1.

Block diagram

$$I_0$$
$$I_1$$
$$I_2$$
$$I_3$$
$$I_4$$
$$I_5$$
$$I_6$$
$$I_7$$

8 X 1 M U X

F

$$S_2 \; S_1 \; S_0$$

Function tabe

S_2	S_1	S_0	F
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

Boolean expression:

$$F = S_2'S_1'S_0'I_0 + S_2'S_1'S_0 I_1 + S_2'S_1 S_0'I_2 + S_2'S_1 S_0 I_3 + S_2 S_1'S_0'I_4 + S_2 S_1'S_0 I_5 + S_2 S_1 S_0'I_6$$
$$+ S_2 S_1 S_0 I_7$$

$$S_2 \qquad S_1 \qquad S_0$$

$$I_0$$
$$I_1$$
$$I_2$$
$$I_3$$
$$I_4$$
$$I_5$$
$$I_6$$
$$I_7$$

F
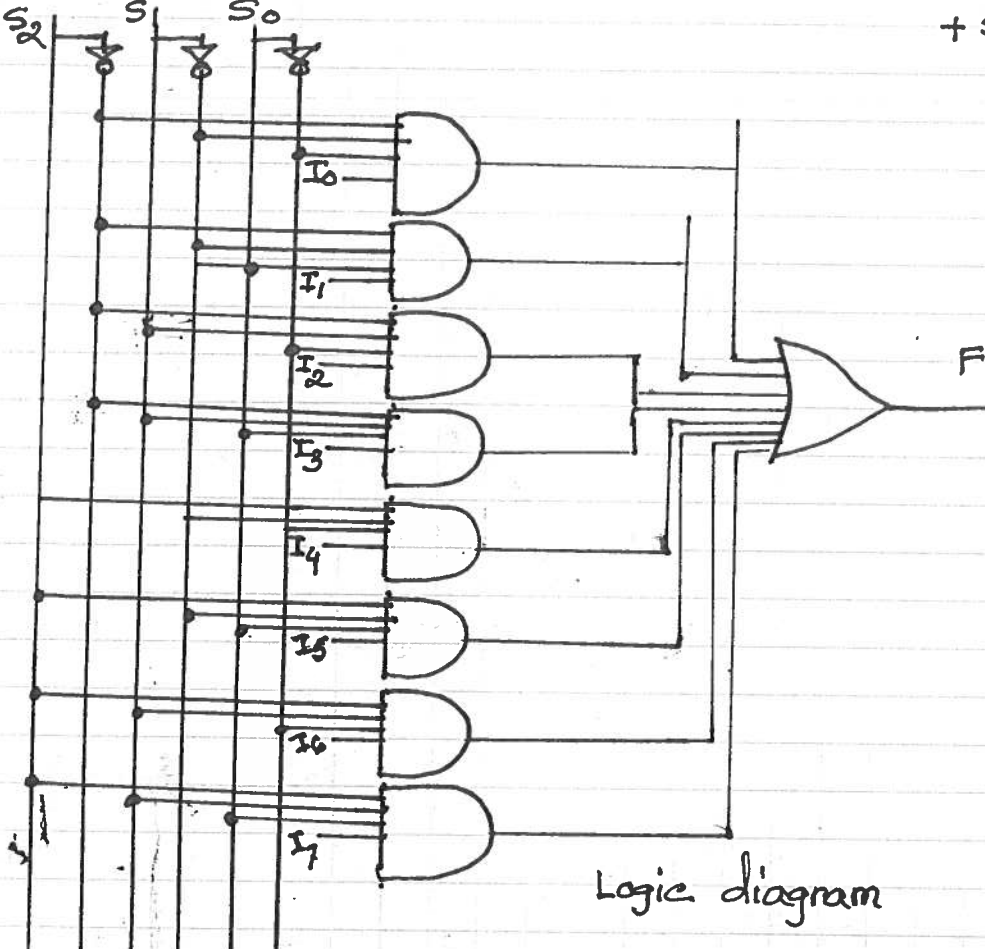
Logic diagram

Cascading of Multiplexer:

Implementing 4×1 Mux with 2×1 Mux :

    First we will determine the no. of 2×1 Mux
and levels of Mux.

— We will divide the no. of inputs of the available
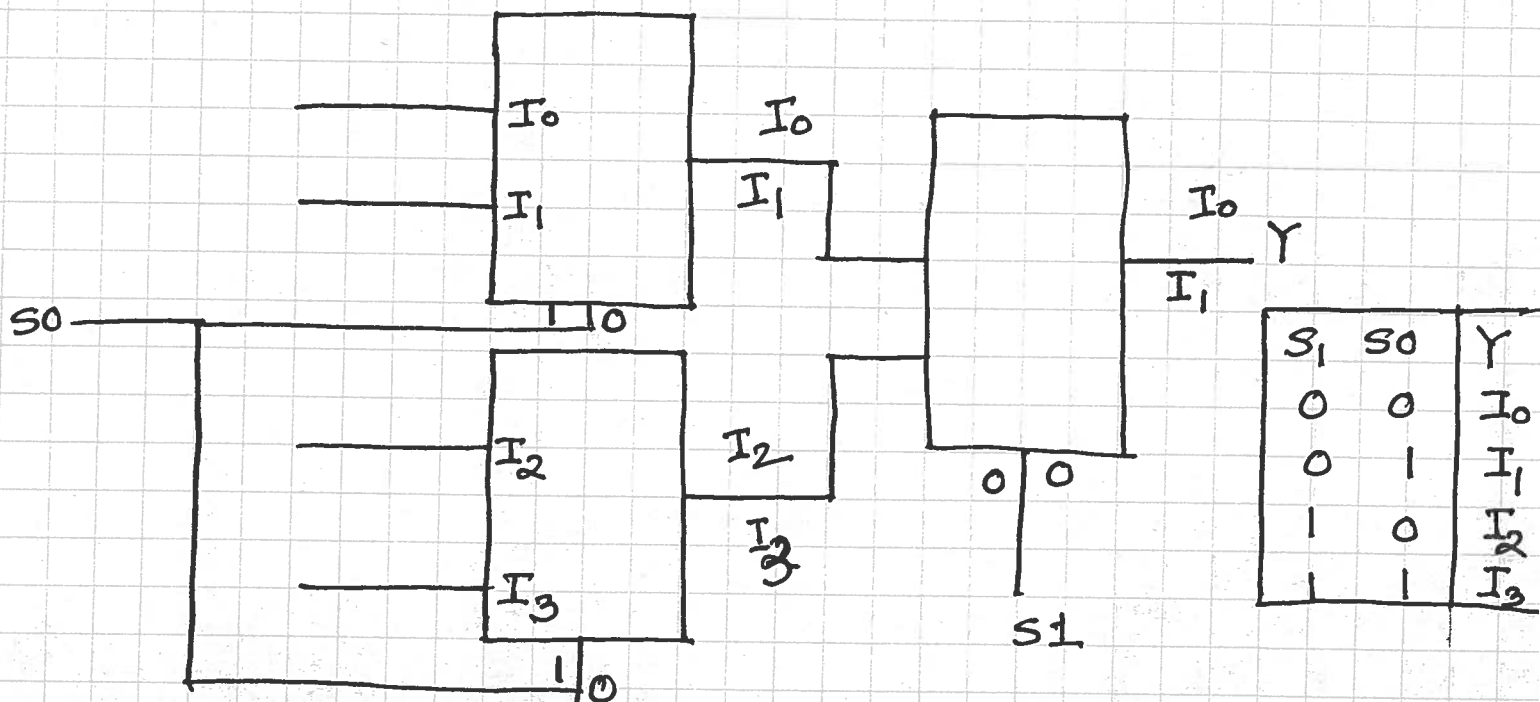mux by the no. of inputs of the required mux.
— In this implementation,

        the no. of inputs of the required mux = 4
        the no. of inputs of the available mux = 2

$$\left. \begin{array}{l} \dfrac{4}{2} = 2 \\[2mm] \dfrac{2}{2} = 1 \end{array} \right\} \quad 2+1 = 3$$

    So, we need 3, 2×1 Mux to implement 4×1 Mux.
We also see that in the 1st level we need 2 and in the
second level we need 1, 2×1 Mux.

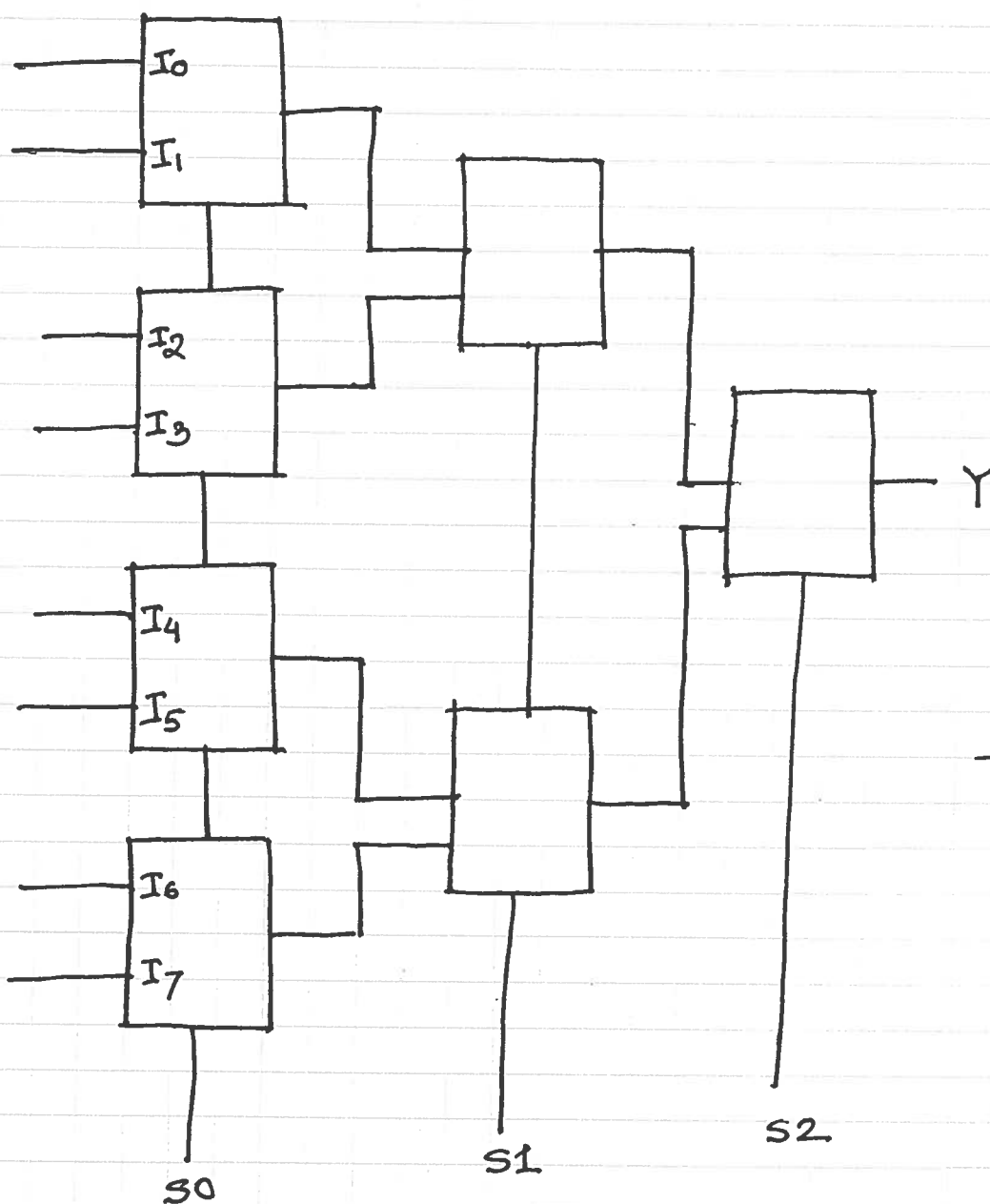| S_1	S_0	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

Implementing 8×1 MUX with 2×1 Mux:

No. of inputs of the required Mux = 2

No. of inputs of the available Mux = 8

$$\frac{8}{2} = 4$$

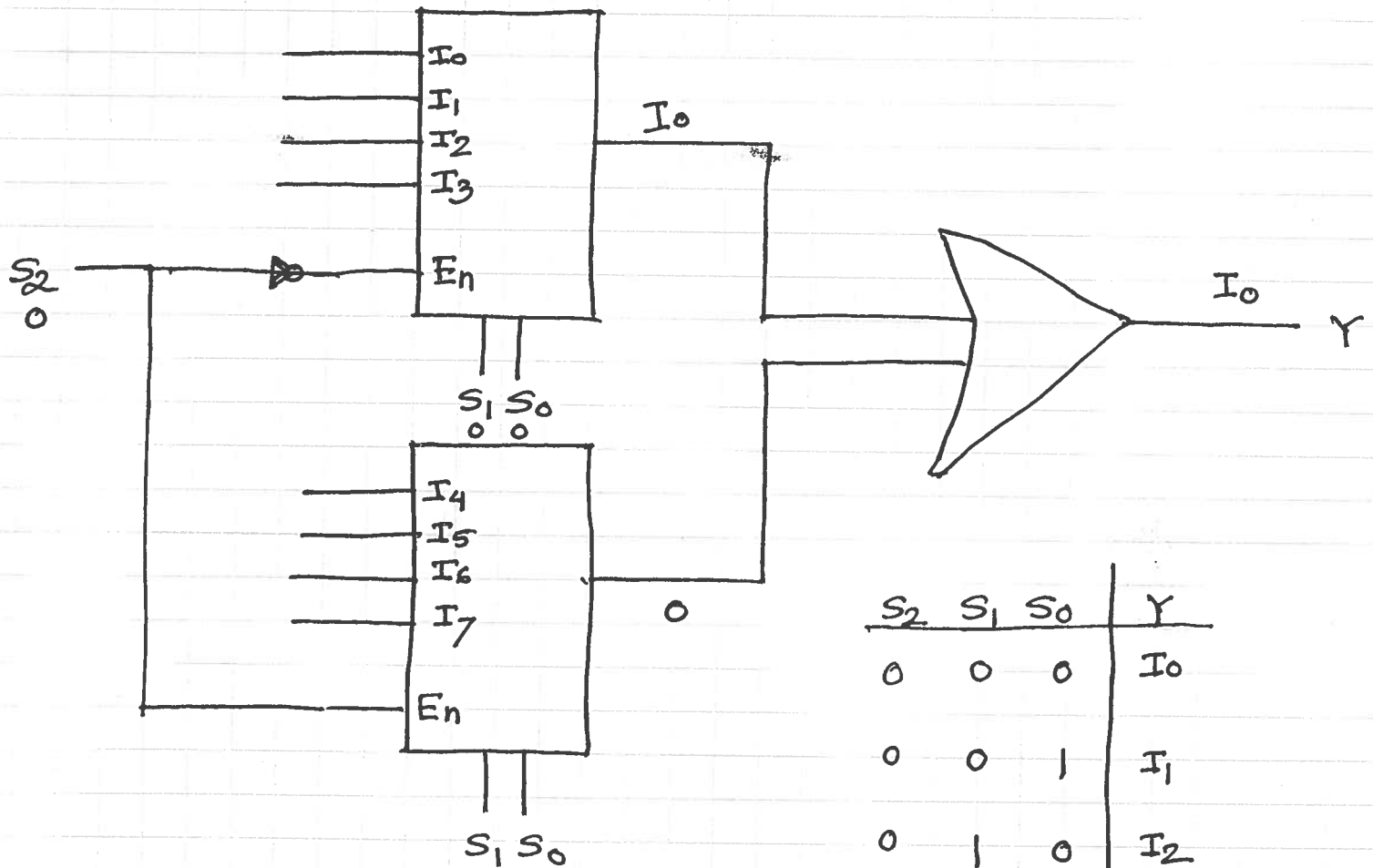$$\frac{4}{2} = 2$$

$$\frac{2}{2} = 1$$

$4+2+1 =$ total 7, $2×1$ Mux in 3 levels.

S_2	S_1	S_0	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

Implementing 8X1 Mux with 4x1 Mux (Exception):

$$\frac{8}{4} = 2$$

$$\frac{2}{4} = 0.5$$

} does not work.

S_2	S_1	S_0	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

$$F(A, B, C, D) = \sum m(0, 2, 3, 6, 8, 9, 13, 14)$$

Implement the function with

    a) 4×1 Mux

    b) 8×1 Mux

    c) 16×1 Mux

a) 4×1 Mux

$$= D' + C$$

$$= CD'$$

$$= C'D + CD' = C \oplus D$$

$$= C'$$
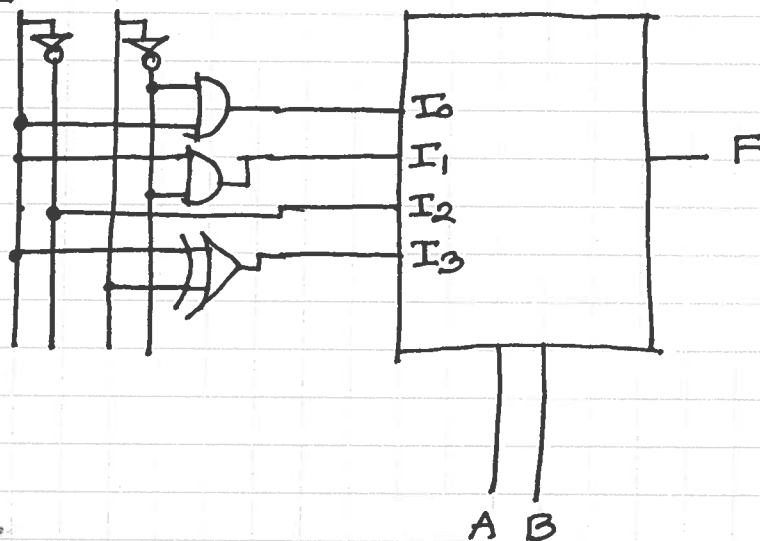
Fig: 4×1 Mux implementation
using AB as select line

a)

CD\AB	00	01	11	10
00	0 **1**	1	3 **1**	2 **1**
01	4	5	7	6 **1**
11	12	13 **1**	15	14 **1**
10	8 **1**	9 **1**	11	10

B' A $A'B'$ $A+B$
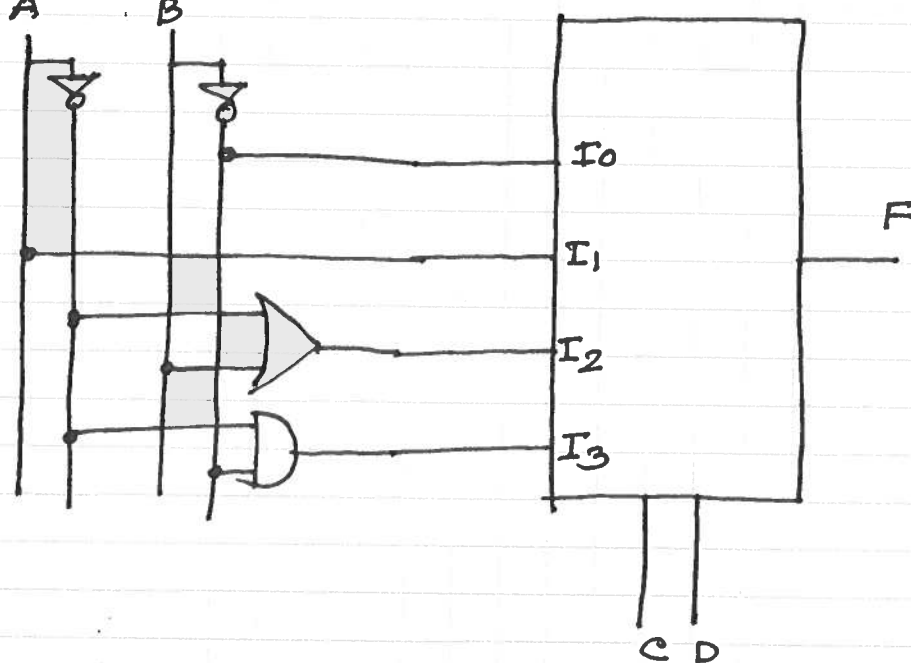
$$F(A,B,C,D) = \sum m \, (0,2,3,6,8,9, \; 13,14)$$

Fig. 4×1 Mux Implementation
using CD as select line

b) 8X1 Mux

$$F(A,B,C,D) = \sum m(0,2,3,6\cancel{*8},9,13,14)$$

A	B	C	D	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

Annotations: D', 1, 0, D', 1, 0, D, D'

Mux inputs:

D' — I_0
1 — I_1
0 — I_2
D' — I_3
1 — I_4
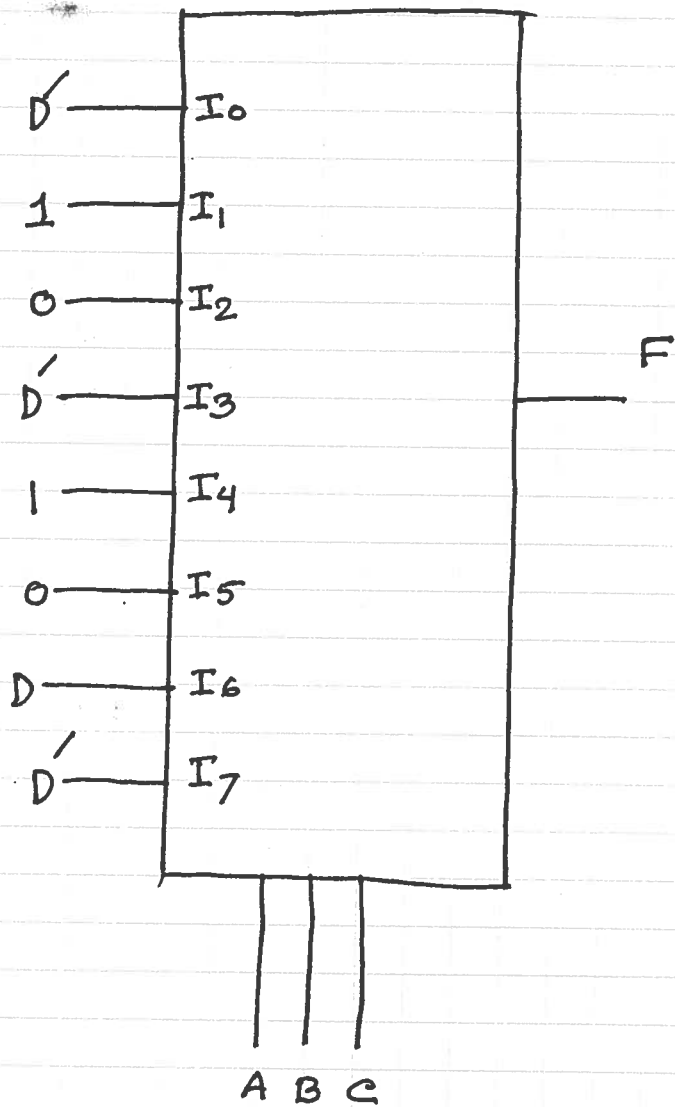0 — I_5
D — I_6
D' — I_7

Output: F

Select lines: A B C

Fig: 8X1 Mux Implementation

c) 16X1 MUX Implementation