	
1	0	0	0	1	$f = D'$
1	0	0	1	0	
1	0	1	0	1	$f = D'$
1	0	1	1	0	
1	1	0	0	0	$f = 0$
1	1	0	1	0	
1	1	1	0	1	$f = D'$
1	1	1	1	0	



(b) $F(A, B, C, D) = \prod^{M} (2, 6, 11)$

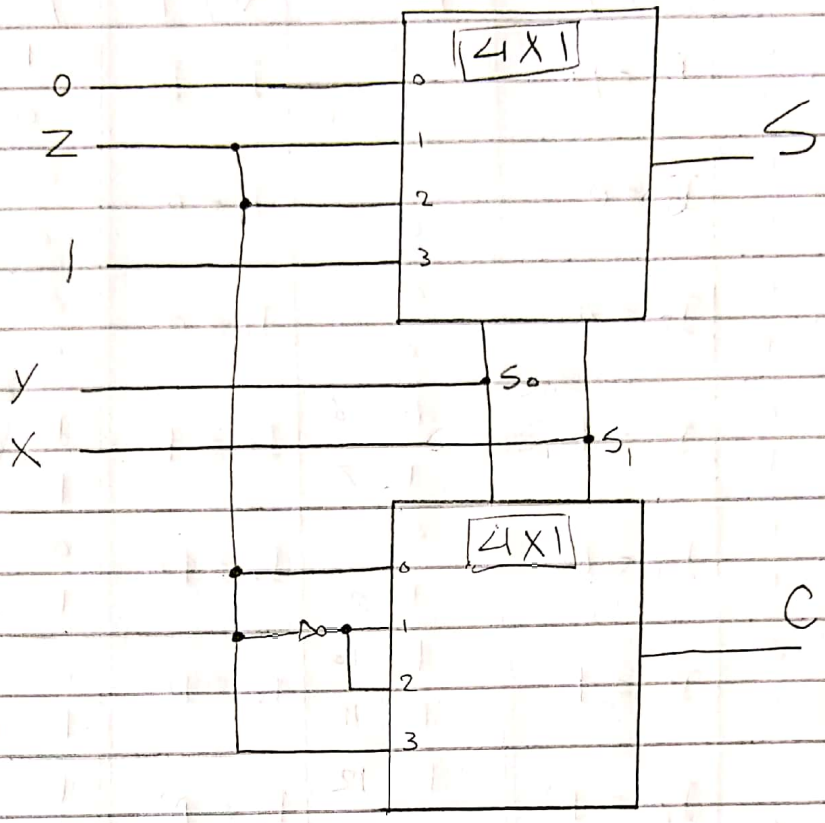
A	B	C	D	F	
0	0	0	0	1	F = 1
0	0	0	1	1	
0	0	1	0	0	f = D
0	0	1	1	1	
0	1	0	0	1	f = 1
0	1	0	1	1	
0	1	1	0	0	f = D
0	1	1	1	1	
1	0	0	0	1	f = 1
1	0	0	1	1	
1	0	1	0	1	f = D'
1	0	1	1	0	
1	1	0	0	1	f = 1
1	1	0	1	1	
1	1	1	0	1	f = 1
1	1	1	1	1	



33- Implement a full adder with two 4X1 multiplexer :-

X	y	Z	C		S	
0	0	0	0	$C_0 = 0$	0	$S_0 = Z$
0	0	1	0		1	
0	1	0	0	$C_1 = Z$	1	$S_1 = Z'$
0	1	1	1		0	
1	0	0	0	$C_2 = Z$	1	$S_2 = Z'$
1	0	1	1		0	
1	1	0	1	$C_3 = 1$	0	$S_3 = Z$
1	1	1	1		1	

>> Implementation of a full adder using two 4x1 multiplexer :-



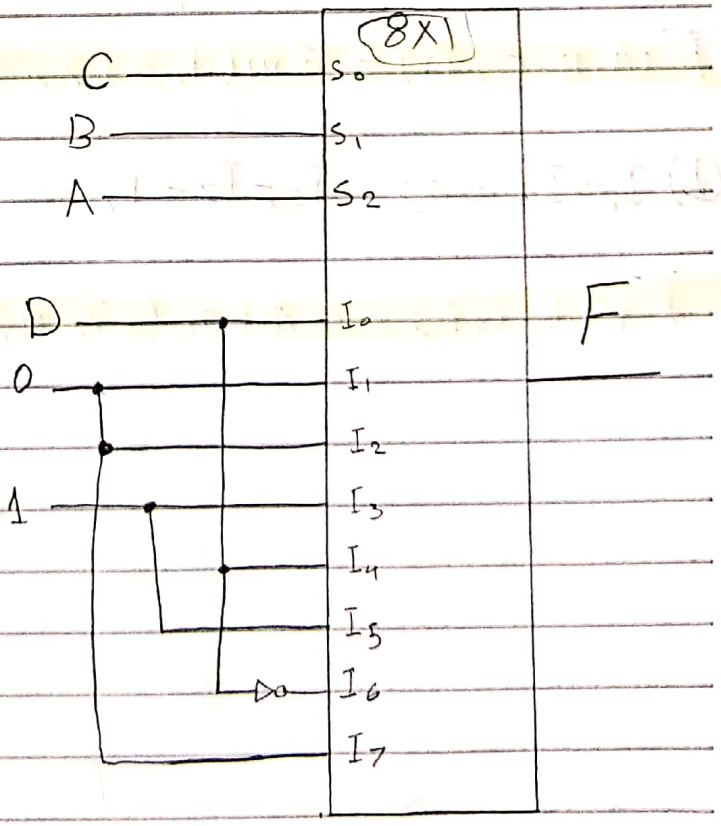
34: An 8x1 multiplexer has inputs A, B, and C connected to selection inputs S_2, S_1, S_0. The data inputs as follow :-

(a) $I_1 = I_2 = I_3 = 0$

$I_3 = I_5 = 1$

$I_0 = I_4 = D$

$I_6 = D'$



(a) $I_1 = I_2 = I_7 = 0$; $I_3 = I_5 = 1$; $I_0 = I_4 = D$; $I_6 = D'$

A	B	C	D	(a) F	F =	(b) F	F =
0	0	0	0	$I_0 = D$	0	$I_0 = D'$	1 0
0	0	0	1		1 1		0
0	0	1	0	$I_1 = 0$	0	$I_1 = 0$	0
0	0	1	1		0		0
0	1	0	0	$I_2 = 0$	0	$I_2 = 0$	0
0	1	0	1		0		0
0	1	1	0	$I_3 = 1$	1 6	$I_3 = 1$	1 6
0	1	1	1		1 7		1 7
1	0	0	0	$I_4 = D$	0	$I_4 = D$	0
1	0	0	1		1 9		1 9
1	0	1	0	$I_5 = 1$	1 10	$I_5 = D$	0
1	0	1	1		1 11		1 11
1	1	0	0	$I_6 = D'$	1 12	$I_6 = D'$	1 12
1	1	0	1		0		0
1	1	1	0	$I_7 = 0$	0	$I_7 = 1$	1 14
1	1	1	1		0		1 15

$F(A,B,C,D) = \Sigma m(1,6,7,9,10,11,12)$

(b) $I_1 = I_2 = 0$; $I_3 = I_7 = 1$; $I_4 = I_5 = D$; $I_0 = I_6 = D'$

$F(A,B,C,D) = \Sigma m(0,6,7,9,11,12,14,15)$