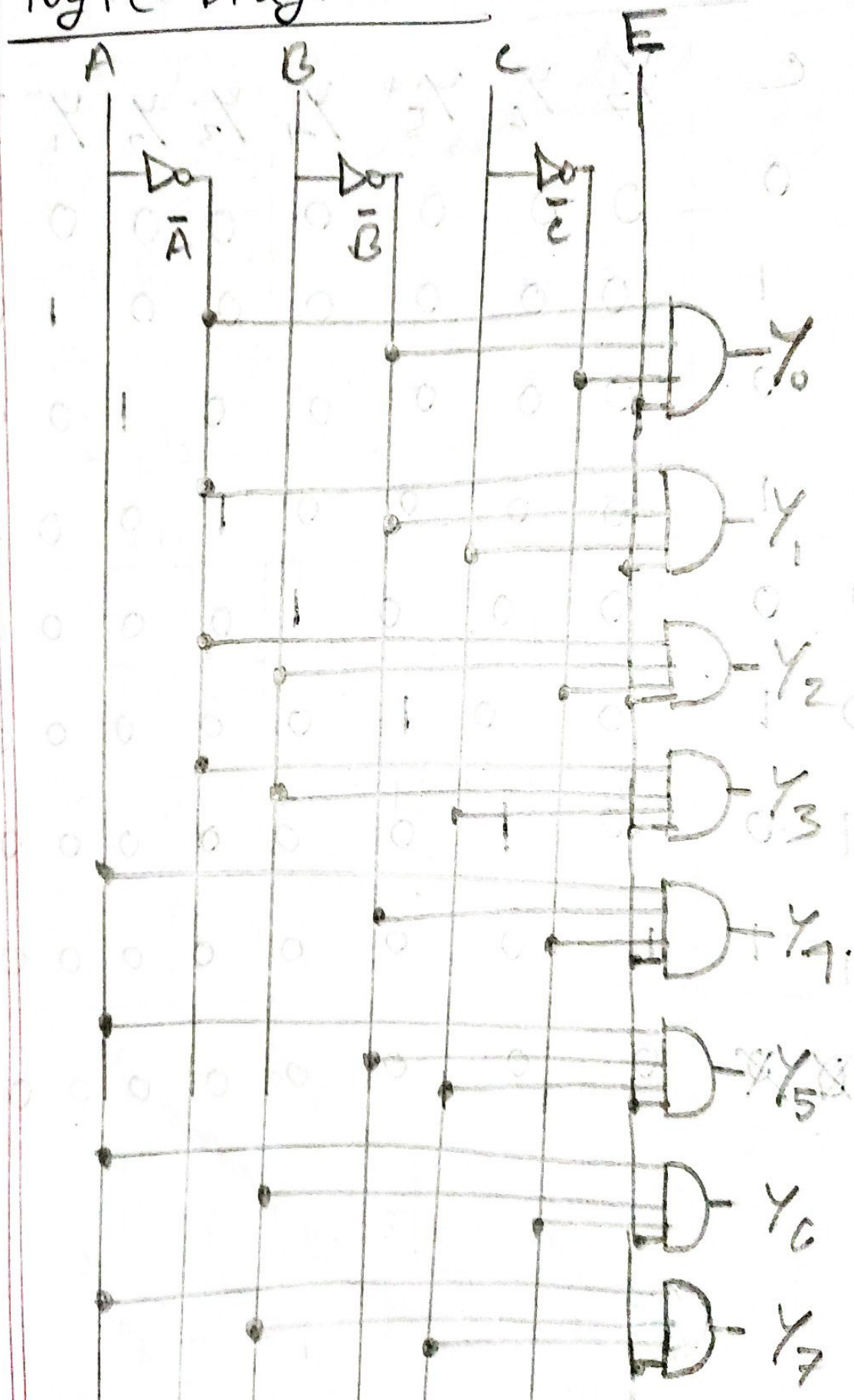
DLD

20-21

Truth table: 7(a)

E	A	B	C	Y_7	Y_6	Y_5	Y_4	Y_3	Y_2	Y_1	Y_0	
1	0	0	0	0	0	0	0	0	0	0	1	$Y_0 = \bar{A}\bar{B}\bar{C}$
1	0	0	1	0	0	0	0	0	0	1	0	$Y_1 = \bar{A}\bar{B}C$
1	0	1	0	0	0	0	0	0	1	0	0	$Y_2 = \bar{A}B\bar{C}$
1	0	1	1	0	0	0	0	1	0	0	0	$Y_3 = \bar{A}BC$
1	1	0	0	0	0	0	1	0	0	0	0	$Y_4 = A\bar{B}\bar{C}$
1	1	0	1	0	0	1	0	0	0	0	0	$Y_5 = A\bar{B}C$
1	1	1	0	0	1	0	0	0	0	0	0	$Y_6 = AB\bar{C}$
1	1	1	1	1	0	0	0	0	0	0	0	$Y_7 = ABC$
0	X	X	X	0	0	0	0	0	0	0	0	

logic Diagram:



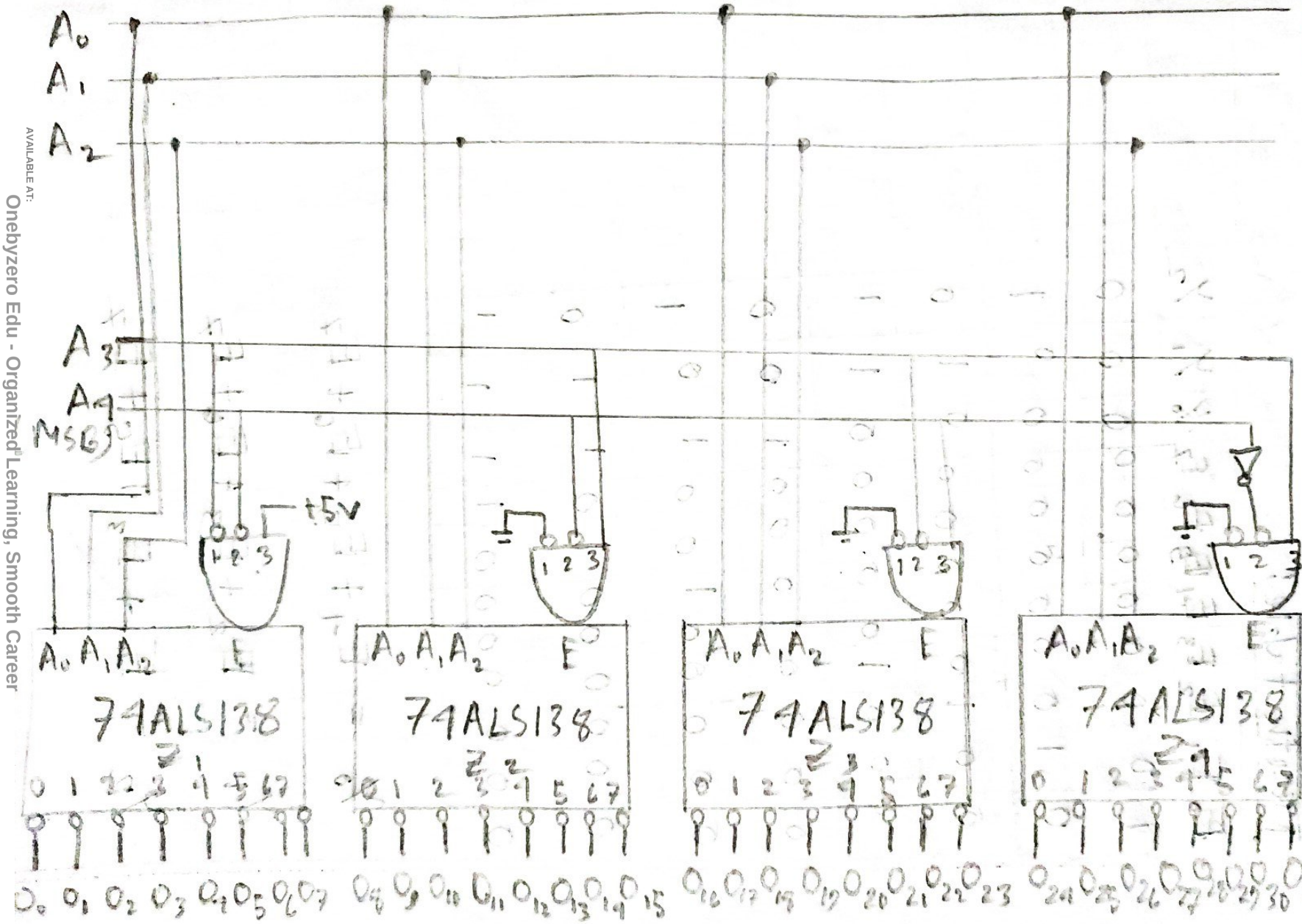


Fig: 1 of 32 Decoder.

7(c)

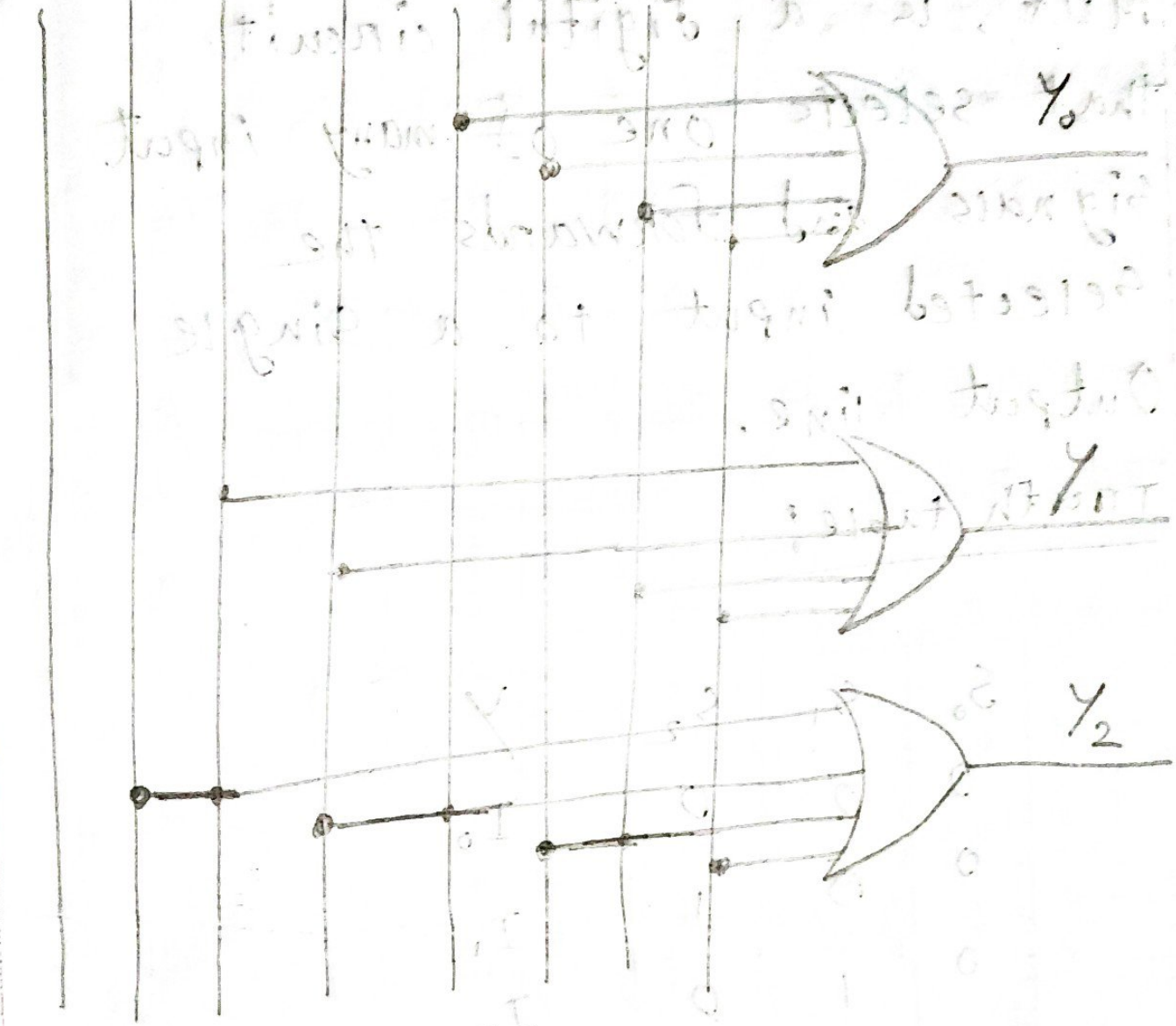
Truth table:

E_0	E_1	E_2	E_3	E_4	E_5	E_6	E_7	Y_0	Y_1	Y_2
1	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	1	0
0	0	0	1	0	0	0	0	0	1	1
0	0	0	0	1	0	0	0	1	0	0
0	0	0	0	0	1	0	0	1	0	1
0	0	0	0	0	0	1	0	1	1	0
0	0	0	0	0	0	0	1	1	1	1

$$Y_0 = E_4 + E_5 + E_6 + E_7$$

$$Y_1 = E_2 + E_3 + E_6 + E_7$$

$$Y_2 = E_1 + E_3 + E_5 + E_7$$



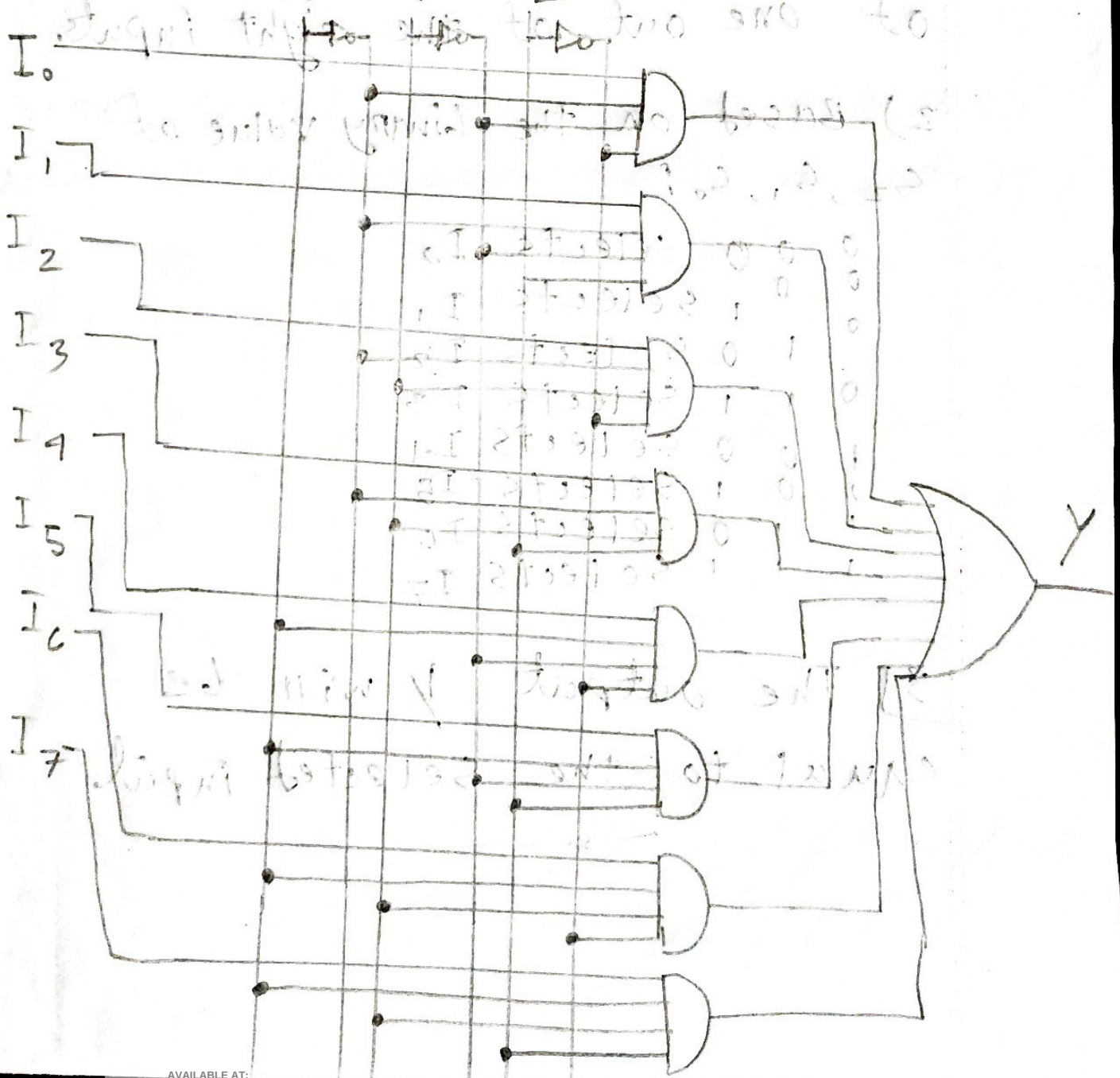
8(a)

A Multiplexer, also known as MUX, is a digital circuit that selects one of many input signals and forwards the selected input to a single output line.

Truth table:

S_0	S_1	S_2	Y
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

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



Operation of an 8 input Mux:

1) The three select lines S_0, S_1, S_2 create a 3-bit binary number, allowing the selection of one out of the eight inputs.

2) Based on the binary value of S_2, S_1, S_0:

0	0	0	selects I_0
0	0	1	selects I_1
0	1	0	selects I_2
0	1	1	selects I_3
1	0	0	selects I_4
1	0	1	selects I_5
1	1	0	selects I_6
1	1	1	selects I_7

3) The output Y will be equal to the selected input.

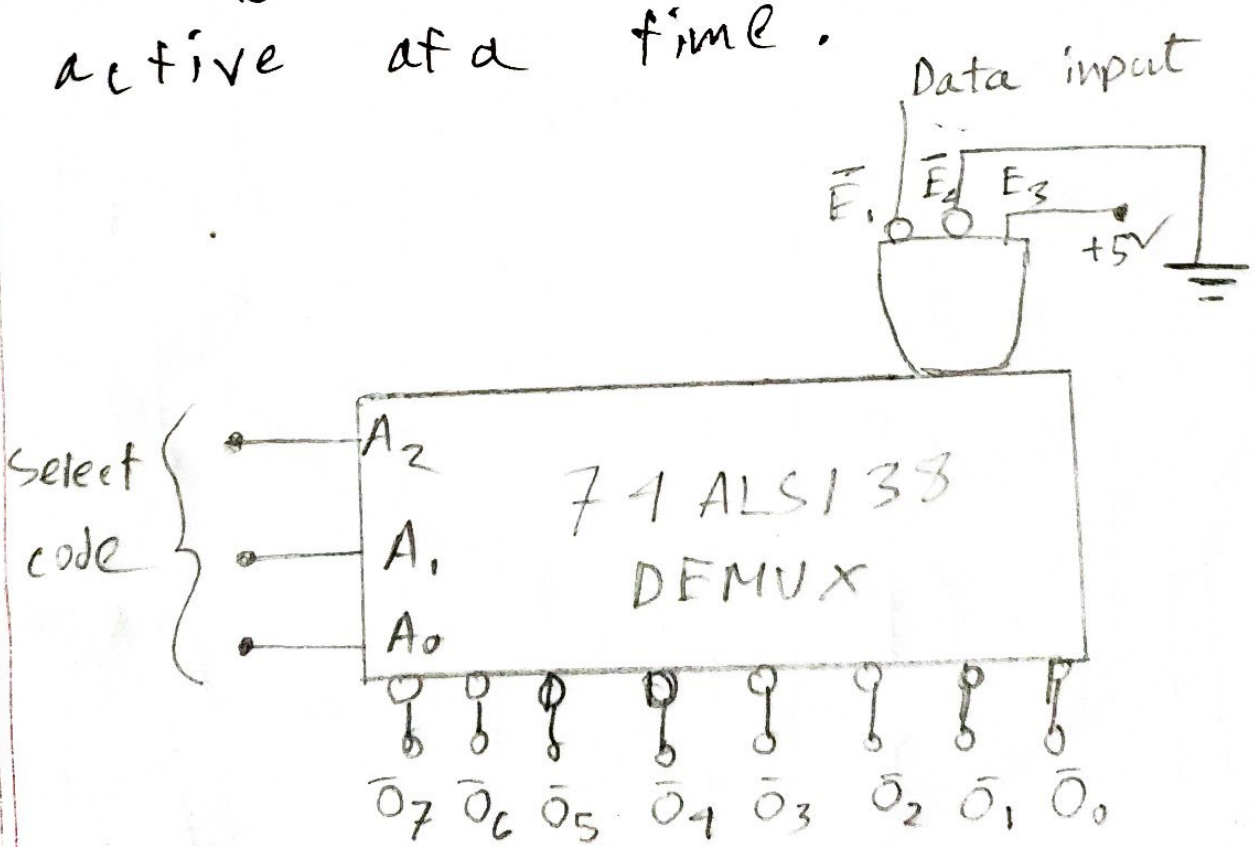
—∞—

8(b)

Using 74138 IC as a DEMUX.

Data input: The signal that needs to be demultiplexed is applied at on of the enable inputs, specifically E_3 in this case.

here, selection inputs are A_2, A_1, A_0. And outputs are O_0 to O_7. Only one of the output lines will be active at a time.

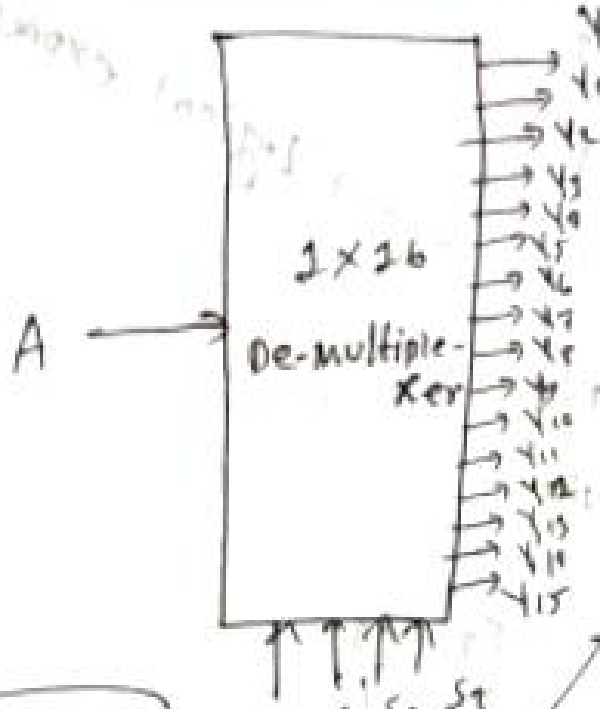


(35) With appropriate diagram explain the working principle of a 1 line to 16 line Demultiplexer.

A 1-to-16 De-multiplexer has one input (A), 4 selection lines (S0, S1, S2, S3), and 16 outputs (Y0 to Y15). Based on the combination of selection lines, the input is routed to one of the 16 outputs, while all others are inactive (low).

Working principle:

- The 4 selection lines create 16 combinations ($2^4 = 16$), each corresponding to one of the outputs being active.
- The input signal A is routed to the selected output based on the combination of S0 to S3.



Block Diagram

Truth table

Inputs

Outputs

S3	S2	S1	S0	Y15	Y14	Y13	Y12	Y11	Y10	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A
0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A	0	0
0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	A	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0
0	1	0	1	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0	0
0	1	1	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0	0	0
0	1	1	1	0	0	0	0	0	0	0	0	A	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0	0	0	0	0
1	0	0	1	0	0	0	0	0	0	A	0	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	0	A	0	0	0	0	0	0	0	0	0	0
1	0	1	1	0	0	0	0	A	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	A	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	1	0	0	A	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	0	0	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

$Y_0 = A\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3$

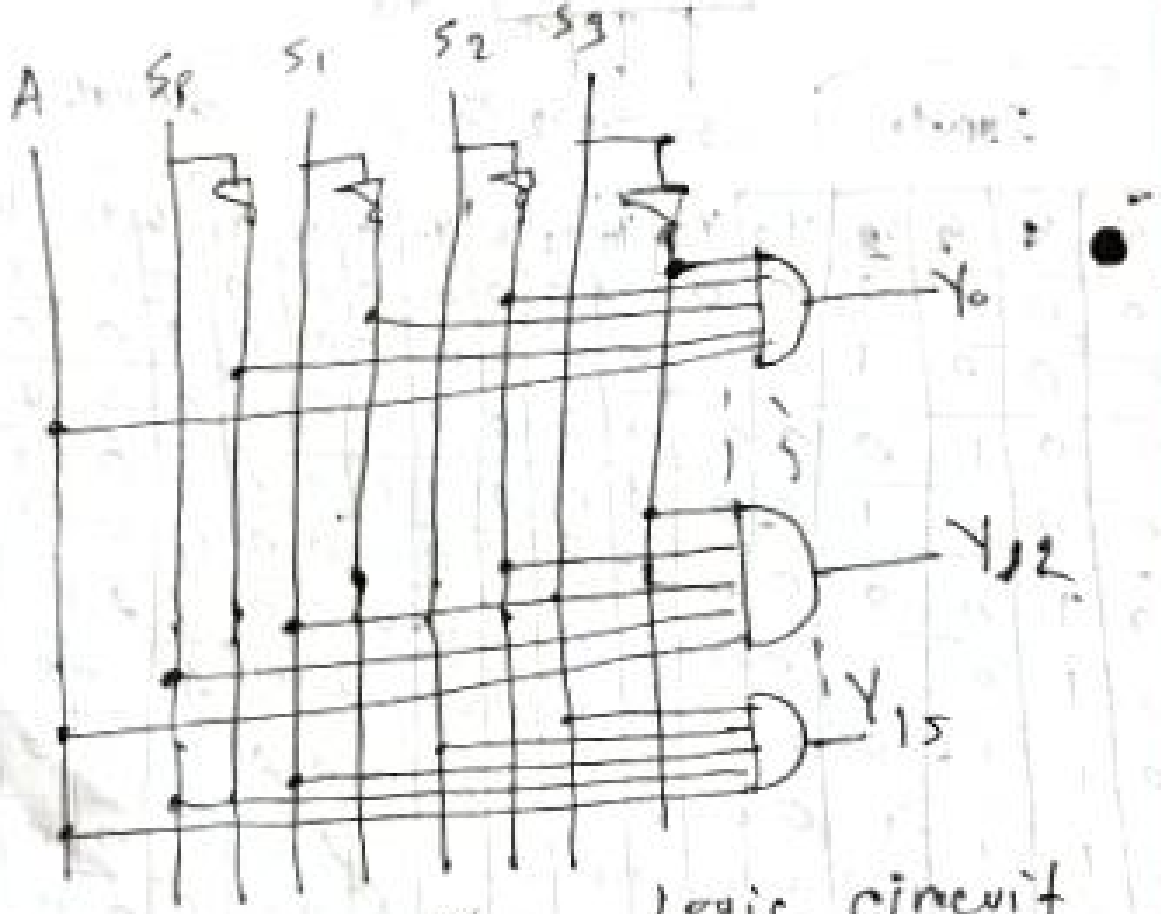
$Y_2 = A\bar{S}_0\bar{S}_1S_2\bar{S}_3$

$Y_8 = AS_0\bar{S}_1\bar{S}_2\bar{S}_3$

$Y_{12} = AS_0S_1\bar{S}_2\bar{S}_3$

$Y_{15} = AS_0S_1S_2S_3$

→ Logical expression



Logic circuit

(36) Draw the diagram and truth table of an octal to Binary encoder?

Inputs								Outputs		
D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	A_2	A_1	A_0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	1	0	0	0	1
0	0	0	0	0	1	0	0	0	1	0
0	0	0	0	1	0	0	0	0	1	1
0	0	0	1	0	0	0	0	1	0	0
0	0	1	0	0	0	0	0	1	0	1
0	1	0	0	0	0	0	0	1	1	0
1	0	0	0	0	0	0	0	1	1	1

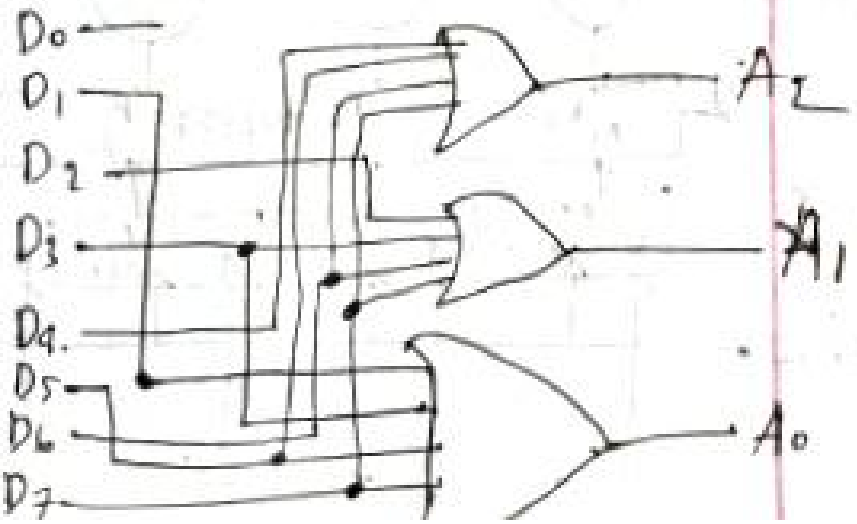
truth table

$A_0 = D_1 + D_3 + D_5 + D_7$

$A_1 = D_2 + D_3 + D_6 + D_7$

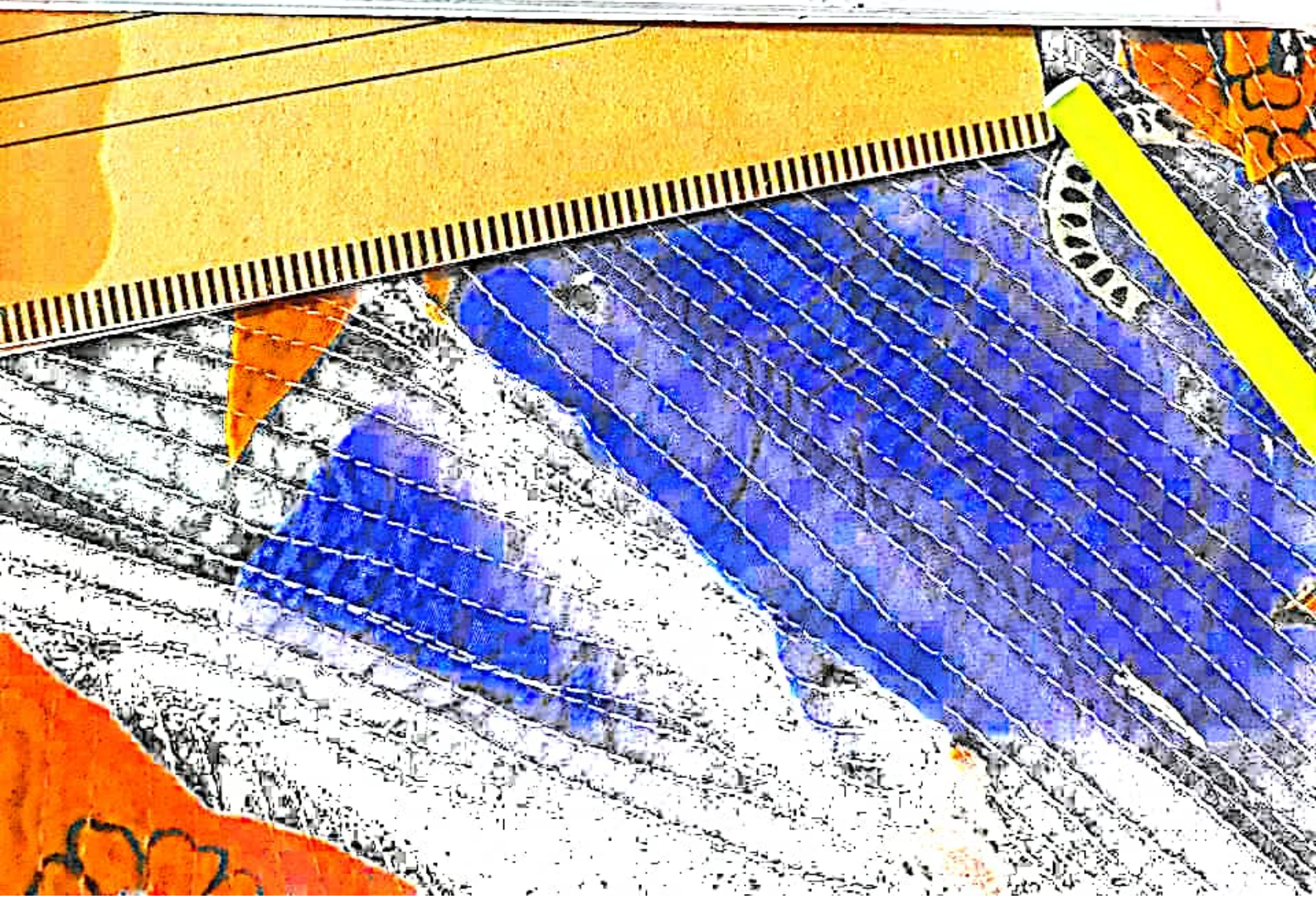
$A_2 = D_4 + D_5 + D_6 + D_7$

Logic Diagram



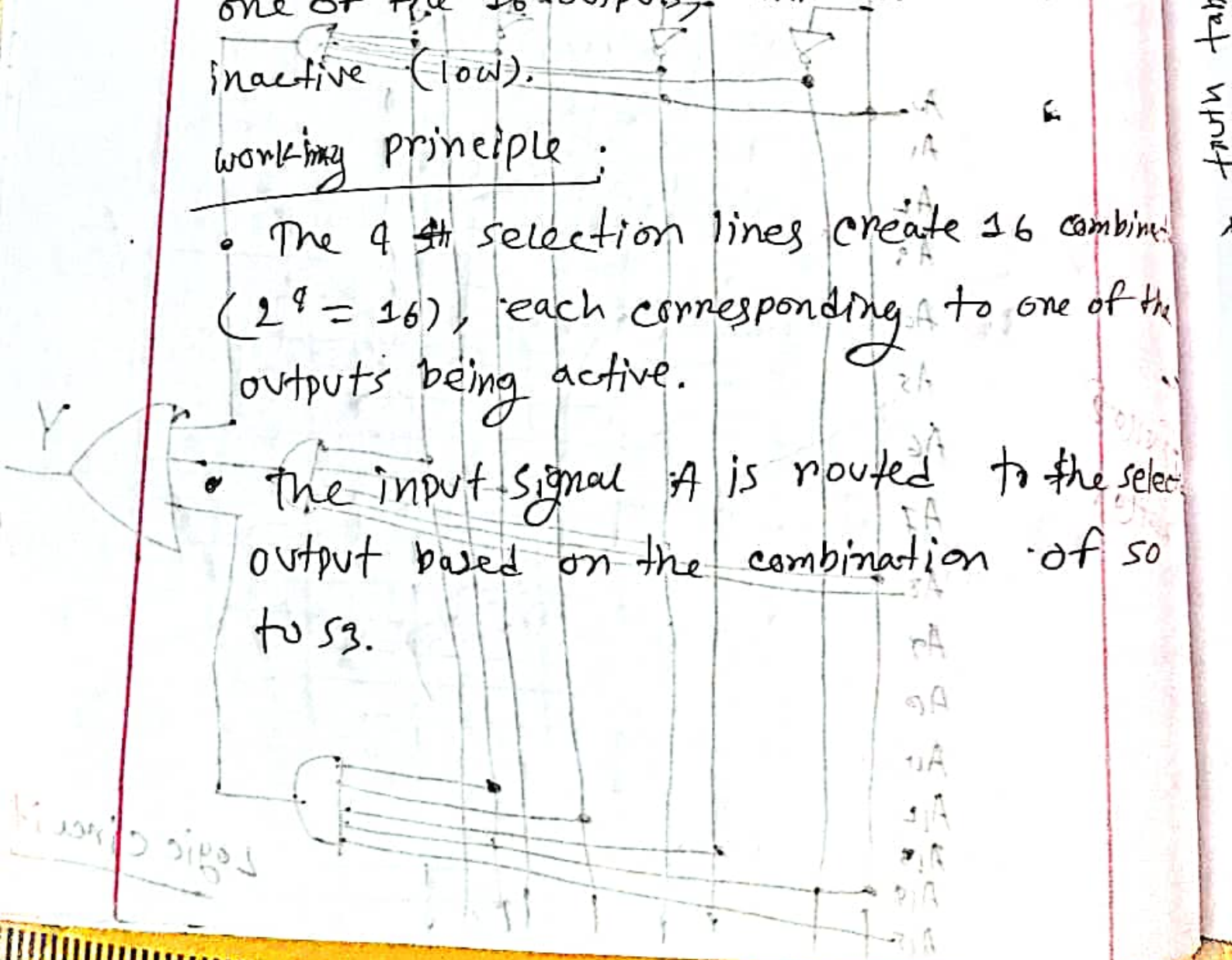
selects one of many input signals and forwards it to a single output based on control s,i,o.

Multiplexer (MUX): A multiplexer is a digital switch that selects one of many inp. signals and forwards it to a single output line based on control signals (selection lines). It is also known as a data selector.



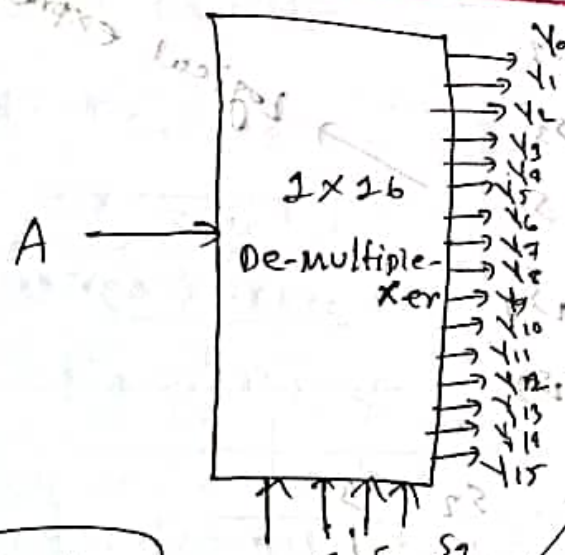
(35) With appropriate diagram explain the working principle of a 1 line to 16 line Demultiplexer.

A 1-to-16 De-multiplexer has one input (A), 4 selection lines (S_0, S_1, S_2, S_3), and 16 outputs (Y_0 to Y_{15}). Based on the combination of selection lines, the input is routed to one of the 16 outputs, while all others are inactive (low).



Working principle:

- The 4 selection lines create 16 combinations ($2^4 = 16$), each corresponding to one of the outputs being active.
- The input signal A is routed to the selected output based on the combination of S_0 to S_3.



Block Diagram

truth table

Inputs

outputs

S_0	S_1	S_2	S_3	Y_{15}	Y_{14}	Y_{13}	Y_{12}	Y_{11}	Y_{10}	Y_9	Y_8	Y_7	Y_6	Y_5	Y_4	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A
0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A	0	0
0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	A	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0
0	1	0	1	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0	0
0	1	1	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0	0	0
0	1	1	1	0	0	0	0	0	0	0	0	A	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0	0	0	0	0
1	0	0	1	0	0	0	0	0	0	A	0	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	0	A	0	0	0	0	0	0	0	0	0	0
1	0	1	1	0	0	0	0	A	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	A	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	1	0	0	A	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	0	0	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

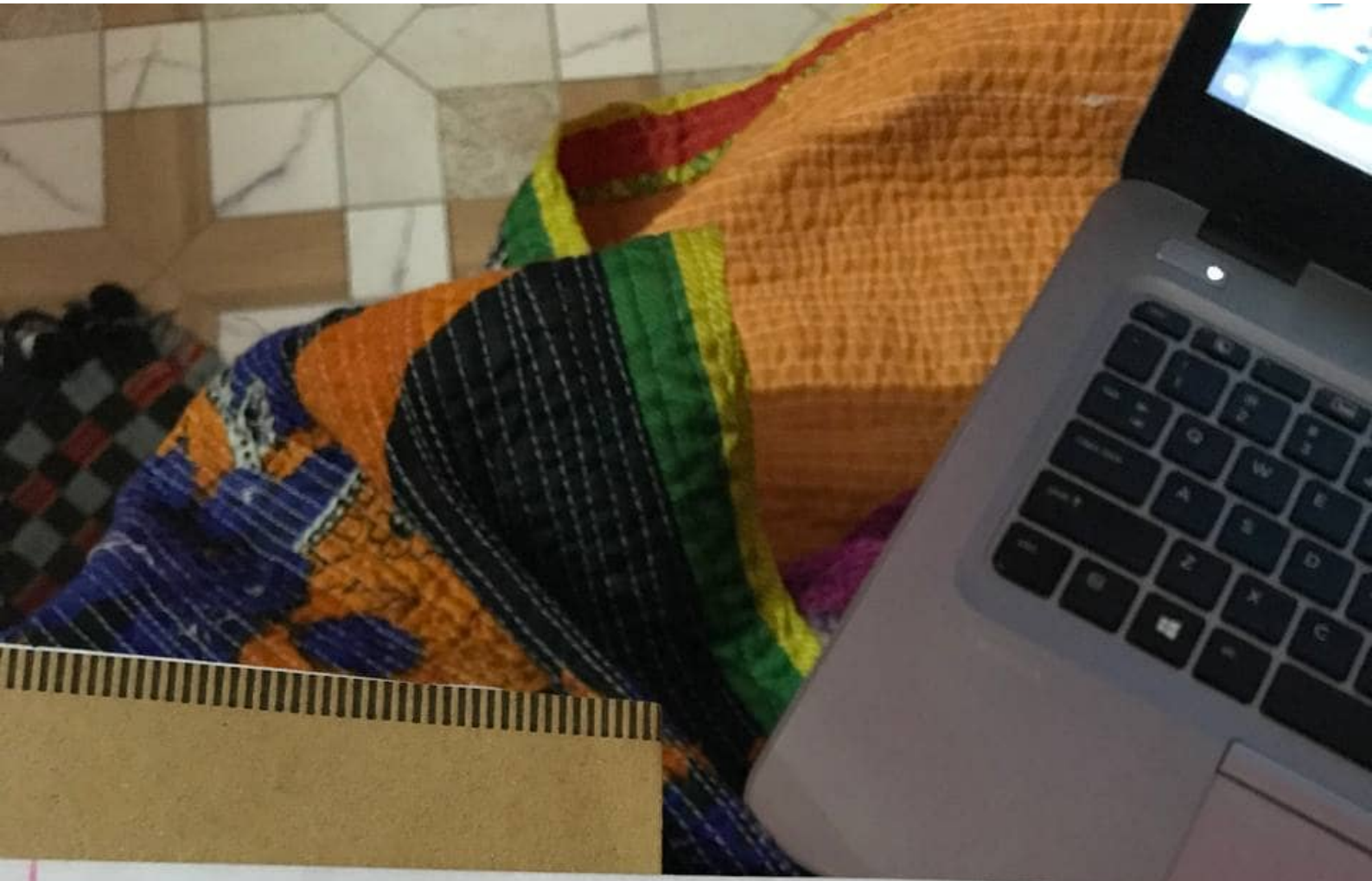
Demultiplexer (DEMUX): A demultiplexer takes a single input signal and routes it to one of many output lines based on control signals (selection lines). It is reverse operation of a multiplexer.

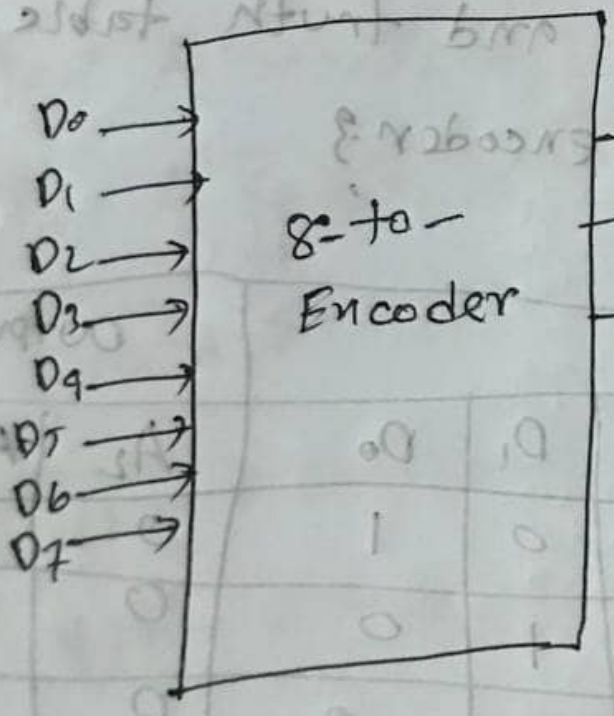
Extra: working principle of a 16-to-1 multiplexer:

A 16-to-1 multiplexer has 16 input lines (A_0 to A_{15}), 4 selection lines (S_0 to S_3), and 1 output (Y). It selects one of the 16 inputs, based on the combination of the 4 selection lines.

Working principle:

- The 4 slection lines (S_0 to S_3) create 16 combinations ($2^4 = 16$), each selecting one of the 16 inputs.





Block Diagram.

(36) Draw the diagram and truth table of an octal to Binary encoder.

Inputs								Outputs		
D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	A_2	A_1	A_0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	1	0	0	0	1
0	0	0	0	0	1	0	0	0	1	0
0	0	0	0	1	0	0	0	0	1	1
0	0	0	1	0	0	0	0	1	0	0
0	0	1	0	0	0	0	0	1	0	1
0	1	0	0	0	0	0	0	1	1	0
1	0	0	0	0	0	0	0	1	1	1

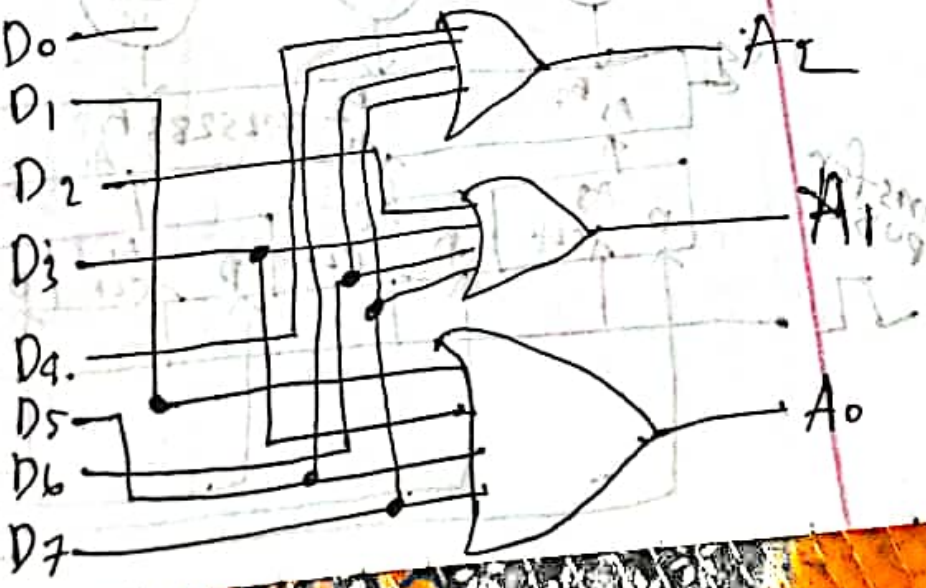
Truth table

$A_0 = D_1 + D_3 + D_5 + D_7$

$A_1 = D_2 + D_3 + D_6 + D_7$

$A_2 = D_4 + D_5 + D_6 + D_7$

Logic Diagram



$Y_0 = A\,\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3$

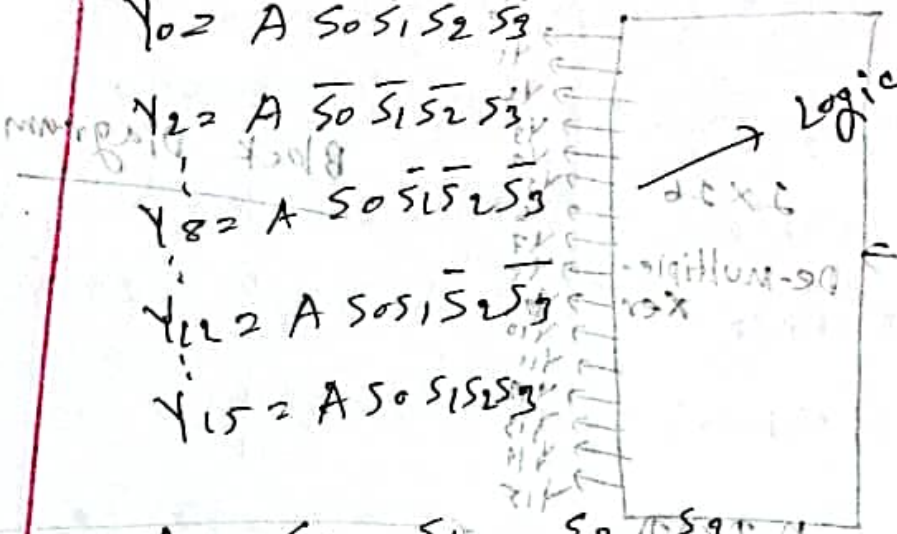
$Y_2 = A\,\bar{S}_0\bar{S}_1 S_2\bar{S}_3$

$Y_8 = A\,S_0\bar{S}_1\bar{S}_2\bar{S}_3$

$Y_{12} = A\,S_0 S_1\bar{S}_2\bar{S}_3$

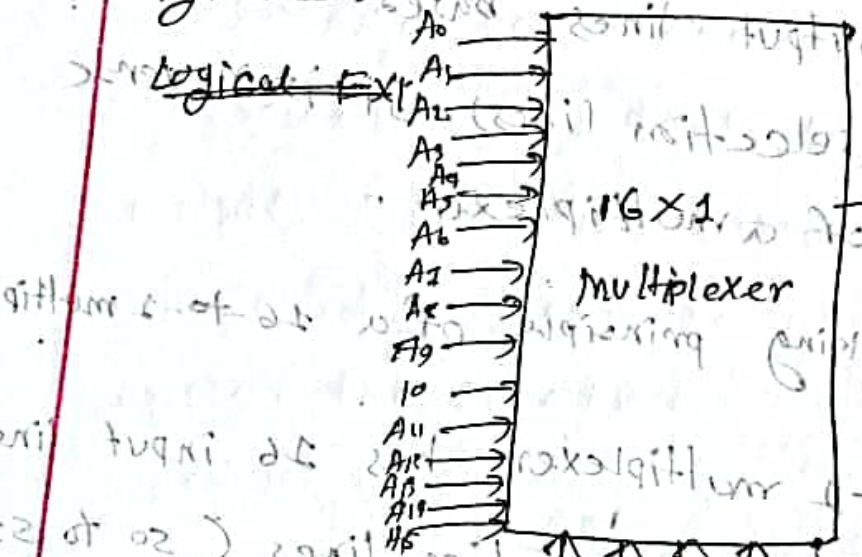
$Y_{15} = A\,S_0 S_1 S_2 S_3$

Logical expression



Logic circuit

the selected input is connected to the output (Y), while the other inputs are ignored.



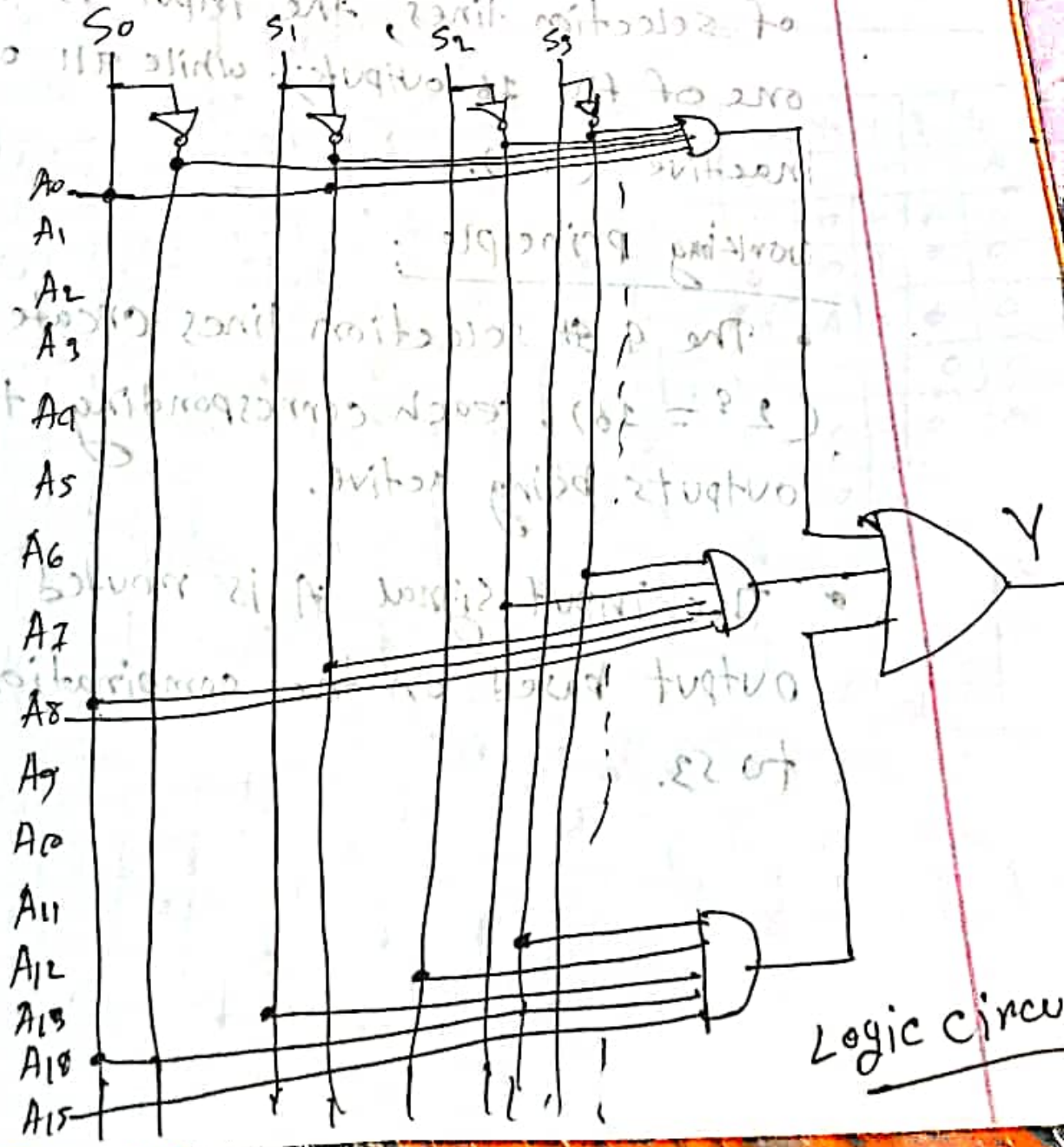
Block diagram

Inputs				outputs
S0	S1	S2	S3	Y
0	0	0	0	A0
0	0	0	1	A1
0	0	1	0	A2
0	0	1	1	A3
0	1	0	0	A4
0	1	0	1	A5
0	1	1	0	A6
0	1	1	1	A7
1	0	0	0	A8
1	0	0	1	A9
1	0	1	0	A10
1	1	0	0	A11
1	1	0	1	A12
1	1	1	0	A13
1	1	1	1	A14
				A15

truth table

Logical Expression :

$$Y = A_0\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3 + A_1\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3 + A_2\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3$$
$$+ A_3\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3 + A_4\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3 + A_5\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3$$
$$+ A_6\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3 + A_7\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3 + A_8\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3$$
$$+ A_9\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3 + \cdots + A_{15}\bar{S}_0\bar{S}_1\bar{S}_2\bar{S}_3$$



Logic circu