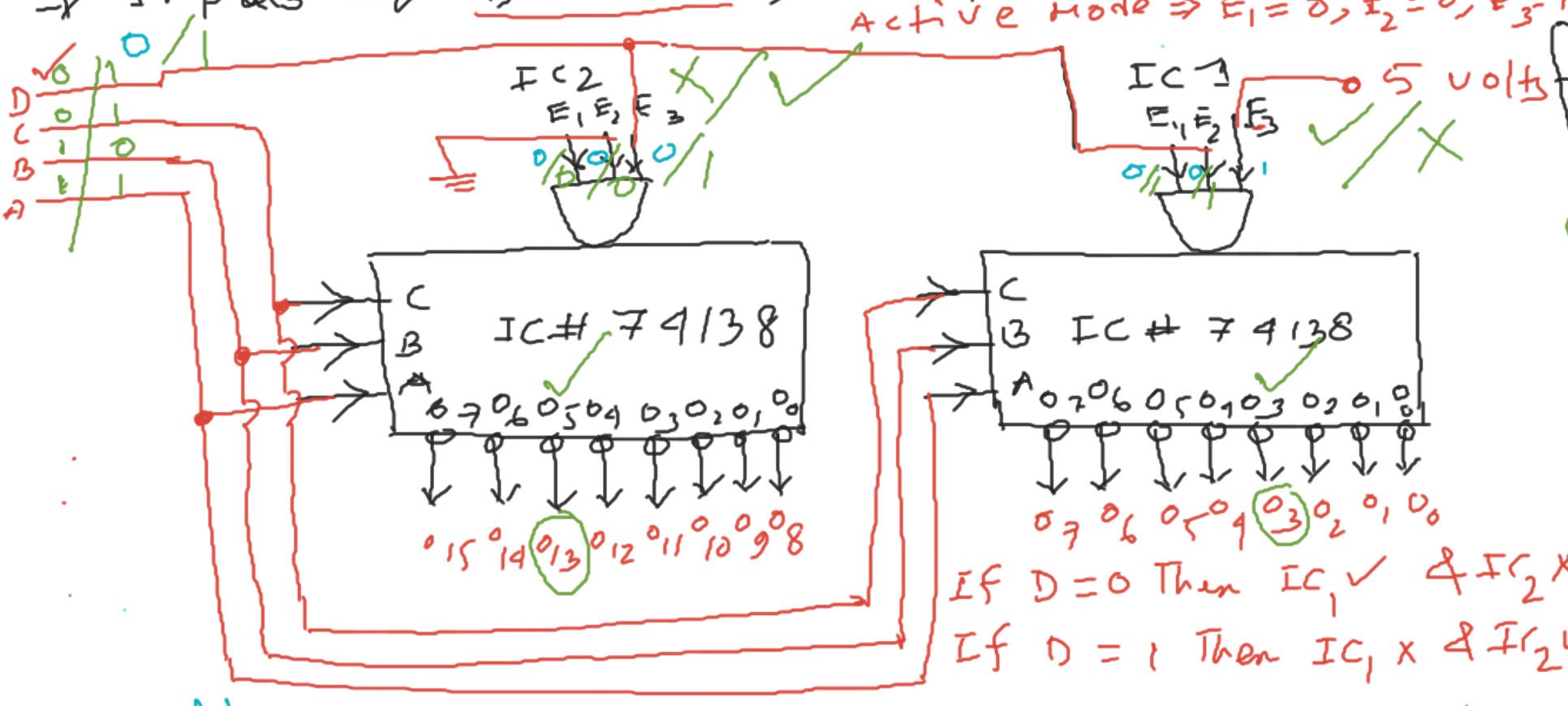
Design 4 Lines to 16 Lines Decoder using IC# 74138. You can use other logic gates, if necessary.

⇒ Inputs → A, B, C, D ; outputs → O_0 to O_{15} ; No. of IC $= \frac{16}{8} = 2$



D	C	B	A	Active output	
0	0	0	0	O_0	IC_1 ✓
0	0	0	1	O_1	
0	0	1	0	O_2	
0	0	1	1	O_3	IC_2 X
0	1	0	0	O_4	
0	1	0	1	O_5	
0	1	1	0	O_6	
0	1	1	1	O_7	
X	0	0	0	O_8	
1	0	0	1	O_9	IC_1 X
1	0	1	0	O_{10}	
1	0	1	1	O_{11}	IC_2 ✓
1	1	0	0	O_{12}	
1	1	0	1	O_{13}	
1	1	1	0	O_{14}	
1	1	1	1	O_{15}	

If D = 0 Then IC_1 ✓ & IC_2 X

If D = 1 Then IC_1 X & IC_2 ✓

operation: If D = 0 ⇒ IC_1 → $E_1 = E_2 = 0$, $E_3 = 1$ 9t is active

IC_2 → $E_1 = E_2 = E_3 = 0$ 9t is inactive

If D = 1 ⇒

IC_1 → $E_1 = E_2 = E_3 = 1$; Inactive

IC_2 → $E_1 = E_2 = 0, E_3 = 1$; IC2 is active

Assignment #3 :

a) Design 5 lines to 32 lines Decoder using IC# 74138. You can use other logic gates/ IC, if necessary.

b) Design 6 lines to 64 lines Decoder using IC# 74138. You can use other logic gates/IC, if necessary.

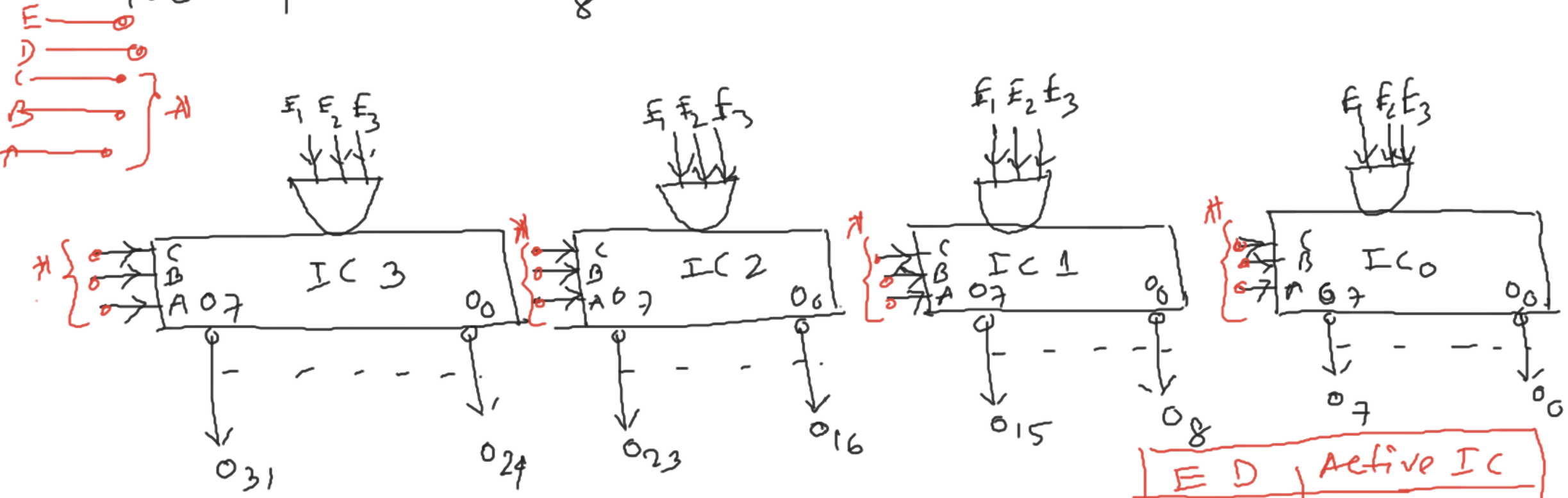
Date : 14.03.202

12:30 PM

a) 5 Lines to 32 Lines Decoder.

Inputs → A, B, C, D, E ; outputs → O_0 to O_{31}

No. of IC = $\frac{32}{8} = 4$

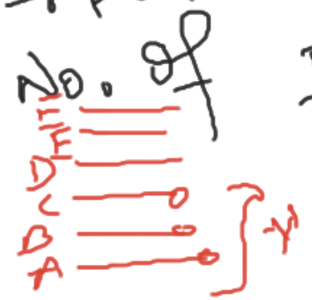


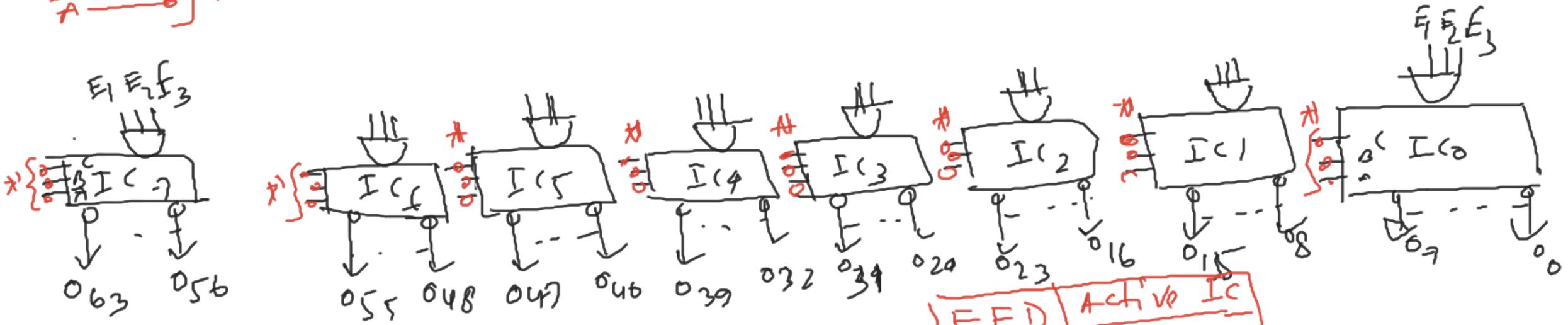
E D	Active IC
0 0	IC_0
0 1	IC_1
1 0	IC_2
1 1	IC_3

b) 6 lines to 64 lines Decoder

Inputs → A, B, C, D, E, F ; outputs → O_0 to O_{63}

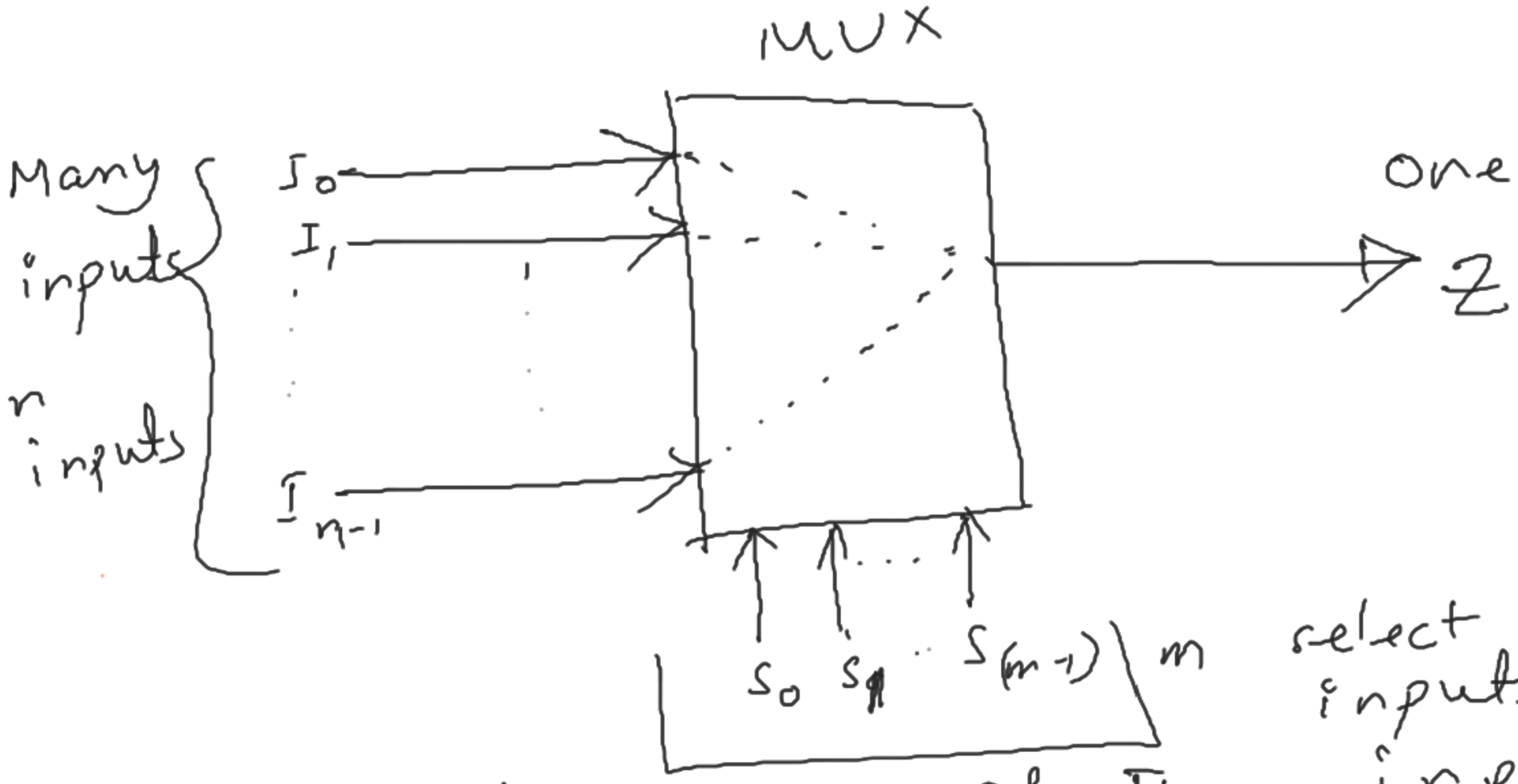
No. of ICs = $\frac{64}{8} = 8$





FED	Active IC
0 0 0	IC_0
0 0 1	IC_1
0 1 0	IC_2
0 1 1	IC_3
1 0 0	IC_4
1 0 1	IC_5
1 1 0	IC_6
1 1 1	IC_7

2) Multiplexer ∴ (MUX)



No. of select inputs	No. of input
2	$4 = 2^2$
3	$8 = 2^3$
4	$16 = 2^4$
5	$32 = 2^5$

At a time according of select one of the inputs to the input goes to output corresponding combination

No. of input = 2 No. of select inputs

$\therefore$ $n = 2^m$

4 input MUX :: (4:1 MUX)

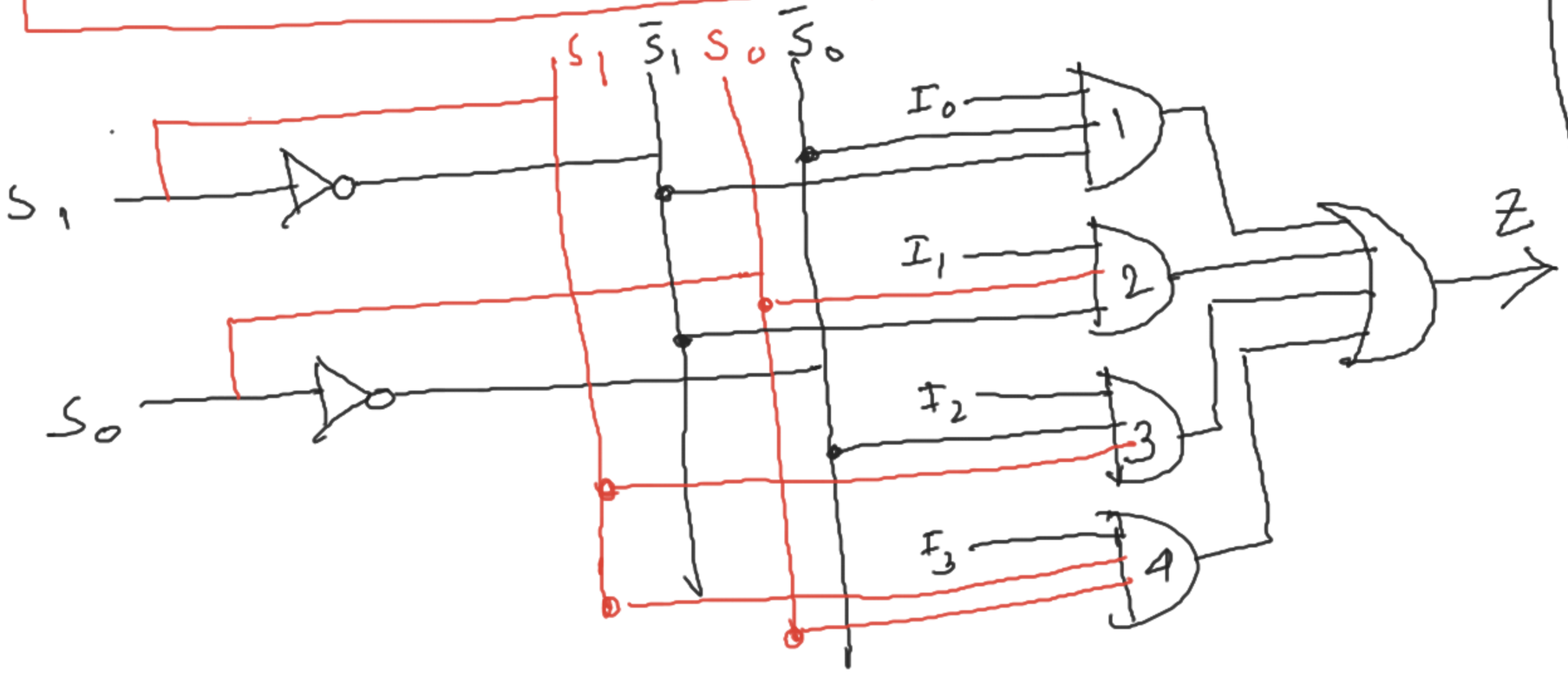
Internal circuit

Select inputs $\Rightarrow 2$; Output = Z ; Inputs = 4 (I_0 to I_3)

S_0, S_1

Z

$$Z = \bar{S}_1 \bar{S}_0 \cdot I_0 + \bar{S}_1 S_0 \cdot I_1 + S_1 \bar{S}_0 \cdot I_2 + S_1 S_0 \cdot I_3$$

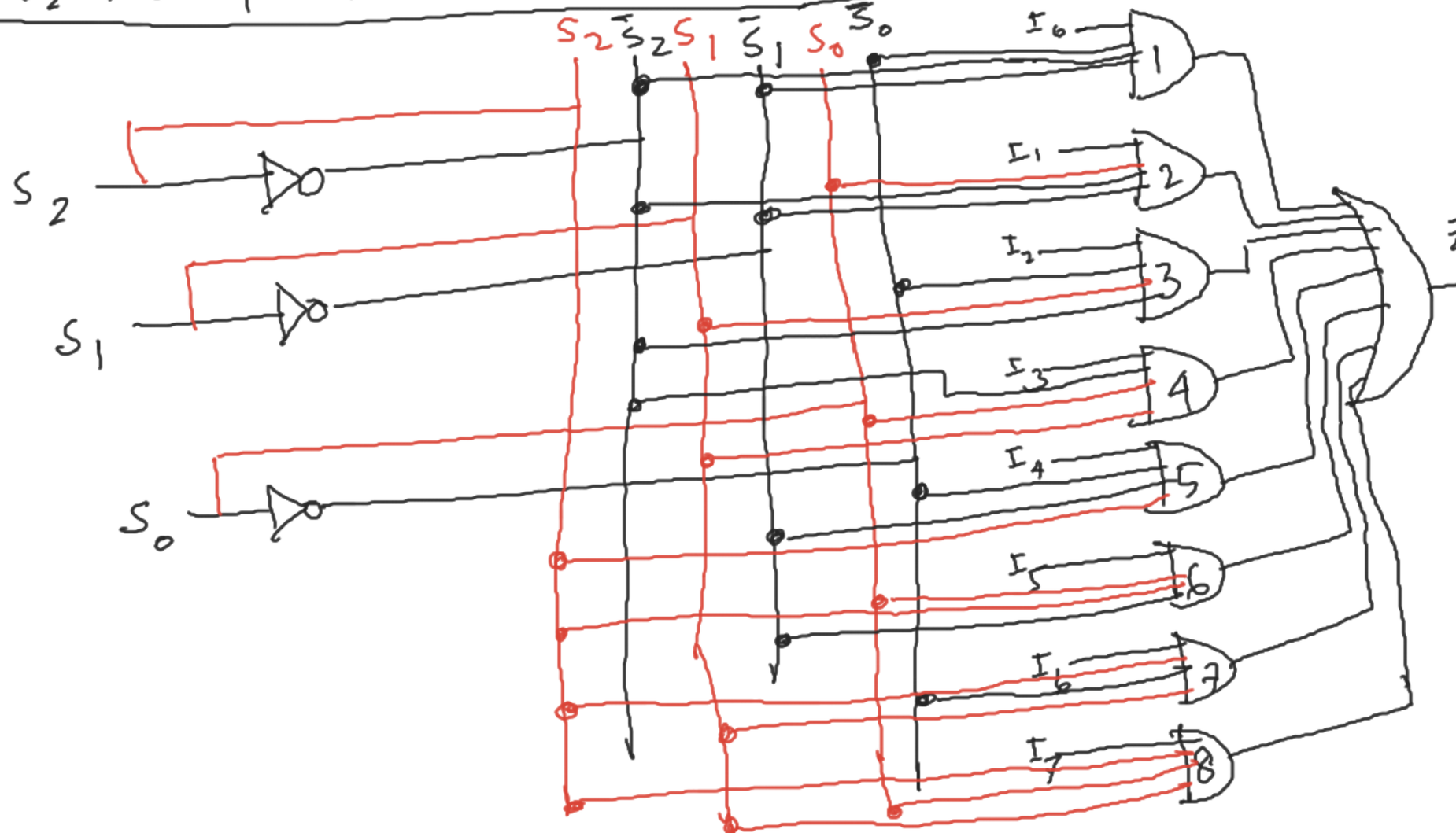


S_1	S_0	Z =
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

8 input MUX (8:1) : Internal circuit

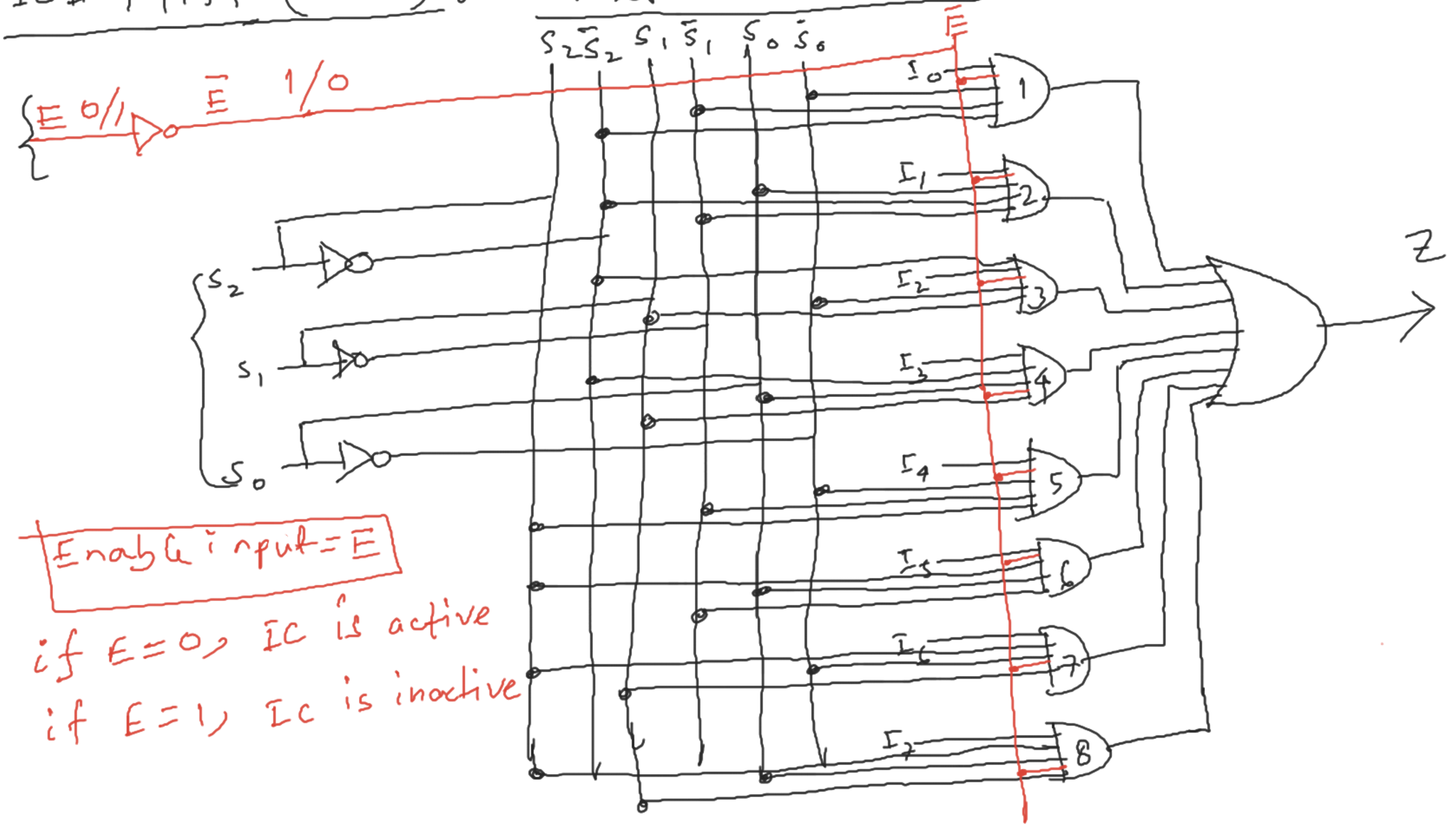
Select inputs = 3 (S_0, S_1, S_2) ; Inputs = 8 (I_0 to I_7) ; Output = 1 (Z)

$$Z = \bar{S}_2\bar{S}_1\bar{S}_0 \cdot I_0 + \bar{S}_2\bar{S}_1 S_0 \cdot I_1 + \bar{S}_2 S_1\bar{S}_0 \cdot I_2 + \bar{S}_2 S_1 S_0 \cdot I_3 + S_2\bar{S}_1\bar{S}_0 \cdot I_4 + S_2\bar{S}_1 S_0 \cdot I_5 + S_2 S_1\bar{S}_0 \cdot I_6 + S_2 S_1 S_0 \cdot I_7$$



S_2 S_1 S_0	Z =
0 0 0	I_0
0 0 1	I_1
0 1 0	I_2
0 1 1	I_3
1 0 0	I_4
1 0 1	I_5
1 1 0	I_6
1 1 1	I_7

IC# 74151 (MUX): Internal Circuit

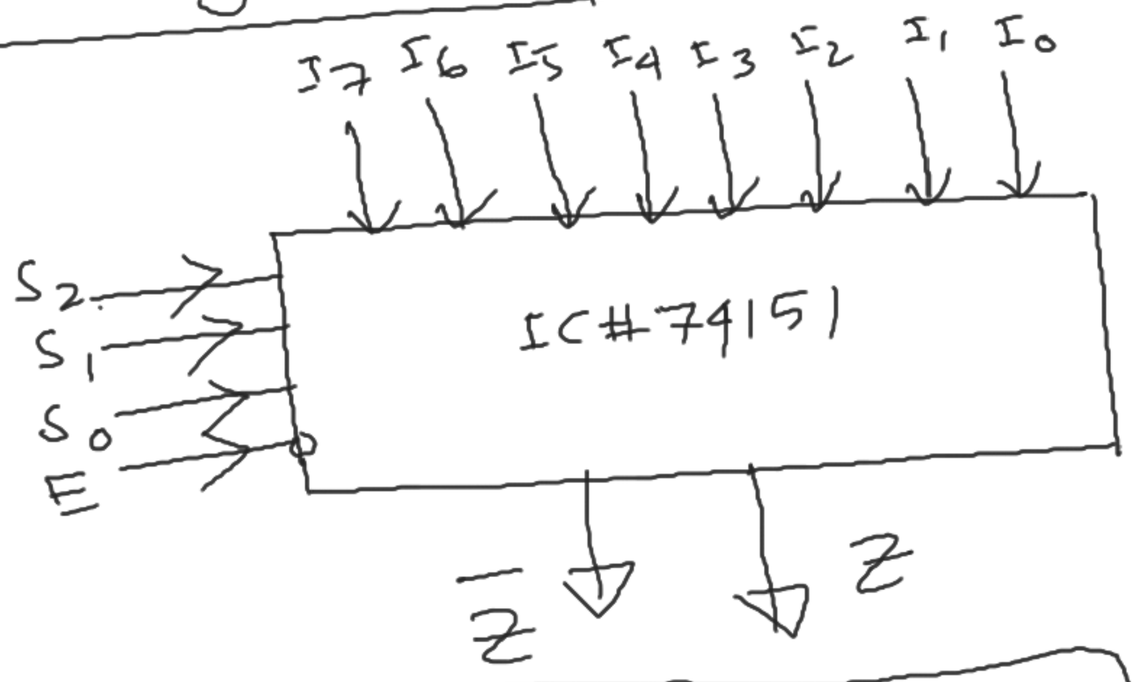


Enable input = $\bar{E}$

if $E = 0$, IC is active

if $E = 1$, IC is inactive

Block diagram of IC # 74151



Active Mode $\Rightarrow E = 0$

Inactive Mode $\Rightarrow E = 1$

$E = 1, S_0 = 1, S_1 = 1, S_2 = 1$

$\therefore Z = ?$

$\hookrightarrow Z = 0$

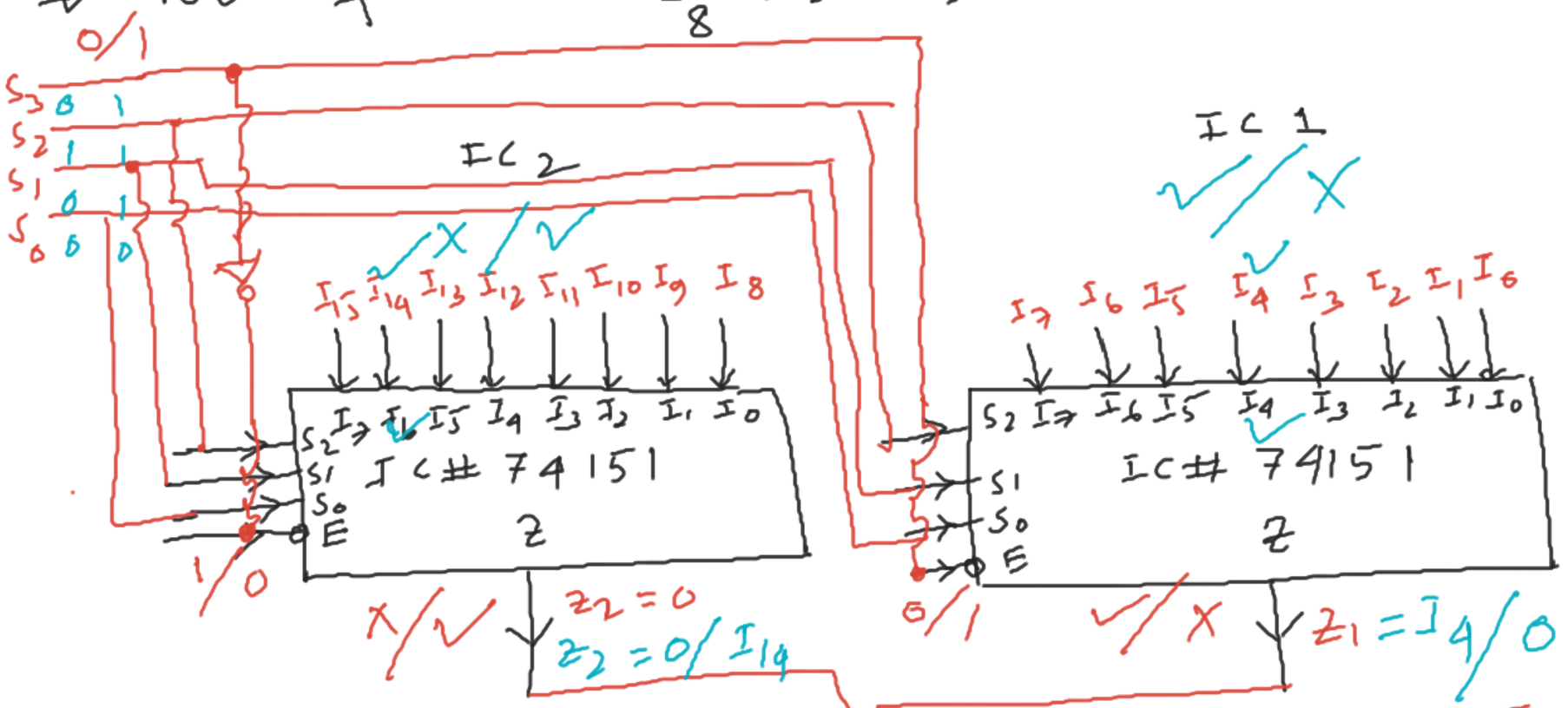
$E = 0, S_0 = 0, S_1 = 1, S_2 = 1$

$\therefore Z = ?$

$\hookrightarrow Z = I_6$

Design 16 input MUX using IC # 74151. You can use other logic gates, if necessary.

⇒ No. of ICs = $\frac{16}{8} = 2$; select input = 4 (S_0 to S_3)



S_3 S_2 S_1 S_0	Z =	
0 0 0 0	I_0	
0 0 0 1	I_1	
0 0 1 0	I_2	IC_1
0 0 1 1	I_3	
0 1 0 0	I_4	IC_2 X
0 1 0 1	I_5	
0 1 1 0	I_6	
0 1 1 1	I_7	
1 0 0 0	I_8	
1 0 0 1	I_9	IC_1 X
1 0 1 0	I_{10}	IC_2 ✓
1 0 1 1	I_{11}	
1 1 0 0	I_{12}	
1 1 0 1	I_{13}	
1 1 1 0	I_{14}	
1 1 1 1	I_{15}	

operation:

when $S_3 = 0$ Then E of $IC_1 = 0$, E of $IC_2 = 1$ ∴ IC_1 is active, IC_2 is inactive ∴ $Z_3 = Z_1$

$Z_3 = Z_1/Z_2$

$Z_3 = I_4/I_{14}$

when $S_3 = 1$ Then E of $IC_1 = 1$, E of $IC_2 = 0$ ∴ IC_1 is inactive & IC_2 is active ∴ $Z_3 = Z_2$

Assignment #4:

a) Design 32 input MUX using IC # 74151. You can use other logic gates/IC, if necessary.

b) Design 64 input MUX using IC# 74151. You can use other logic gates/IC, if necessary.

Date: 16.03.2021

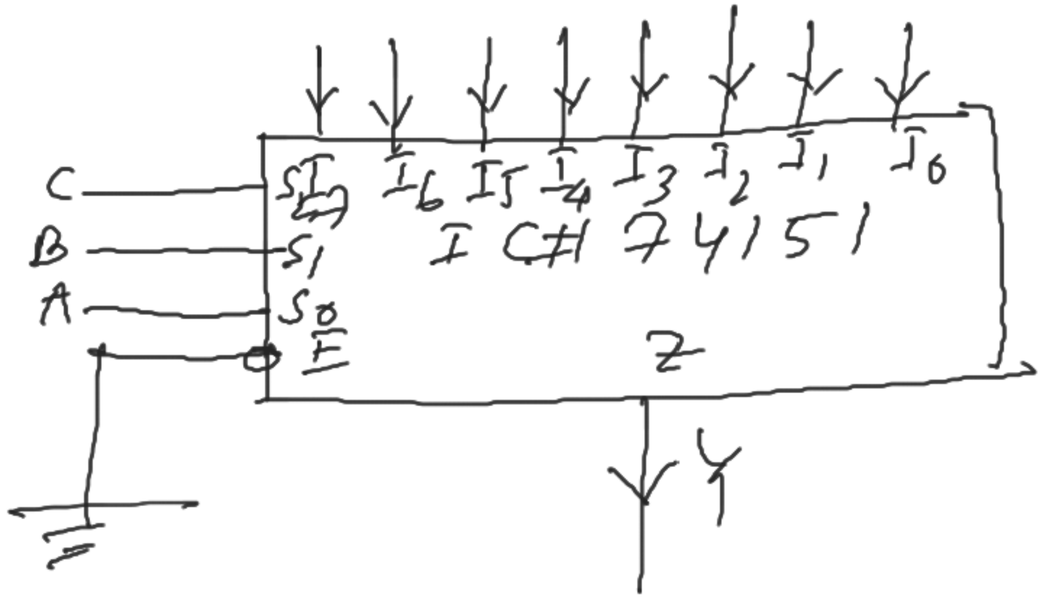
Time 11:59 p.m.

Application Of MUX:

1) Logic function generation

C	B	A	Y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

Implement the circuit using IC# 74151 →

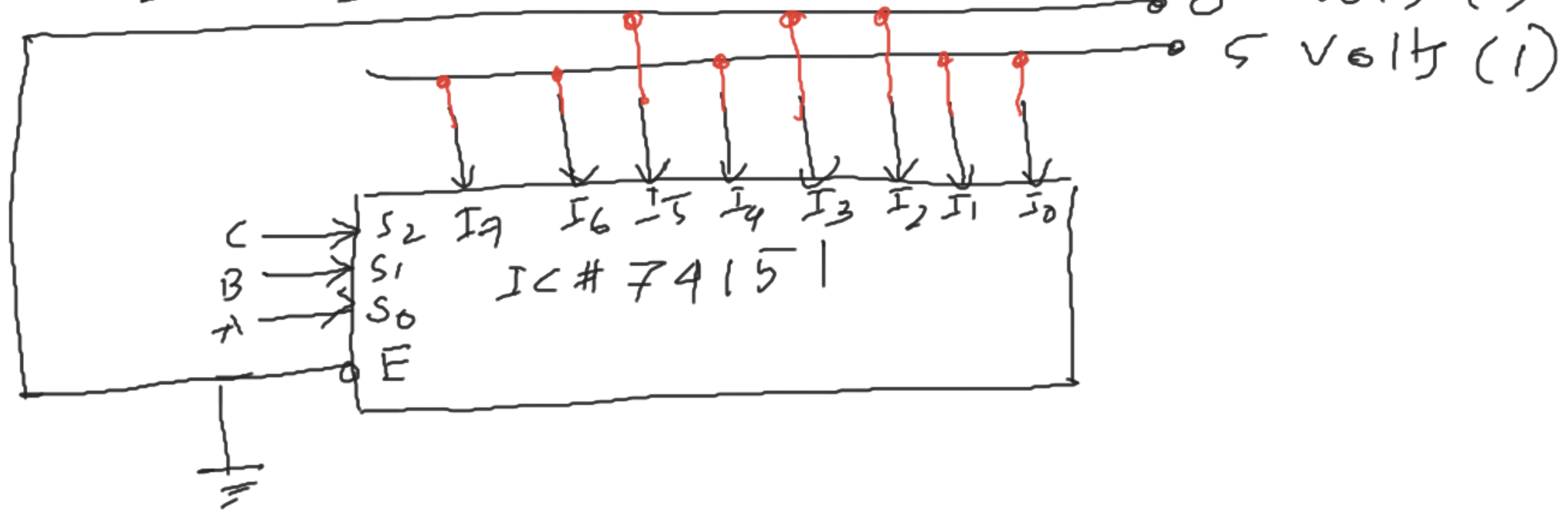


S_2	S_1	S_0	Z =
0	0	0	I_0
0	0	1	I_1
0	1	0	I_2
0	1	1	I_3
1	0	0	I_4
1	0	1	I_5
1	1	0	I_6
1	1	1	I_7

Implement $F(A, B, C) = \sum(0, 1, 4, 6, 7)$ using IC # 74151.

$\Rightarrow$ $1 = I_0 = I_1 = I_4 = I_6 = I_7$ I_0 to I_7

$0 = I_2 = I_3 = I_5$



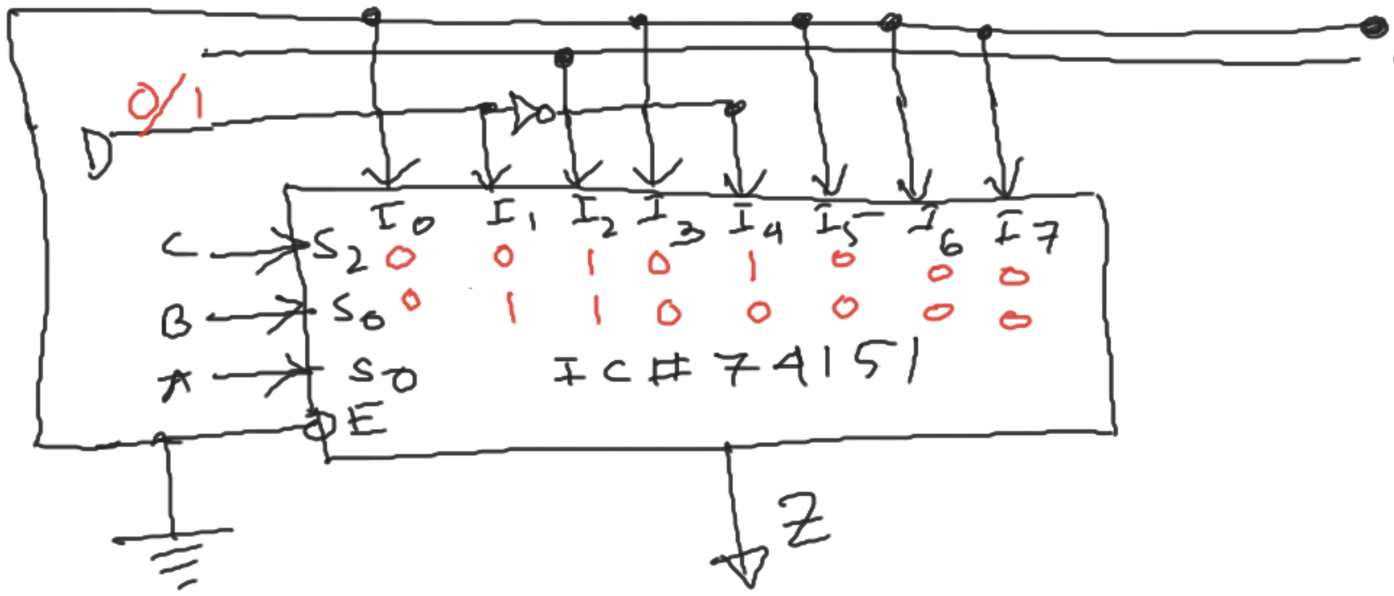
Implement $F(A, B, C, D) = \sum(0, 1, 2, 6, 9, 11, 14, 15)$ using IC #74151.

⇒ Design 16 input MUX. using IC#74151

$1 = I_0 = I_1 = I_2 = I_6 = I_9 = I_{11} = I_{14} = I_{15}$

$0 = I_3 = I_4 = I_5 = I_7 = I_8 = I_{10} = I_{12} = I_{13}$

9.37 :



i) Draw the truth Table.

ii) simplify using K-map or otherwise.

iii) Draw the circuit.

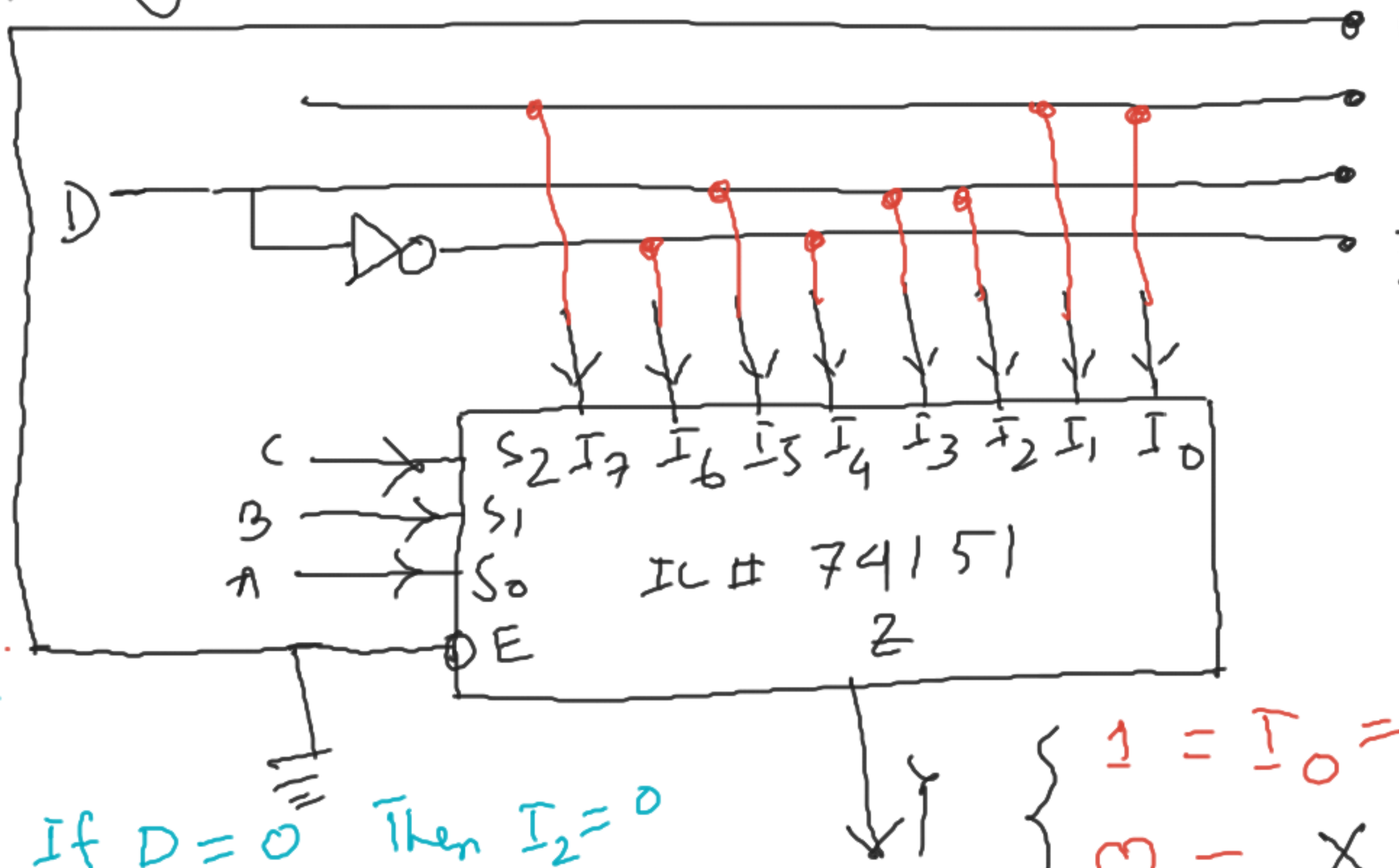
D	C	B	A	Z
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

iv)

$\bar{C}\bar{D}$ \ $\bar{A}\bar{B}$	$A\bar{B}$	AB	$\bar{A}B$
$\bar{C}\bar{D}$	0	0	0	1
$C\bar{D}$	1	0	0	0
CD	0	0	0	0
$\bar{C}D$	0	1	0	1

$$Z = \bar{A}\bar{B}C\bar{D} + A\bar{B}\bar{C}D + \bar{A}B\bar{C}$$

Implement $F(A, B, C, D) = \sum(0, 1, 4, 6, 7, 8, 9, 10, 11, 13, 15)$ using one IC # 74151 and one NOT gate, if necessary.



D	C	B	A	Y	
0	0	0	0	1	I_0
0	0	0	1	1	I_1
0	0	1	0	0	I_2
0	0	1	1	0	I_3
0	1	0	0	1	I_4
0	1	0	1	0	I_5
0	1	1	0	1	I_6
0	1	1	1	1	I_7
1	0	0	0	1	I_0
1	0	0	1	1	I_1
1	0	1	0	1	I_2
1	0	1	1	1	I_3
1	1	0	0	0	I_4
1	1	0	1	1	I_5
1	1	1	0	0	I_6
1	1	1	1	1	I_7

If $D = 0$ Then $I_2 = 0$
If $D = 1$ Then $I_2 = 1$
If $D = 0$, Then $I_4 = 1$
If $D = 1$, Then $I_4 = 0$

$1 = I_0 = I_1 = I_7$
$0 = X$
$D = I_2 = I_3 = I_5$
$\bar{D} = I_4 = I_6$

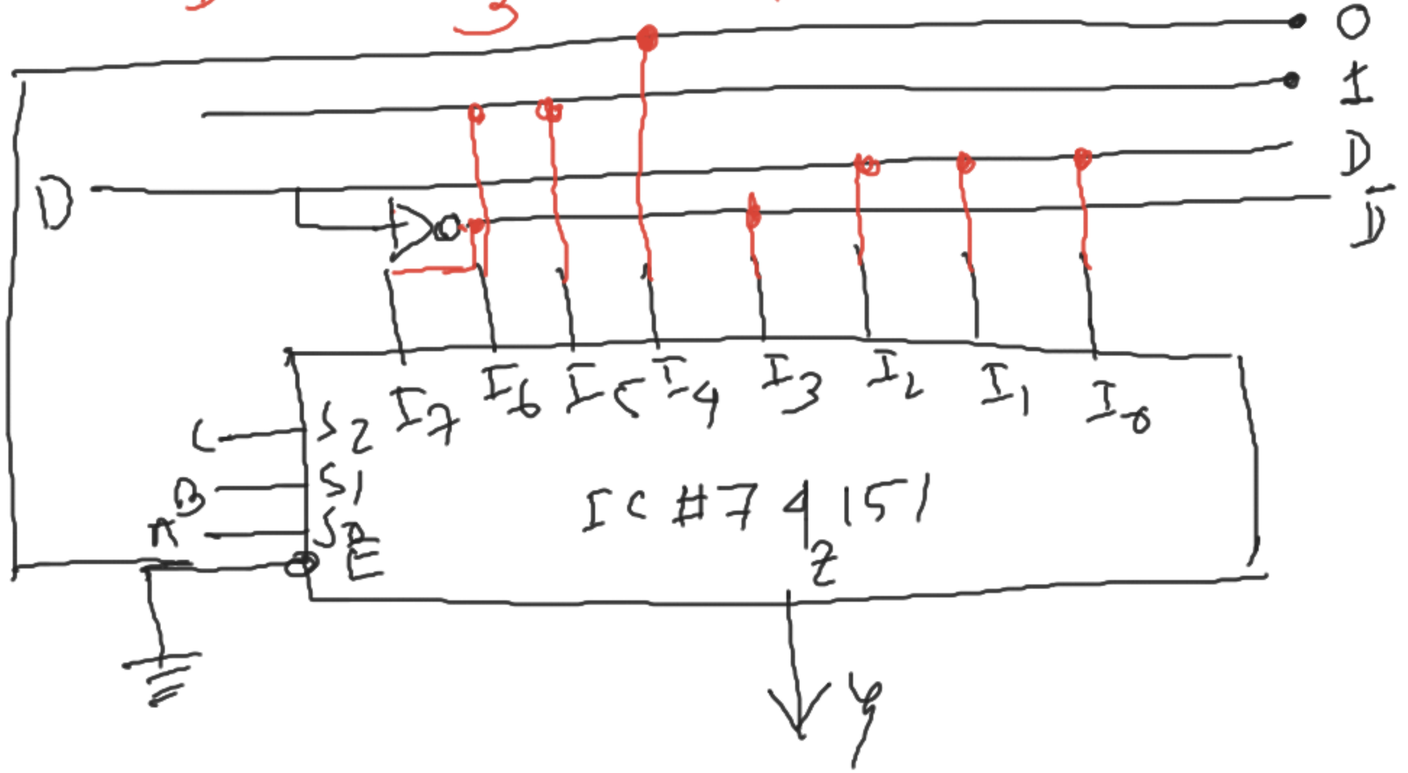
Implement $F(A, B, C, D) = \sum(3, 5, 6, 7, 8, 9, 10, 13, 14)$ using one IC #74151 and NOT gate, if necessary.

$\Rightarrow$ $0 = I_4$

$1 = I_5 = I_6$

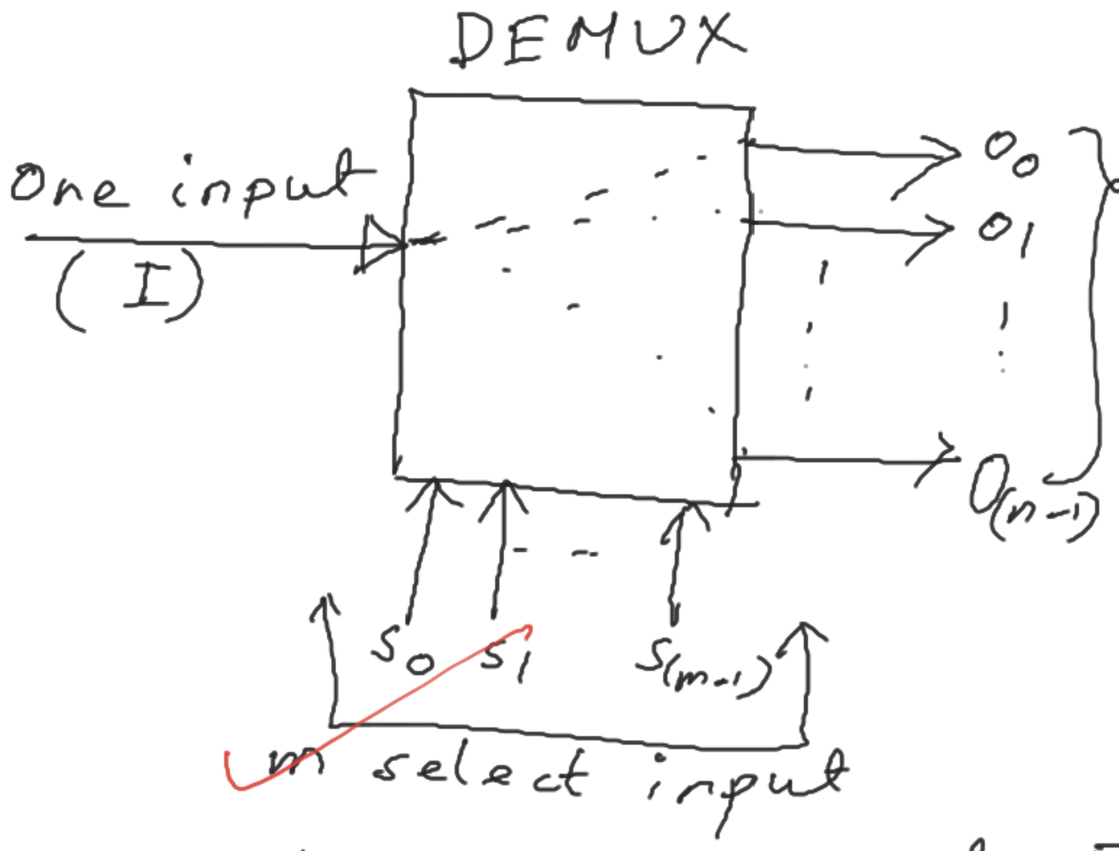
$D = I_0 = I_1 = I_2$

$\overline{D} = I_3 = I_7$



D	C	B	A	Y	
0	0	0	0	0	I_6
0	0	0	1	0	I_1
0	0	1	0	0	I_2
0	0	1	1	1	I_3
0	1	0	0	0	I_4
0	1	0	1	1	I_5
0	1	1	0	1	I_6
0	1	1	1	1	I_7
1	0	0	0	1	I_0
1	0	0	1	1	I_1
1	0	1	0	1	I_2
1	0	1	1	0	I_3
1	1	0	0	0	I_4
1	1	0	1	1	I_5
1	1	1	0	1	I_6
1	1	1	1	0	I_7

3) Demultiplexer (DEMUX):



No. of select input	No. of output
2	$4 = 2^2$
3	$8 = 2^3$
4	$16 = 2^4$
5	$32 = 2^5$

(No. of

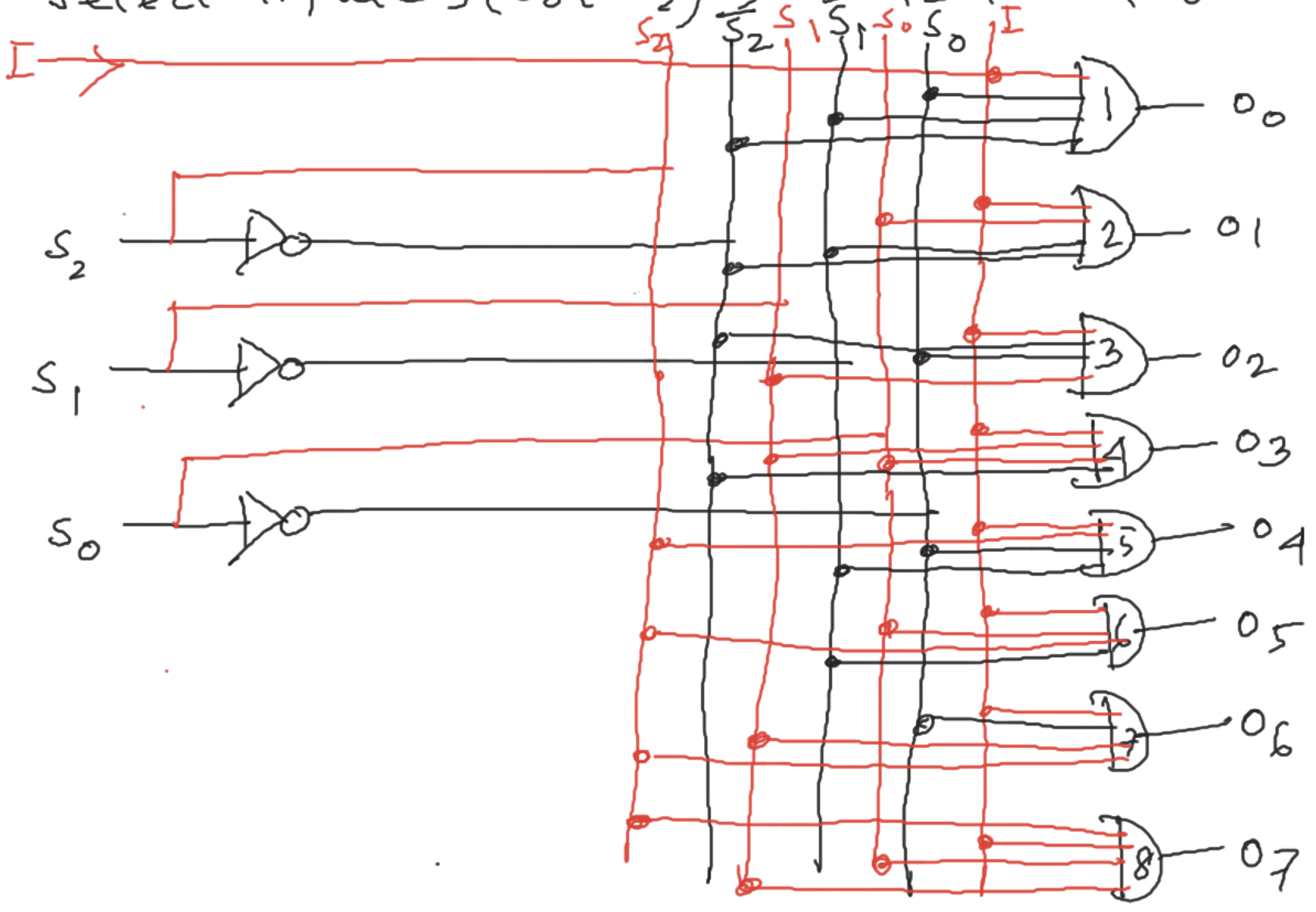
$\therefore$ No. of output = 2 select inputs

$\therefore$ $n = 2^m$

Input goes to the one of the output according to corresponding combination of select inputs.

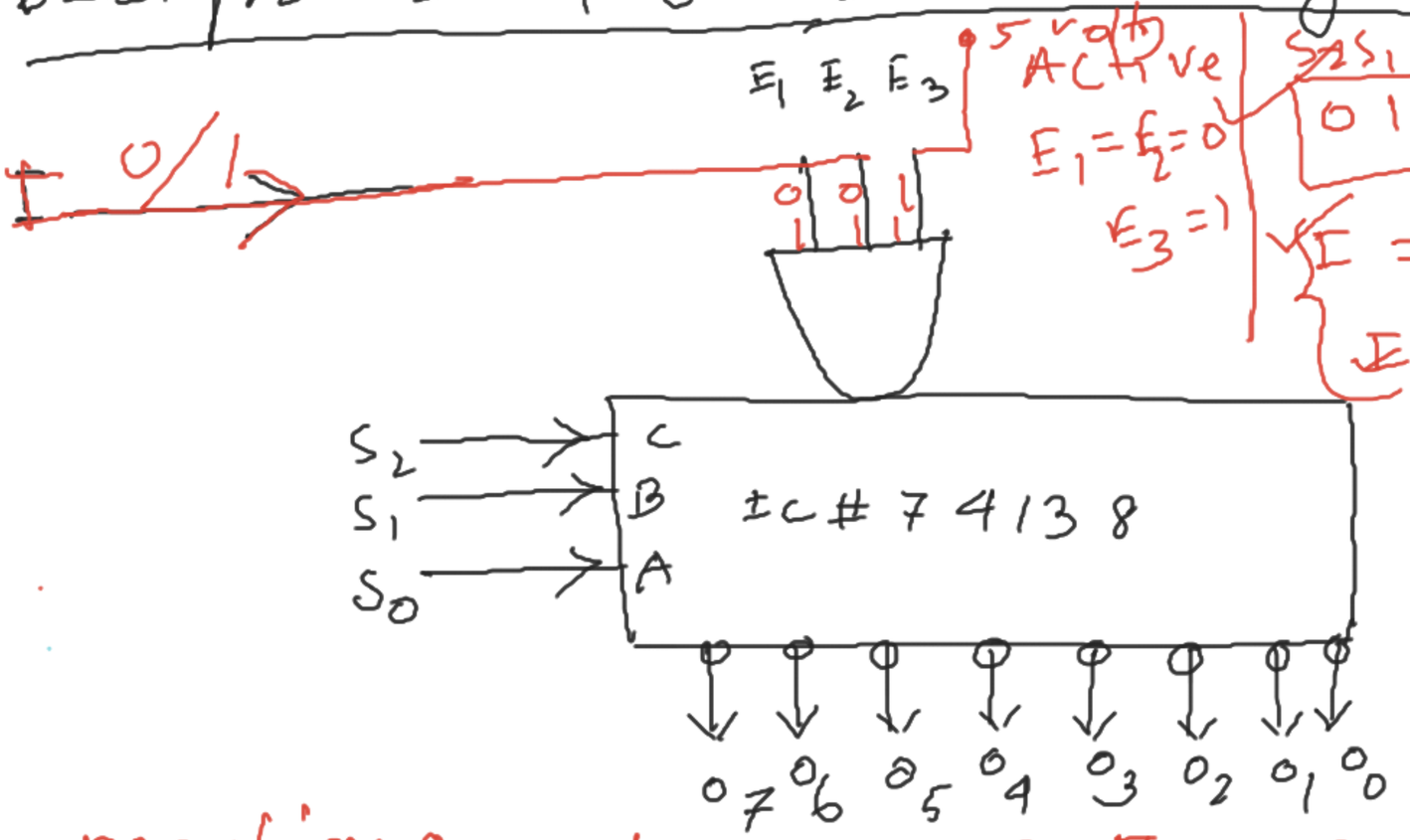
1 of 8 DEMUX (1 line to 8 lines DEMUX)

select input = 3 (S_0 to S_2) ; output = 8 (O_0 to O_7) ; input = 1 (I)



S_2 S_1 S_0	I =
0 0 0	$O_0 = \bar{S}_2\bar{S}_1\bar{S}_0 \cdot I$
0 0 1	$O_1 = \bar{S}_2\bar{S}_1 S_0 \cdot I$
0 1 0	$O_2 = \bar{S}_2 S_1 \bar{S}_0 \cdot I$
0 1 1	$O_3 = \bar{S}_2 S_1 S_0 \cdot I$
1 0 0	$O_4 = S_2\bar{S}_1\bar{S}_0 \cdot I$
1 0 1	$O_5 = S_2\bar{S}_1 S_0 \cdot I$
1 1 0	$O_6 = S_2 S_1 \bar{S}_0 \cdot I$
1 1 1	$O_7 = S_2 S_1 S_0 \cdot I$

Design 1 of 8 DEMUX using IC # 74138 ∴ DECODER / DEMUX



$S_2 S_1 S_0$ = 0 1 1 $\Rightarrow$ $I = O_3$

$I = 0 \Rightarrow O_3 = 0$

$I = 1 \Rightarrow O_3 = 1$

$I = 0$, Active

$I = 1$, Inactive

$S_2 S_1 S_0$	I
0 0 0	O_0
0 0 1	O_1
0 1 0	O_2
0 1 1	O_3
1 0 0	O_4
1 0 1	O_5
1 1 0	O_6
1 1 1	O_7

operation: when $I = 0$ Then $E_1 = E_2 = 0$, $E_3 = 1$

∴ IC is active. That is I goes to corresponding output.

when $I = 1$ Then $E_1 = E_2 = E_3 = 1$

∴ IC is inactive. That is no output will be active. ∴ Corresponding output = 1