COMPUTER SCIENCE & IT

DIGITAL LOGIC

Lecture No. 08

Combinational Circuit

By- Chandan Gupta Sir

- Comparator CKt
- MUX

MUX Cont.

Higher order MUX using lower order MUX

- $4:1$ $\xrightarrow{\text{Using } 2:1 \text{ MUX}}$ $2+1=3=(2^2-1)$
  $2^2:1$
- $8:1$ MUX $\xrightarrow{\text{Using } 2:1 \text{ MUX}}$ $4+2+1=7=(2^3-1)$
  $2^3:1$
- $16:1$ MUX $\xrightarrow{\text{Using } 2:1 \text{ MUX}}$ $8+4+2+1=15=2^4-1$
  $2^4:1$
- $2^n:1$ MUX $\xrightarrow{\text{Using } 2:1 \text{ MUX}}$ (2^n-1)

$16:1 \xrightarrow{4:1} 4+1=5$

$256:1 \xrightarrow{4:1} 64+16+4+1=85$

$64:1 \xrightarrow{8:1} 8+1=9$

$32:1 \xrightarrow{4:1} 8+2+1(2:1)$

$10(4:1)$

or 11 (4:1) MUX but one (4:1) MUX is used as (2:1) MUX

$256:1 \xrightarrow{8:1} 32+4$

$36(8:1) + 1(4:1)$ MUX

or

$37(8:1)$ but one (8:1) MUX is used as (4:1) MUX.

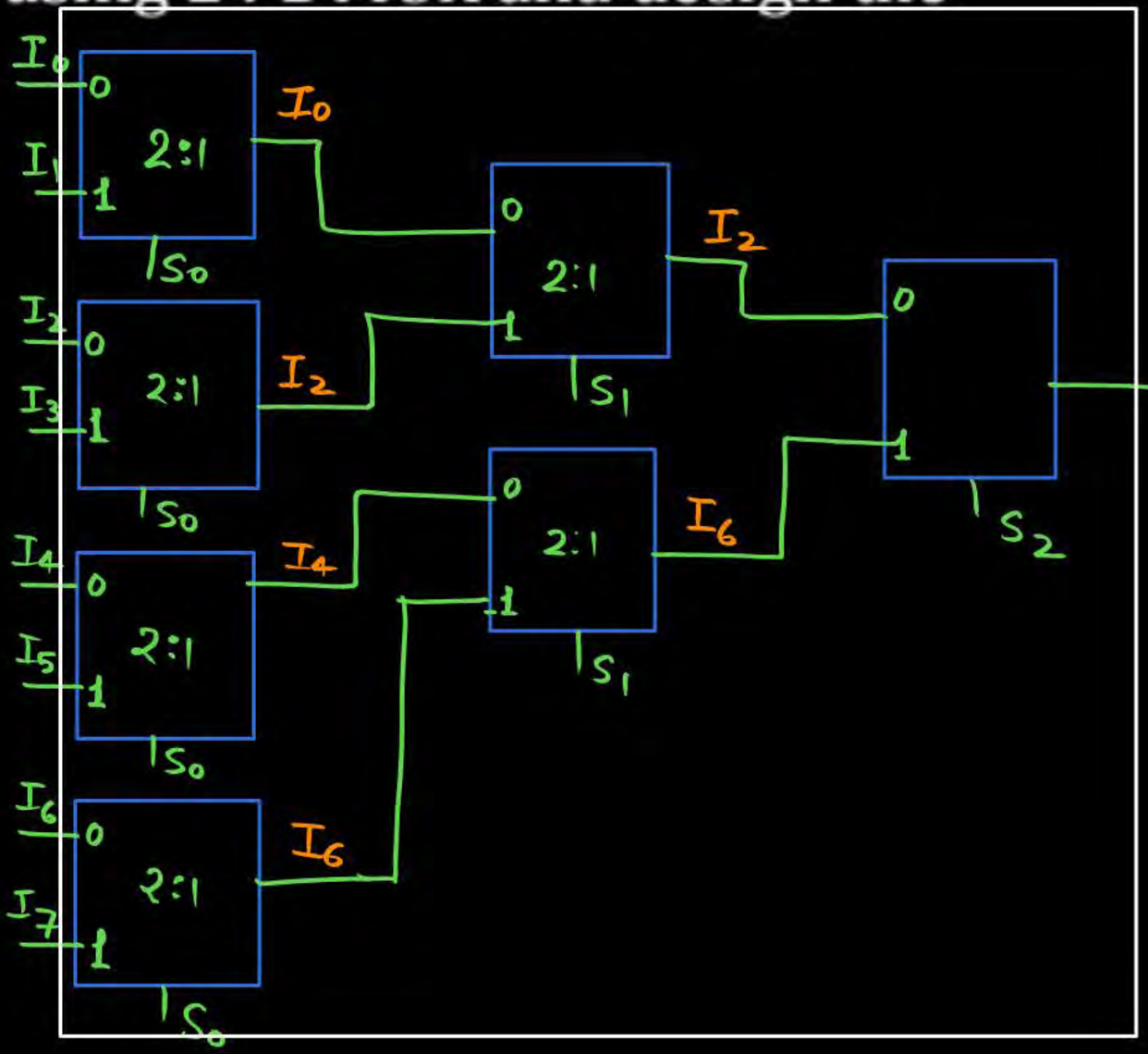
Implement 8 : 1 MUX using 2 : 1 MUX and design the complete circuit.

$I_0 - I_7$ → available

S_2, S_1, S_0

$8:1 \xrightarrow{2:1} 4+2+1$

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



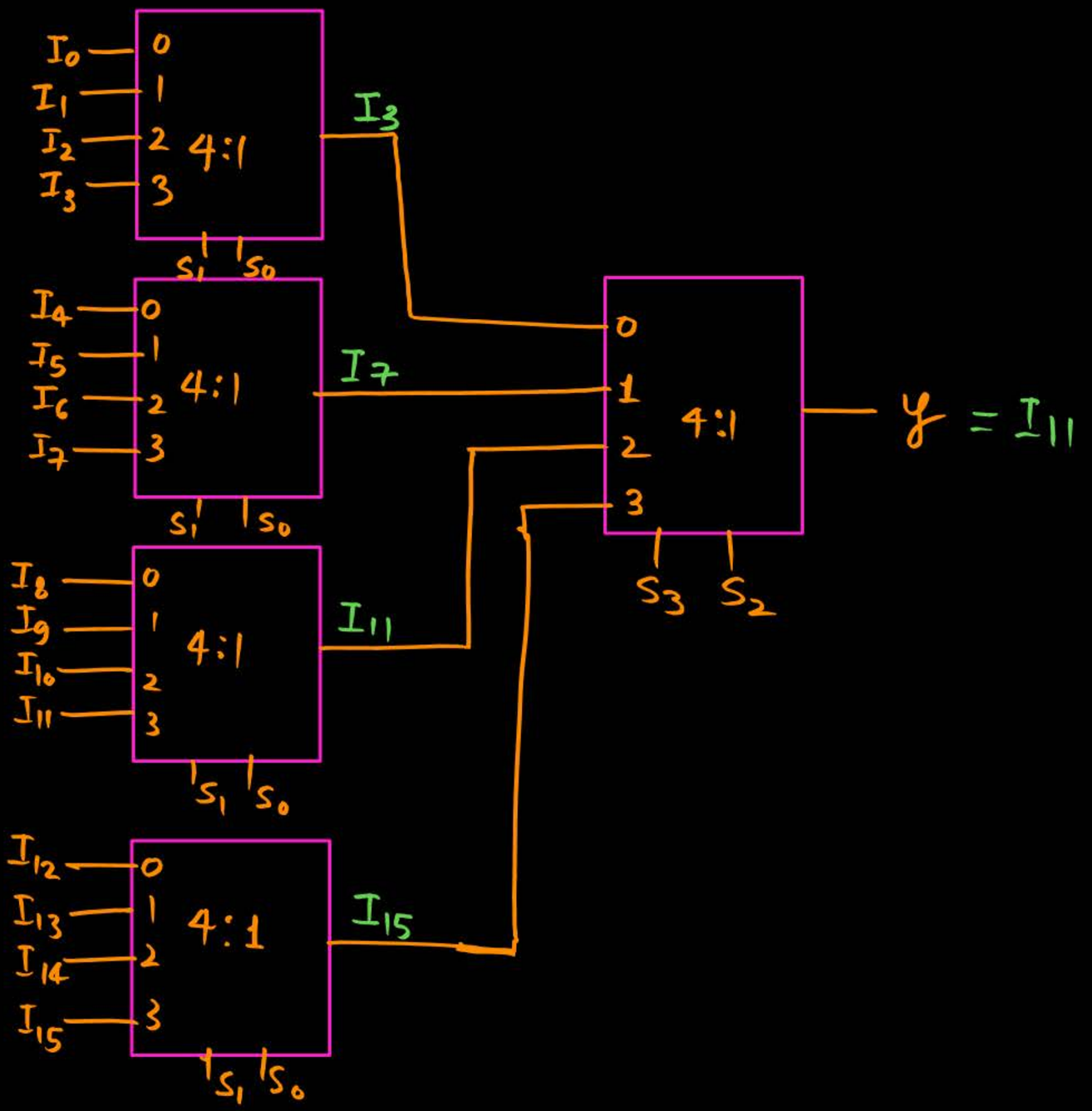
16:1 $\xrightarrow{4:1}$ 4+1

$(I_0 - I_{15})$ → available

$S_3\ S_2\ S_1\ S_0$

$S_3 S_2 S_1 S_0 = (1011)$

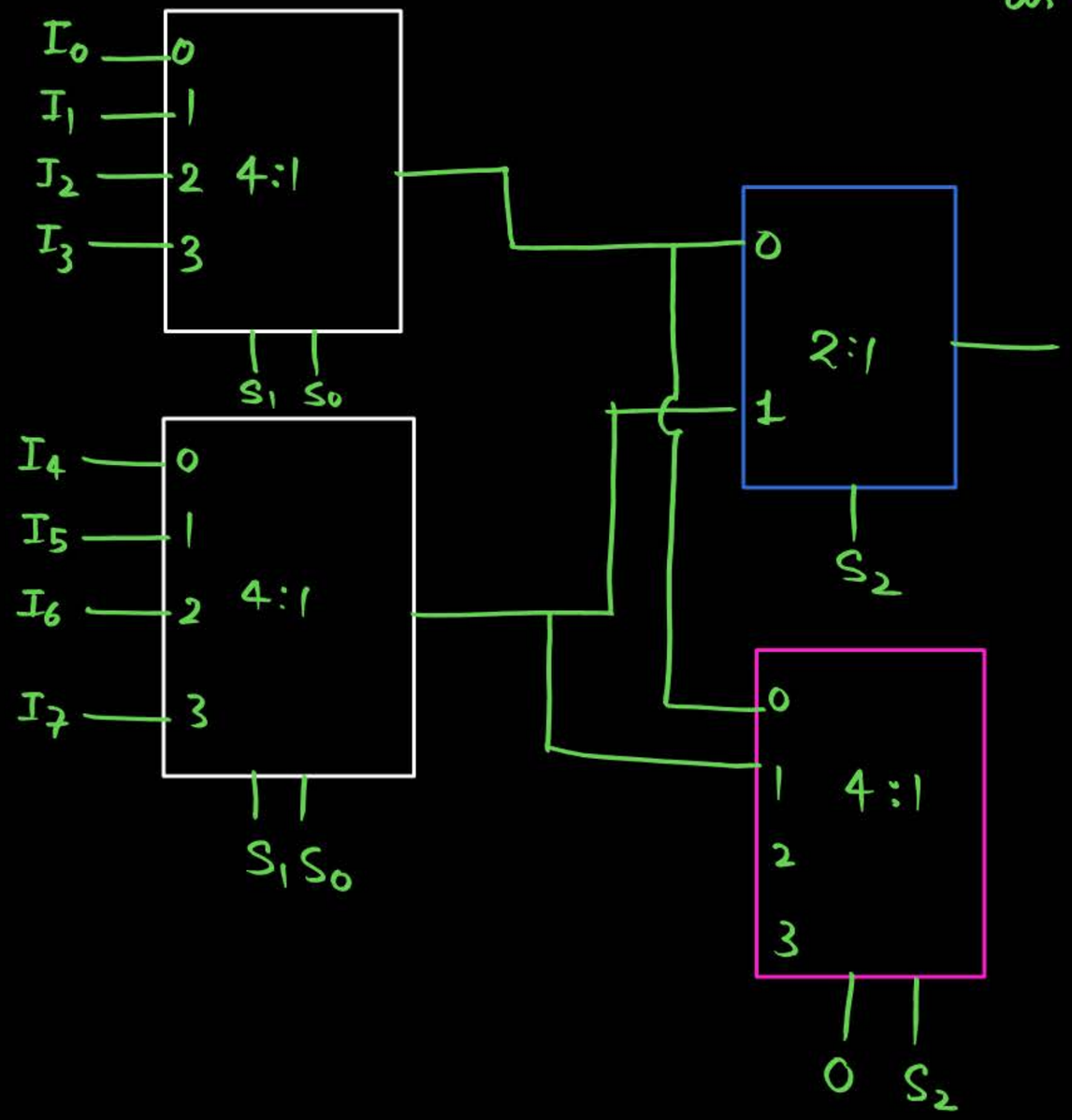
$y = I_{11}$



8:1 $\xrightarrow{4:1}$ 2 (4:1) MUX + 1(2:1) or 3 (4:1) but one 4:1 MUX will be used as 4:1 MUX

$I_0 - I_7$

S_2, S_1, S_0



- 16 : 1 MUX $\xrightarrow{\text{Using 8 : 1 MUX}}$ 2(8:1) + 1(2:1) Mux
  or
  3(8:1)

- 32 : 1 MUX $\xrightarrow{\text{Using 4 : 1 MUX}}$ (8 + 2)
  10(4:1) MUX + 1(2:1) MUX
  or
  11(4:1) MUX

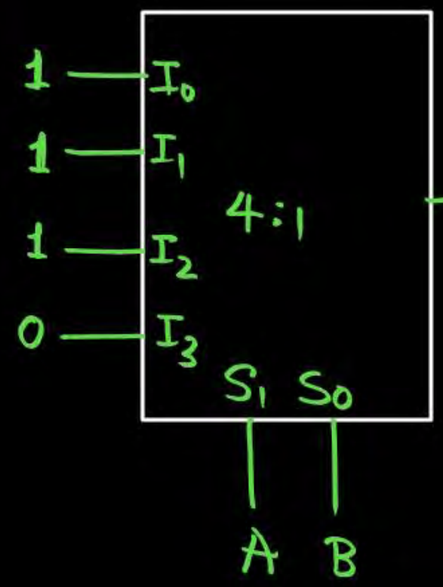
Implementation of Boolean function using MUX

Q. $f(A, B) = \Sigma(0, 1, 2)$ → implement this logical function

(i) using 4 : 1 MUX

(ii) using 2 : 1 MUX

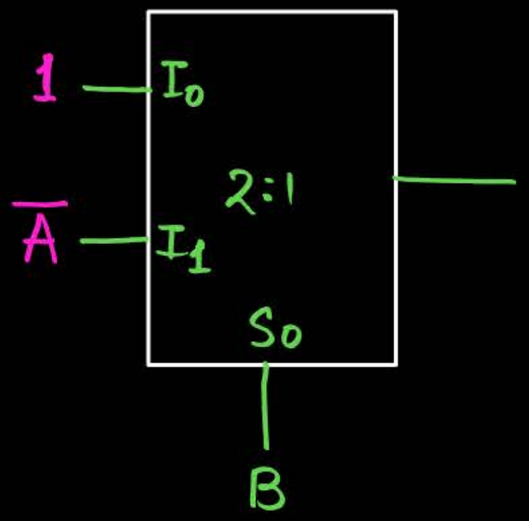
(i).



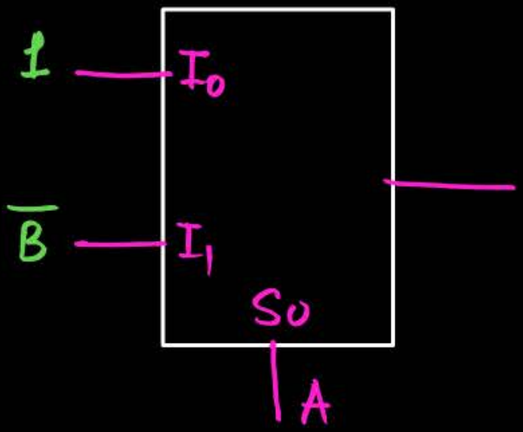
$\bar{A}\bar{B}\cdot 1 + \bar{A}B\cdot 1 + A\bar{B}\cdot 1 + AB\cdot 0 = f(A,B)$

$f(\overset{2^1}{A}, \overset{2^0}{B}) = \Sigma(0,1,2)$

(iii).

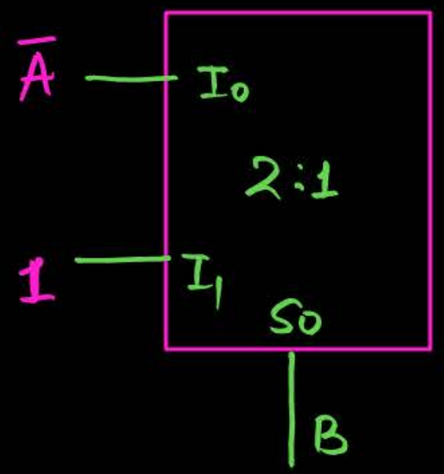


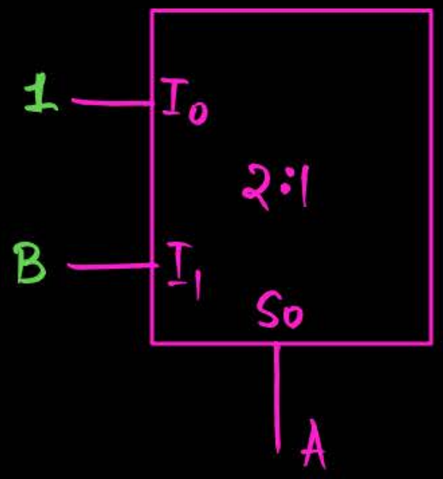
		I_0	I_1
0	$\overline{A}$	0	1
1	A	2	3
		1	$\overline{A}$



		I_0	I_1
0	$\overline{B}$	0	2
1	B	1	3
		1	$\overline{B}$

- $f(A, B) = \Sigma(0, 1, 3)$





	I_0	I_1
$\bar{A}$	0	1
A	2	3

$\bar{A}$ 1

	I_0	I_1
$\bar{B}$	0	2
B	1	3

1 B

- $f(A,B,C) = \Sigma(0,1,3,4,5)$ ($2^2\ 2^1\ 2^0$)

(i). 8:1

(ii). 4:1

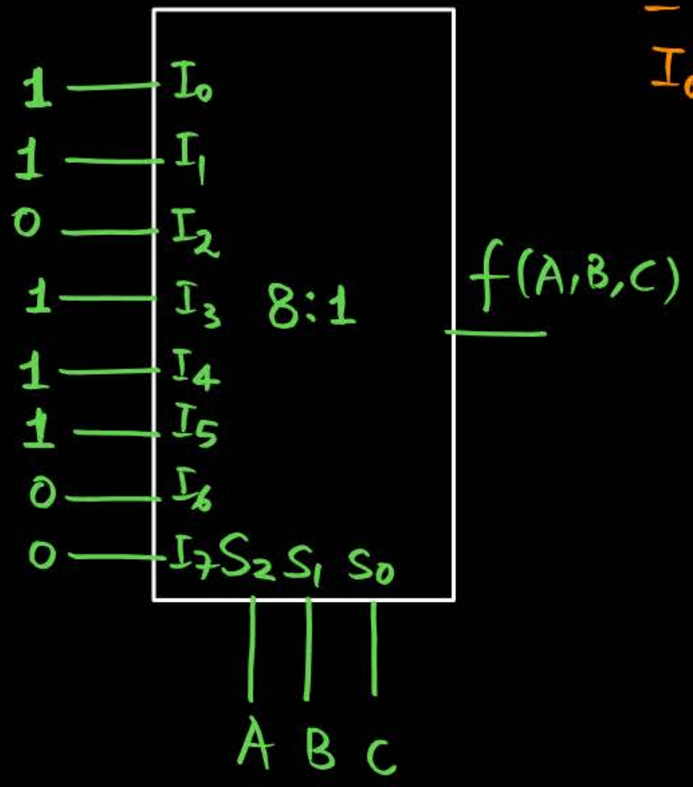
$f(0,B,0)$

$= \Sigma(0) = \bar{A}\bar{B}\bar{C}$

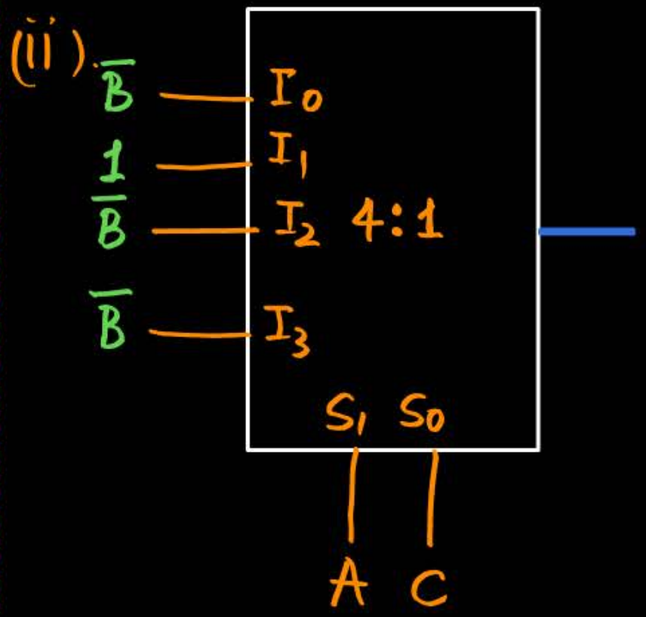
$= \bar{B}$

$I_0 = \bar{B}$

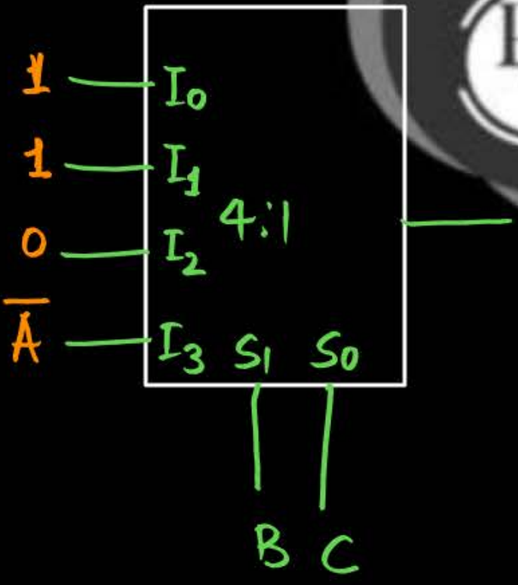
(i).



(ii).



		I_0	I_1	I_2	I_3
0	$\bar{B}$	0	1	4	5
1	B	2	3	6	7
		$\bar{B}$	1	$\bar{B}$	$\bar{B}$



		I_0	I_1	I_2	I_3
$\bar{A}$		0	1	2	3
A		4	5	6	7
		1	1	0	$\bar{A}$

- $f(A,B,C,D) = (A+\bar{C})(\bar{B}+\bar{D}) = \pi(2,3,5,6,7,13,15) = \Sigma(0,1,4,8,9,10,11,12,14)$

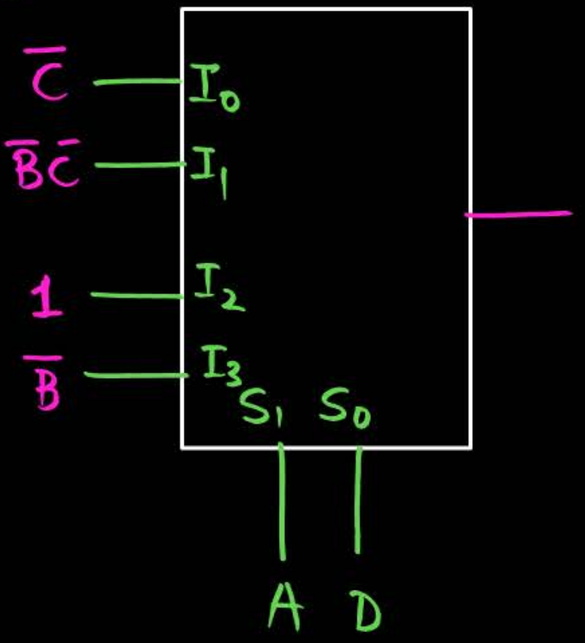
to implement it using (4:1) MUX & A & D as select line.

$A + \bar{C}$

0 0 1 0 → 2
0 0 1 1 → 3
0 1 1 0 → 6
0 1 1 1 → 7

$\bar{B} + \bar{D}$

0 1 0 1 → 5
0 1 1 1 → 7
1 1 0 1 → 13
1 1 1 1 → 15



	I_0	I_1	I_2	I_3
$\bar{B}\bar{C}$	(0)	(1)	(8)	(9)
$\bar{B}C$	2	3	(10)	(11)
$B\bar{C}$	(4)	5	(12)	13
BC	6	7	(14)	15
	$\bar{B}\bar{C}$	$\bar{B}\bar{C}$	1	$\bar{B}$

$\bar{B}\bar{C} + B\bar{C}$

$= \bar{C}$

$f(0, B, C, 0) = \overline{C}$, $I_0 = \overline{C}$

$f(0, B, C, 1) = \overline{B}\,\overline{C}$, $I_1 = \overline{B}\,\overline{C}$

$f(1, B, C, 0) = 1$, $I_2 = 1$

$f(1, B, C, 1) = \overline{B}$, $I_3 = \overline{B}$

- H.W.
- Implement 16:1 MUX using 8:1 MUX
- Implement 32:1 MUX using 8:1 MUX.
- $f(A,B,C,D) = (\bar{A}+B+\bar{D})(A+\bar{C})$

  implement it using 4:1 MUX & B & C as select line.
- $f(A,B,C) = \bar{A}\bar{B}+BC$

  (i) implement it using (2:1) MUX & A as select line

  (ii) implement it using (4:1) MUX & A & C as select line.

2 Minute Summary

MUX

Thank you

GW

Soldiers !