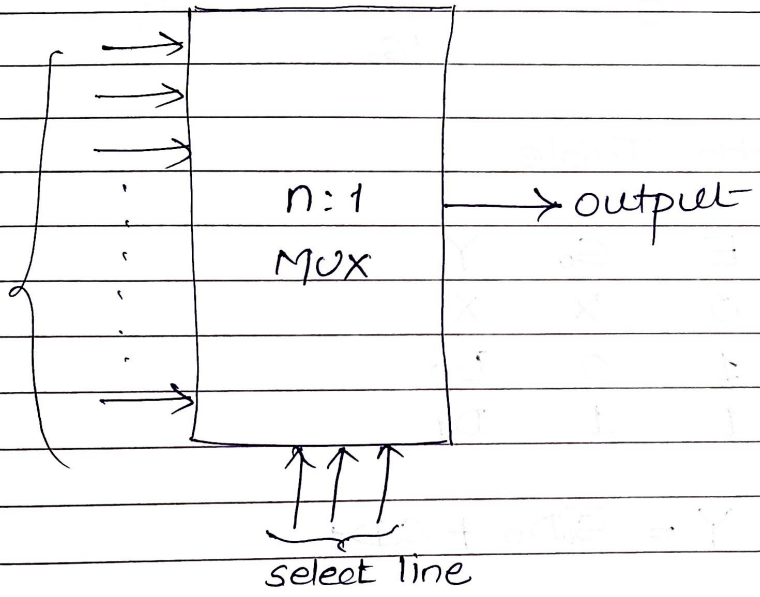
Multiplexer

Multiplexer is a combinational logic circuit having many inputs and one output.

Multiplexer is many to one.

In multiplexer select line select the one input as a output



Types of Multiplexer

1. 2:1 Multiplexer
2. 4:1 Multiplexer
3. 8:1 Multiplexer
4. 16:1 Multiplexer

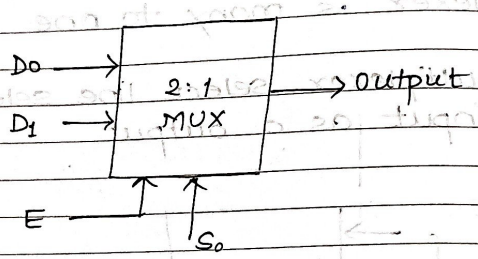
Select lines

$2^m = n$

m = Select lines

2:1 Multiplexer

Inputs : 2
Output : 1
Select lines : 1

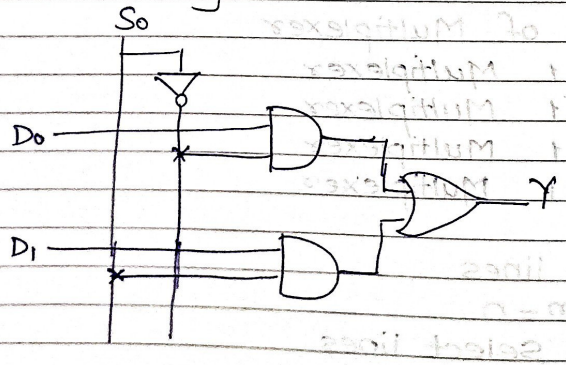


Truth Table

E	S_0	Y
0	X	X
1	0	D_0
1	1	D_1

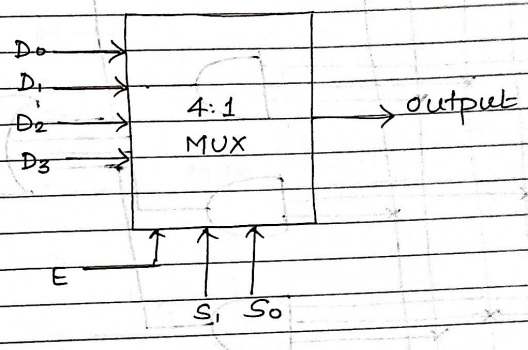
$$Y = \overline{S_0} D_0 + S_0 D_1$$

Circuit diagram



4:1 Multiplexer

Inputs : 4
Outputs : 1
Select lines : 2



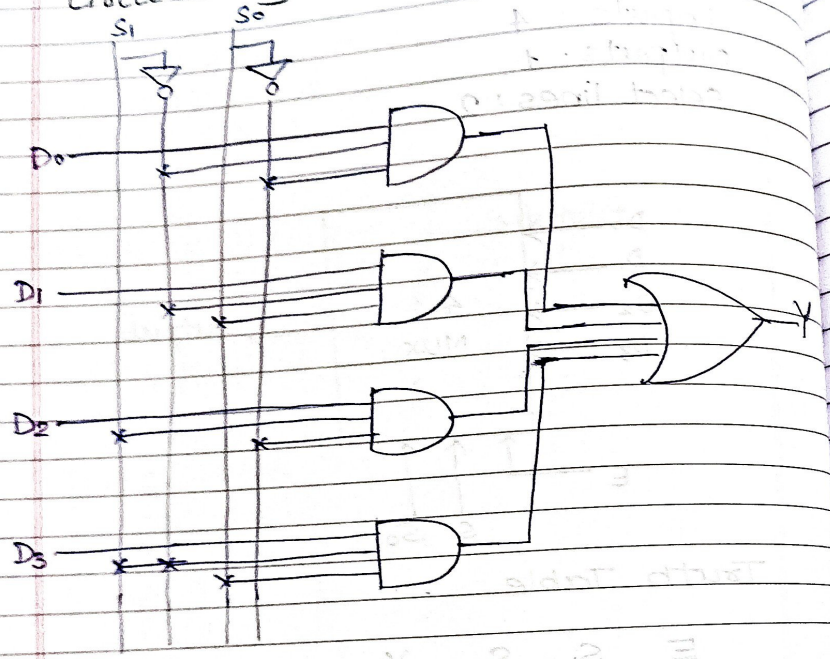
Truth Table

E	S_1	S_0	Y
0	X	X	X
1	0	0	D_0
1	0	1	D_1
1	1	0	D_2
1	1	1	D_3

Equation :

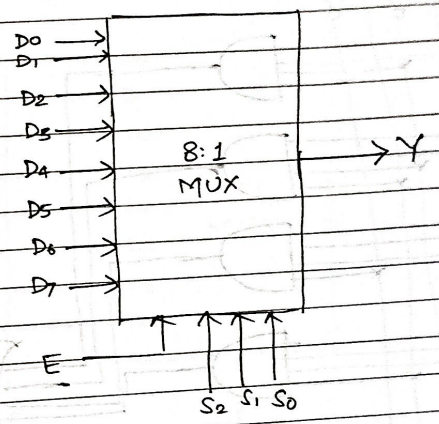
$$Y = \overline{S_1}\,\overline{S_0} D_0 + \overline{S_1} S_0 D_1 + S_1 \overline{S_0} D_2 + S_1 S_0 D_3$$

Circuit diagram:



8:1 Multiplexer

Inputs : 08
Outputs: 01
Select lines: 03

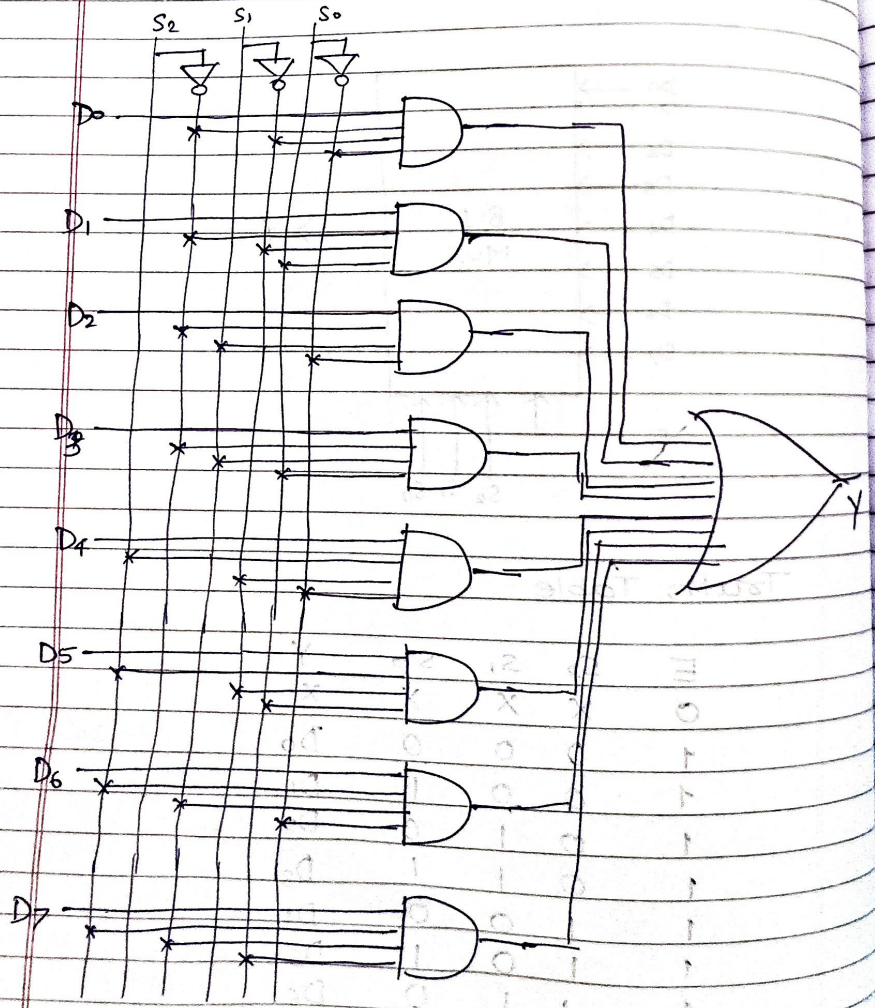


Truth Table

E	S_2	S_1	S_0	Y
0	X	X	X	X
1	0	0	0	D_0
1	0	0	1	D_1
1	0	1	0	D_2
1	0	1	1	D_3
1	1	0	0	D_4
1	1	0	1	D_5
1	1	1	0	D_6
1	1	1	1	D_7

Equation:

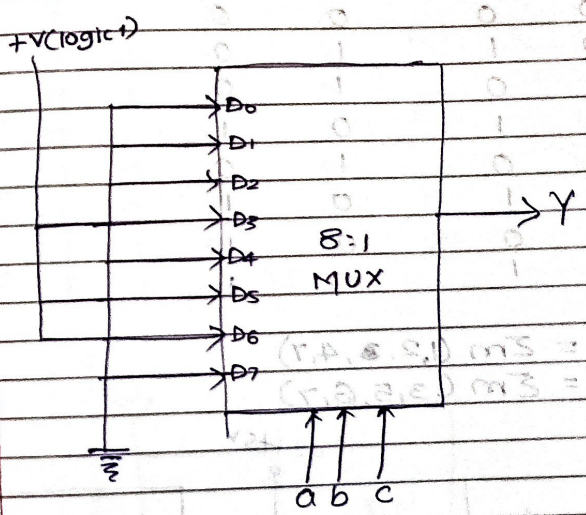
$$Y = \bar{S_2}\bar{S_1}\bar{S_0}D_0 + \bar{S_2}\bar{S_1}S_0D_1 + \bar{S_2}S_1\bar{S_0}D_2 + \bar{S_2}S_1S_0D_3 + S_2\bar{S_1}\bar{S_0}D_4 + S_2\bar{S_1}S_0D_5 + S_2S_1\bar{S_0}D_6 + S_2S_1S_0D_7$$



Multiplexer as a function generator

Implement the following function using 8:1 Multiplexer.

$$F(a,b,c) = \Sigma m(3,5,6)$$



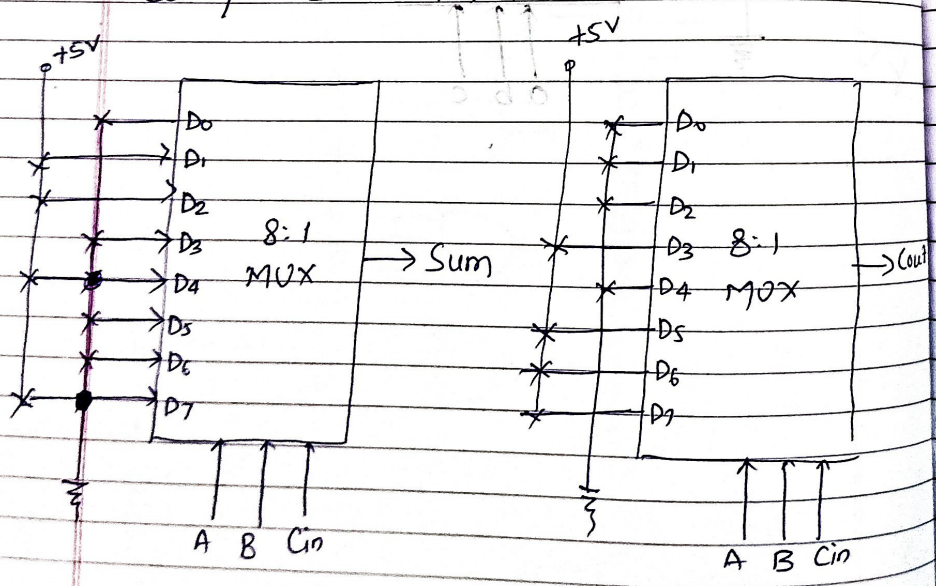
Implement full Adder using 8:1 MUX.

Truth Table:

A	B	Cin	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Sum = $\Sigma m(1,2,3,4,7)$

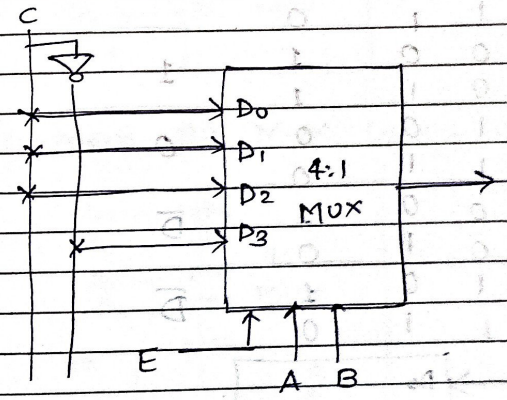
Carry = $\Sigma m(3,5,6,7)$



Implement following function using 4:1 MUX

$F(A,B,C) = \Sigma m(1,3,5,6)$

A	B	C	Y	Y
0	0	0	0	
0	0	1	1	C
0	1	0	0	
0	1	1	1	C
1	0	0	0	
1	0	1	1	C
1	1	0	1	$\bar{C}$
1	1	1	0	

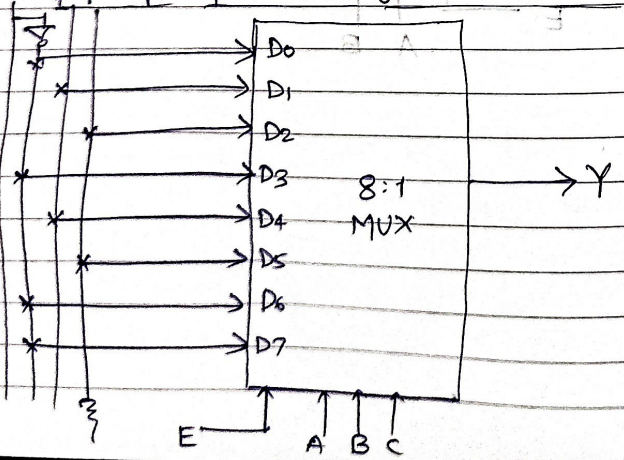


Implement expression using 8:1 MUX

$F(A,B,C,D) = \Sigma m(0,2,3,6,8,9,12,14)$

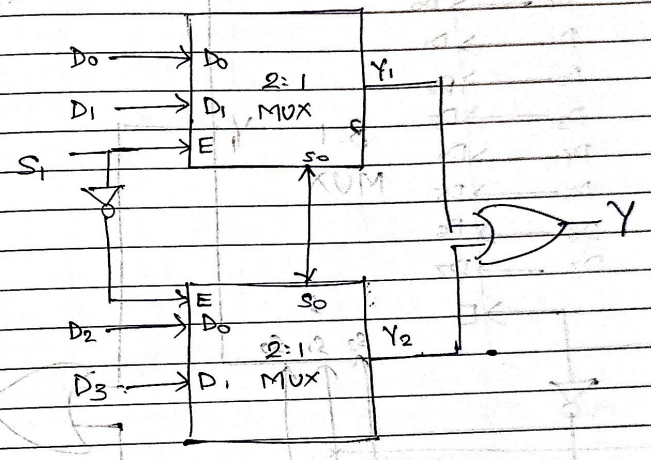
Truth Table

A	B	C	D	Y	Y
0	0	0	0	1	$\bar{D}$
0	0	0	1	0	
0	0	1	0	1	1
0	0	1	1	1	
0	1	0	0	0	0
0	1	0	1	0	
0	1	1	0	1	$\bar{D}$
0	1	1	1	0	
1	0	0	0	1	1
1	0	0	1	1	
1	0	1	0	0	0
1	0	1	1	0	
1	1	0	0	1	$\bar{D}$
1	1	0	1	0	
1	1	1	0	1	$\bar{D}$
1	1	1	1	0	

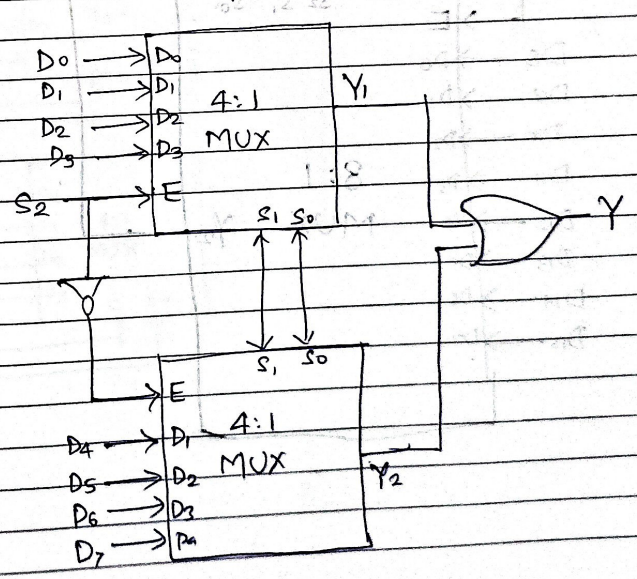


Cascading Multiplexer

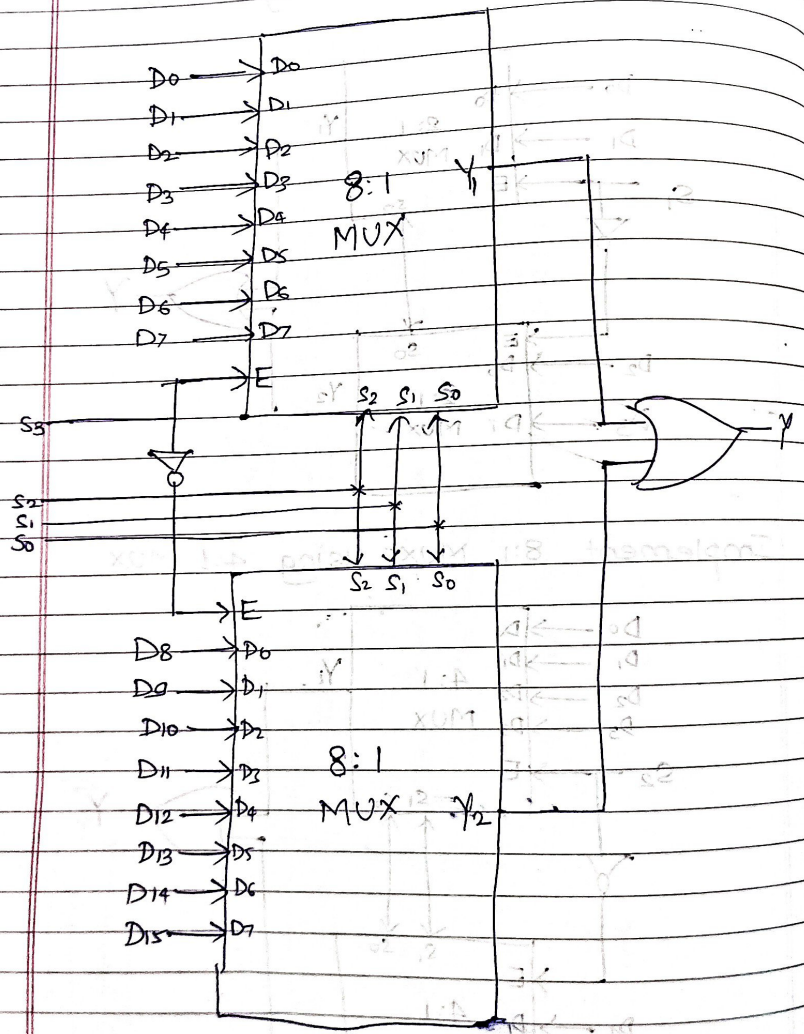
Implement 4:1 MUX using 2:1 MUX



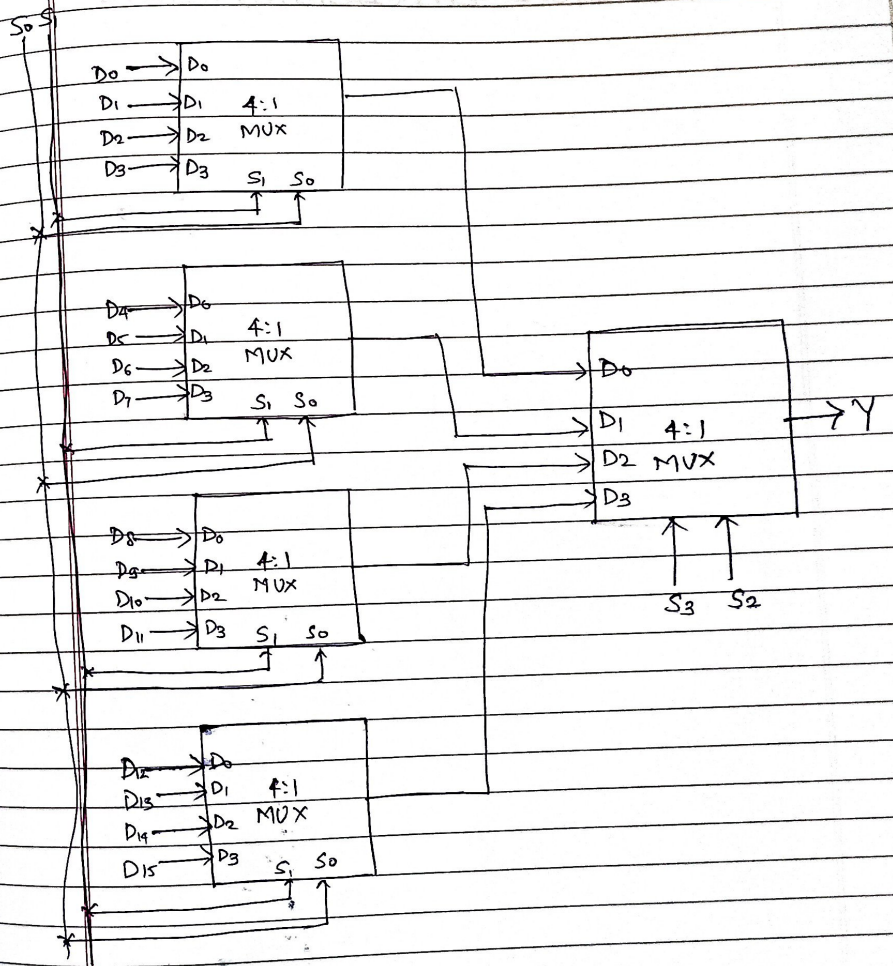
Implement 8:1 MUX using 4:1 MUX



Implement 16:1 Multiplexer using 8:1 MUX



Design 16:1 Multiplexer using 4:1 MUX



Implement function using 4:1 MUX

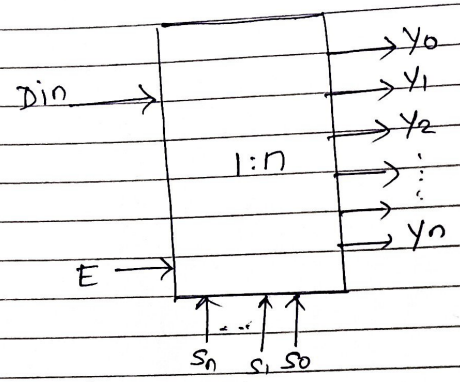
$F(A,B,C) = \Sigma m(1,3,5,6)$

Implement function using 8:1 MUX

$F(A,B,C,D) = \Sigma m(0,2,3,6,8,9,12,14)$

Demultiplexer

Demultiplexer is one input and many output

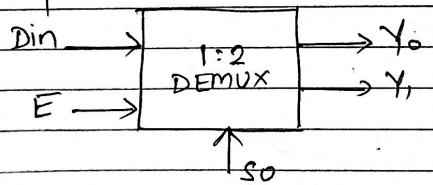


Type of demultiplexers

1. 1:2 demultiplexer
2. 1:4 demultiplexer
3. 1:8 demultiplexer
4. 1:16 demultiplexer

1:2 Demultiplexer

input - one Select line - 1
output - two

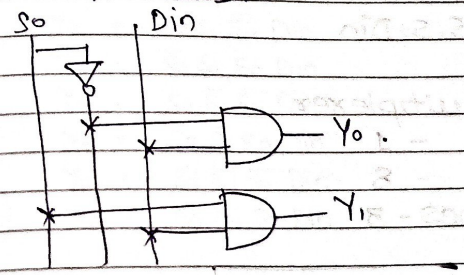


E	S0	Y0	Y1
0	X	0	0
1	0	Din	0
1	1	0	Din

The logical expression

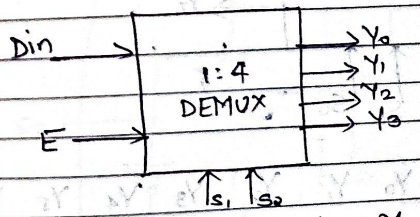
$Y_0 = \overline{S_0}\, Din$

$Y_1 = S_0\, Din$



1:14 Demultiplexer

inputs - 1
outputs - 4
selectline - 2



E	S1	S0	Y0	Y1	Y2	Y3
0	X	X	0	0	0	0
1	0	0	Din	0	0	0
1	0	1	0	Din	0	0
1	1	0	0	0	Din	0
1	1	1	0	0	0	Din

The logical expression of the term of Y

$Y_0 = \bar{S_1}\bar{S_0}\,Din$

$Y_1 = \bar{S_1}S_0\,Din$

$Y_2 = S_1\bar{S_0}\,Din$

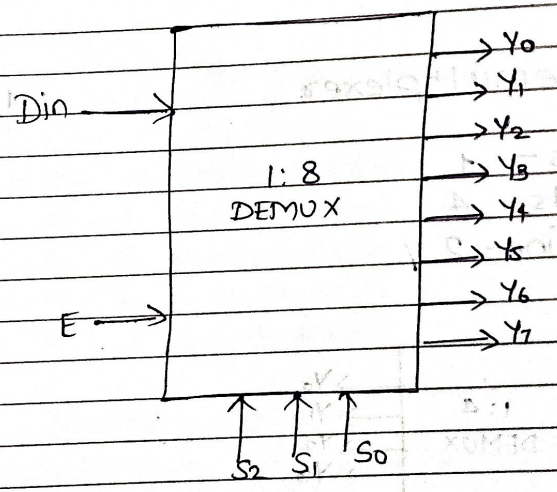
$Y_3 = S_1 S_0\,Din$

1:8 Demultiplexer

inputs - 1

outputs - 8

select lines - 3



E	S_2	S_1	S_0	Y_0	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
0	X	X	X	0	0	0	0	0	0	0	0
1	0	0	0	Din							
1	0	0	1		Din						
1	0	1	0			Din					
1	0	1	1				Din				
1	1	0	0					Din			
1	1	0	1						Din		
1	1	1	0							Din	
1	1	1	1								Din

logical Expression

$Y_0 = \bar{S_2}\bar{S_1}\bar{S_0}\,Din$

$Y_1 = \bar{S_2}\bar{S_1}S_0\,Din$

$Y_2 = \bar{S_2}S_1\bar{S_0}\,Din$

$Y_3 = \bar{S_2}S_1 S_0\,Din$

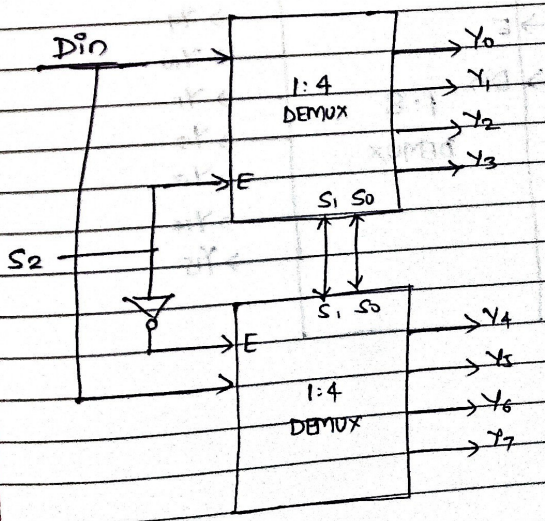
$Y_4 = S_2\bar{S_1}\bar{S_0}\,Din$

$Y_5 = S_2\bar{S_1}S_0\,Din$

$Y_6 = S_2 S_1\bar{S_0}\,Din$

$Y_7 = S_2 S_1 S_0\,Din$

Design 1:8 demultiplexer using 1:4 demux



Design 1:16 demultiplexer using 1:8 Demux