CS & IT ENGINEERING

DIGITAL LOGIC

Combinational Circuit

Lecture No. 6

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01 MULTIPLEXER

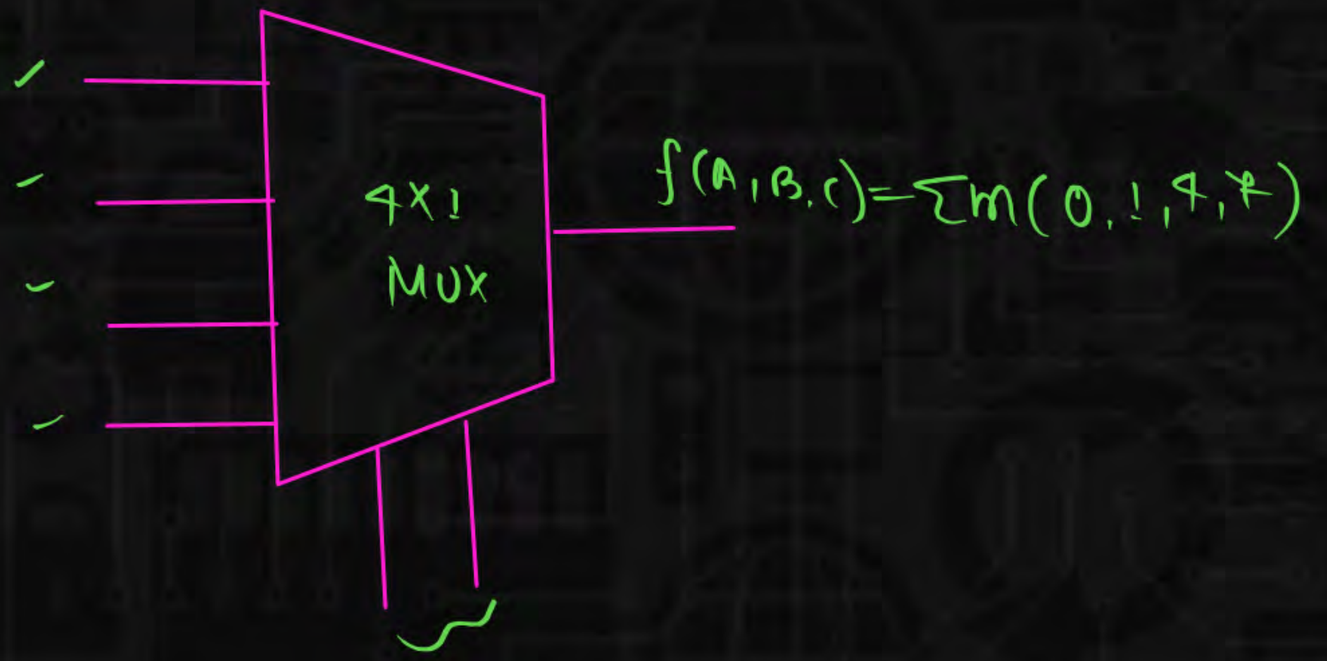
02 QUESTION PRACTICE

03 DISCUSSION

By using 4 x 1 MUX

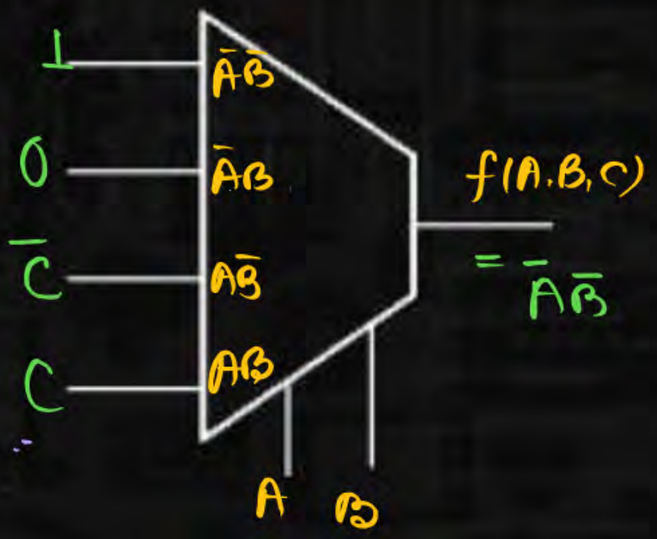
$$f(A,B,C) = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + A\bar{B}\bar{C} + ABC = \Sigma m(0,1,4,7)$$

1. AB as a select line
2. BC as a select line
3. AC as a select line



1. AB is a select line

$$f(A,B,C) = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + A\bar{B}\bar{C} + ABC$$
$$= \Sigma m(0,1,4,7)$$

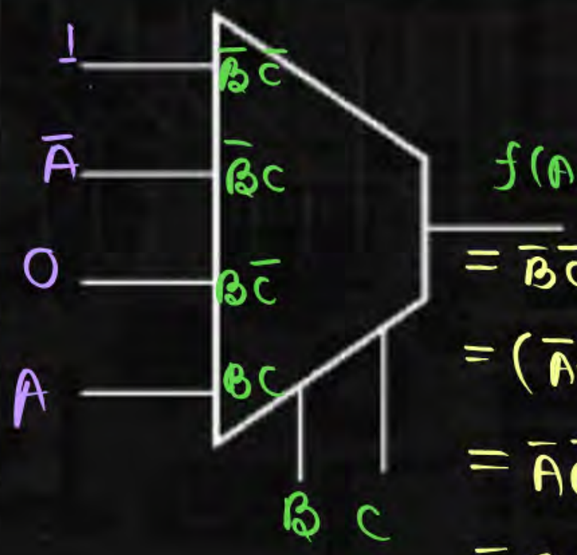


	$\bar{A}\bar{B}$	$\bar{A}B$	$A\bar{B}$	AB
$\bar{C}$	$\bar{A}\bar{B}\bar{C}$ 0	$\bar{A}B\bar{C}$ 2	$A\bar{B}\bar{C}$ 4	$AB\bar{C}$ 6
C	$\bar{A}\bar{B}C$ 1	$\bar{A}BC$ 3	$A\bar{B}C$ 5	ABC 7
	1	0	$\bar{C}$	C

2. BC is a select line

$$f(A,B,C) = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + A\bar{B}\bar{C} + ABC$$

$$= \Sigma m(0,1,4,7)$$



$f(A,B,C)$

$= \bar{B}\bar{C} + \bar{A}\bar{B}C + ABC$

$= (\bar{A}+A)\bar{B}\bar{C} + \bar{A}\bar{B}C + ABC$

$= \bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C} + \bar{A}\bar{B}C + ABC$

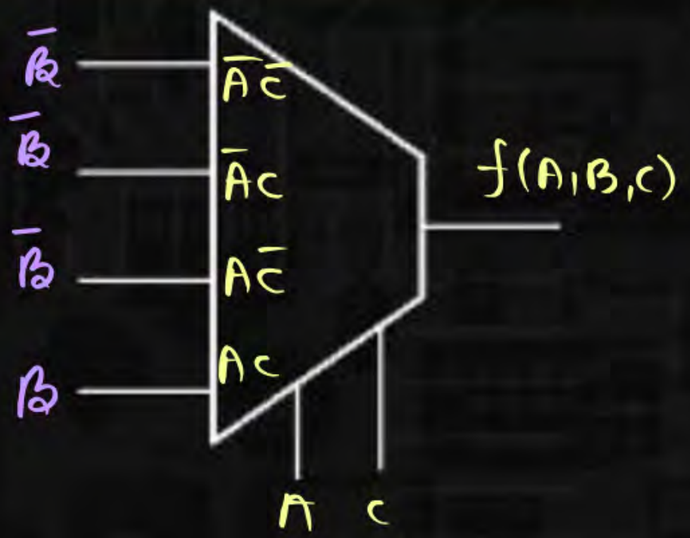
$= \Sigma m(0,1,4,7)$

	$\bar{B}\bar{C}$	$\bar{B}C$	$B\bar{C}$	BC
$\bar{A}$	$\bar{A}\bar{B}\bar{C}$ (0)	$\bar{A}\bar{B}C$ (1)	$\bar{A}B\bar{C}$ 2	$\bar{A}BC$ 3
A	$A\bar{B}\bar{C}$ (4)	$A\bar{B}C$ 5	$AB\bar{C}$ 6	ABC (7)
	1	$\bar{A}$	0	A

3. AC as a select line

$$f(A,B,C) = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + A\bar{B}\bar{C} + ABC$$

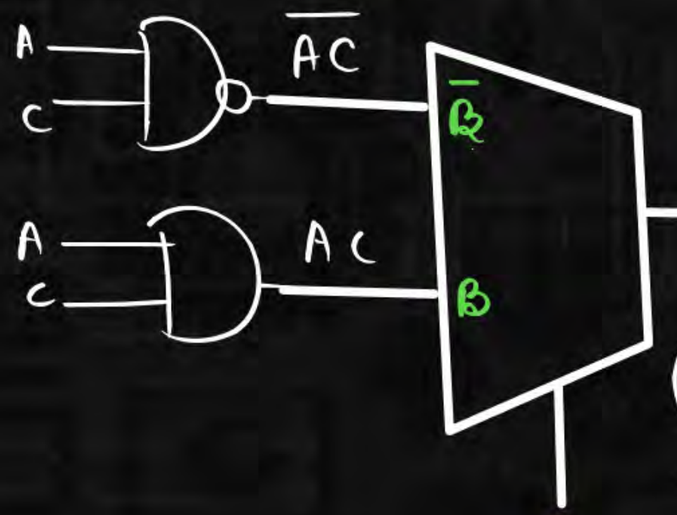
$$= \Sigma m(0,1,4,7)$$



	$\bar{A}\bar{C}$	$\bar{A}C$	$A\bar{C}$	AC
$\bar{B}$	$\bar{A}\bar{B}\bar{C}$ 0	$\bar{A}\bar{B}C$ 1	$A\bar{B}\bar{C}$ 4	$A\bar{B}C$ 5
B	$\bar{A}B\bar{C}$ 2	$\bar{A}BC$ 3	$AB\bar{C}$ 6	ABC 7
	$\bar{B}$	$\bar{B}$	$\bar{B}$	B

By using 2 x 1 MUX

$f(A,B,C) = \Sigma m(0,1,4,7)$



$\bar{A}\bar{C}\cdot\bar{B} + ABC$

$(\bar{A}+\bar{C})\bar{B} + ABC$

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

$\bar{A}\bar{B}(\bar{C}+C) + (\bar{A}+A)\bar{B}\bar{C} + ABC$

$= \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}\bar{B}C + A\bar{B}\bar{C} + ABC$

$= \Sigma m(0,1,4,7)$

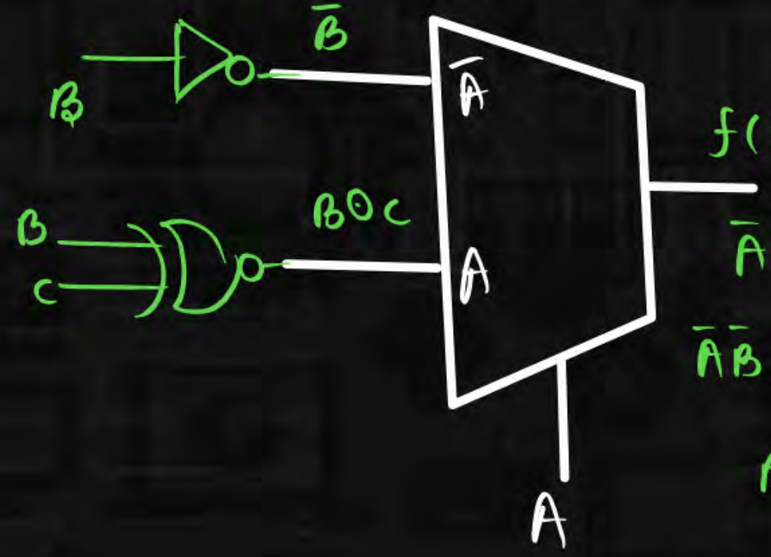
$\bar{A}\bar{C} + \bar{A}C + A\bar{C}$

$\bar{A}(\bar{C}+C) + A\bar{C} = \bar{A} + A\bar{C} = \bar{A}+\bar{C} = \overline{A\cdot C}$

	$\bar{B}$	B
$\bar{A}\bar{C}$	$\bar{A}\bar{B}\bar{C}$ 0	$\bar{A}B\bar{C}$ 2
$\bar{A}C$	$\bar{A}\bar{B}C$ 1	$\bar{A}BC$ 3
$A\bar{C}$	$A\bar{B}\bar{C}$ 4	$AB\bar{C}$ 6
AC	$A\bar{B}C$ 5	ABC 7
	$\overline{A\cdot C}$	AC

By using 2 x 1 MUX

$f(A,B,C) = \Sigma m(0,1,4,7)$



$\bar{A}\bar{B} + A(B \odot C)$

$\bar{A}\bar{B}(\bar{C}+C) + A(\bar{B}\bar{C}+BC)$

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

$= \Sigma m(0,1,4,7)$

	$\bar{A}$	A
$\bar{B}\bar{C}$	$\bar{A}\bar{B}\bar{C}$ 0	$A\bar{B}\bar{C}$ 4
$\bar{B}C$	$\bar{A}\bar{B}C$ 1	$A\bar{B}C$ 5
$B\bar{C}$	$\bar{A}B\bar{C}$ 2	$AB\bar{C}$ 6
BC	$\bar{A}BC$ 3	ABC 7
	$\bar{B}\bar{C} + \bar{B}C$	$\bar{B}\bar{C} + BC$
	$\bar{B}(\bar{C}+C)$	$B \odot C$
	$\bar{B}$	

Q. $f(A,C,B,D) = \Sigma m(0, 1, 3, 5, 7, 9, 12, 15)$

a) 1. ABD as select line } 8x1 MUX

2. ACD as a select line. } 8x1 MUX

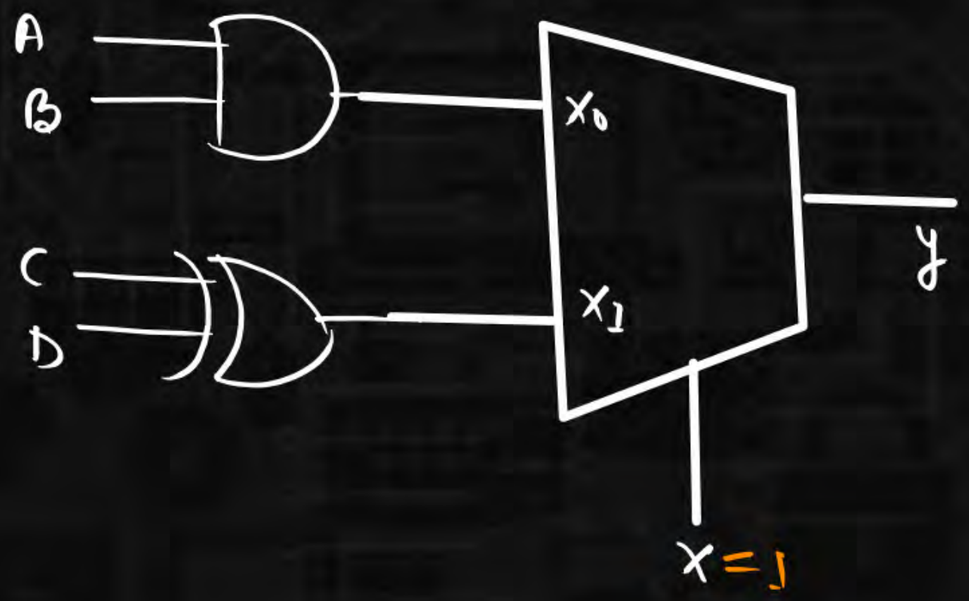
b) AB as a select line } 4x1 MUX

c) AC as a select line

Type- 6 Delay

$T_{AND} = 10\,\mu s$.
$T_{XOR} = 15\,\mu s$.
$T_{MUX} = 15\,\mu s$.

Ex.



for 'y' find the maximum and minimum Delay?

Case (1) $x = 0$

$T = T_{AND} + T_{MUX}$

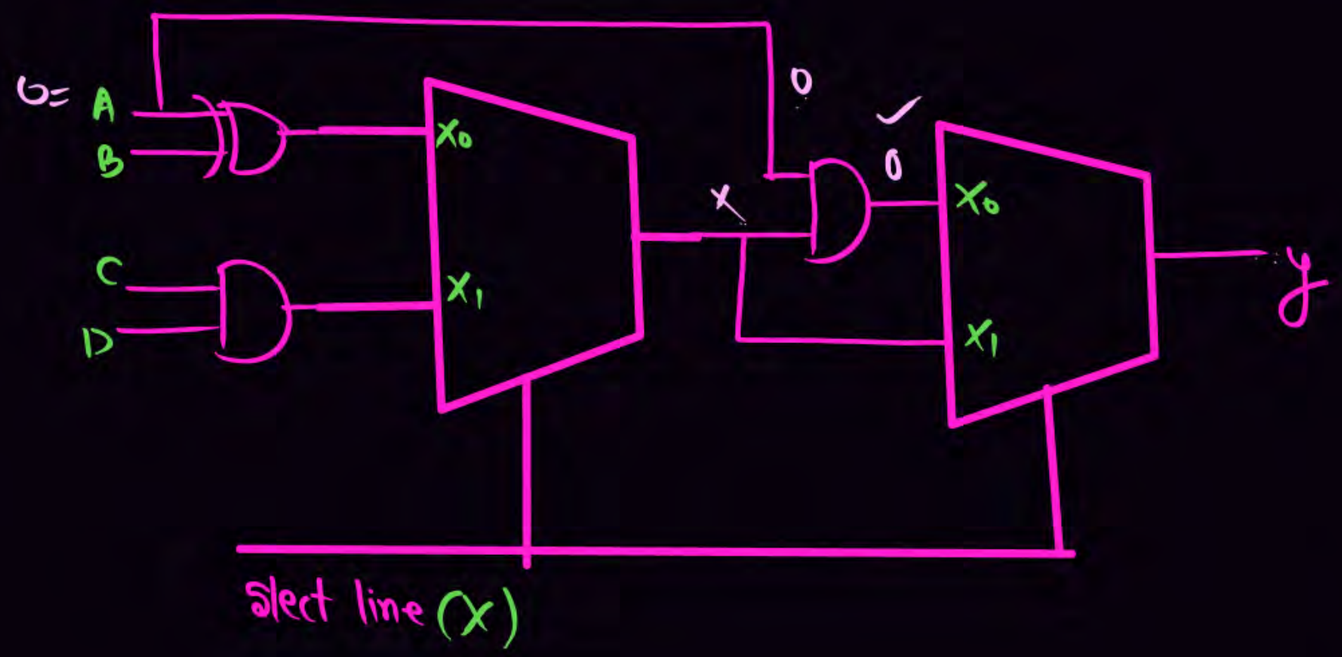
$= 10 + 15 = 25\,\mu s$

Case (2) $x = 1$

$T = T_{XOR} + T_{MUX}$

$T = 15 + 15 = 30\,\mu s$

Ex.



$T_{XOR} = 2\,\mu s$

$T_{AND} = 1\,\mu s$

$T_{MUX} = 2\,\mu s.$

case (1) $X = 0$

$T = T_{XOR} + T_{MUX} + T_{AND} + T_{MUX}$

$T = 2 + 2 + 1 + 2 = 7\,\mu s$

case(2) $X = 1$

$T = T_{AND} + T_{MUX} + T_{MUX}$

$= 1 + 2 + 2 = 5\,\mu s$

Q.

PYQ

The propagation delays of the XOR gate, AND gate multiplexer (MUX) in the circuit shown in the figure are 4 ns, 2 ns and 1 ns, respectively.

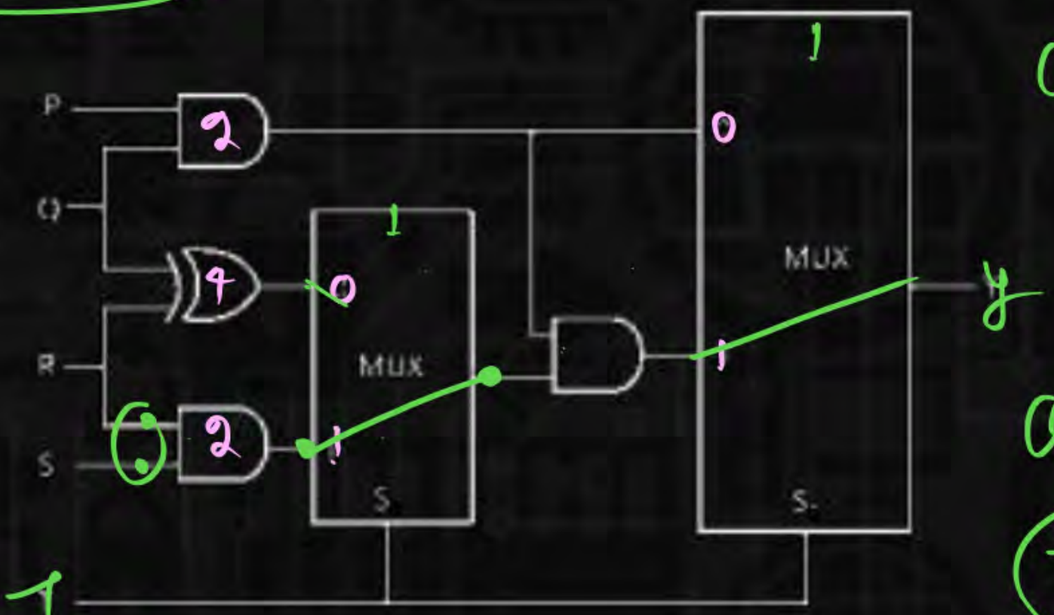
If all the inputs P, Q, R, S and T are applied simultaneously and held constant, the maximum propagation delay of the circuit is

A. 3ns

B. 6ns

C. 5ns

D. 7ns



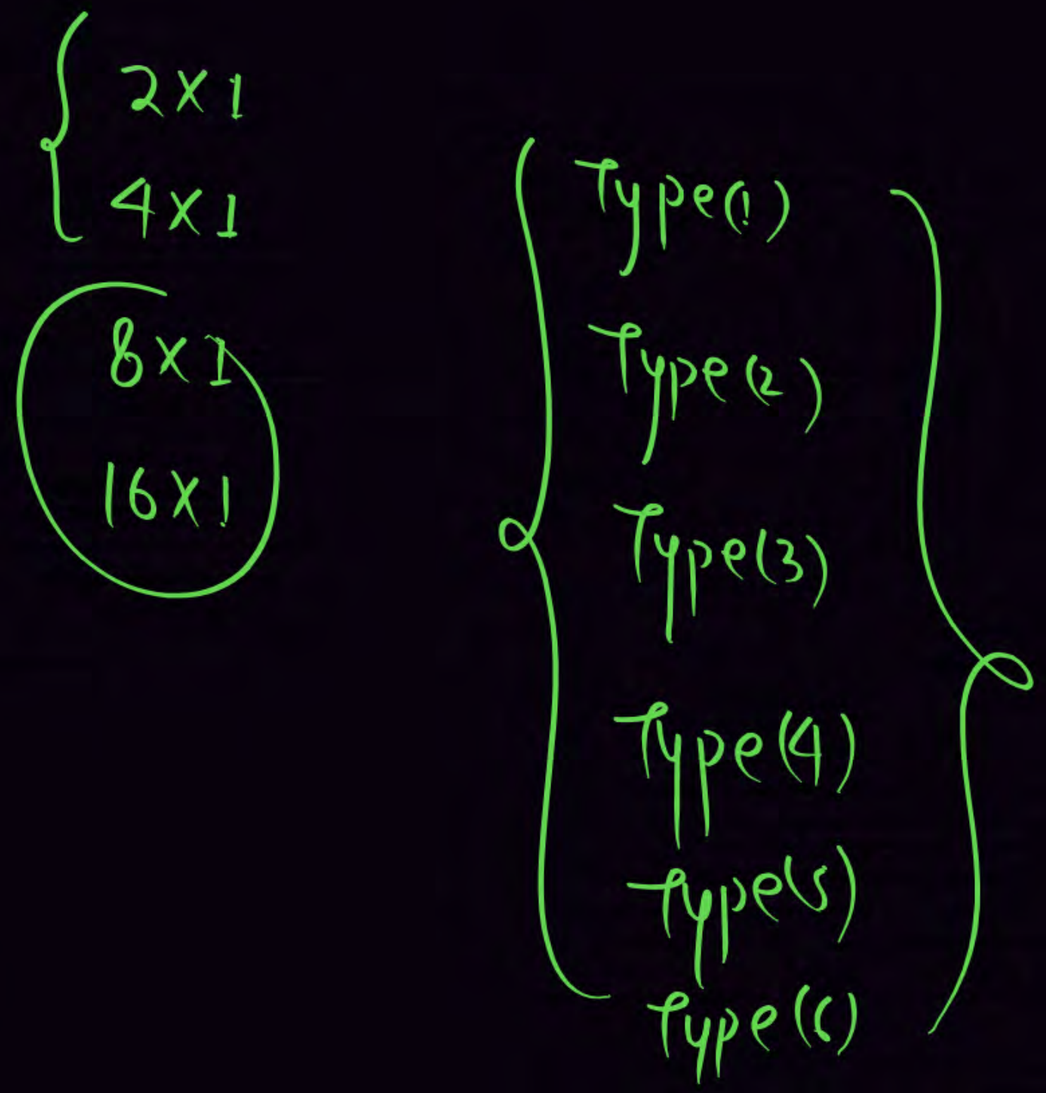
(E) Sir, Mujhe nahi ata, kyuki Mai Tare jameen par hu

Case(1) T=0

T = 3 ns

Case(2) T=1

T = 6 ns


2x1
4x1
8x1
16x1
Type(1)
Type(2)
Type(3)
Type(4)
Type(5)
Type(6)

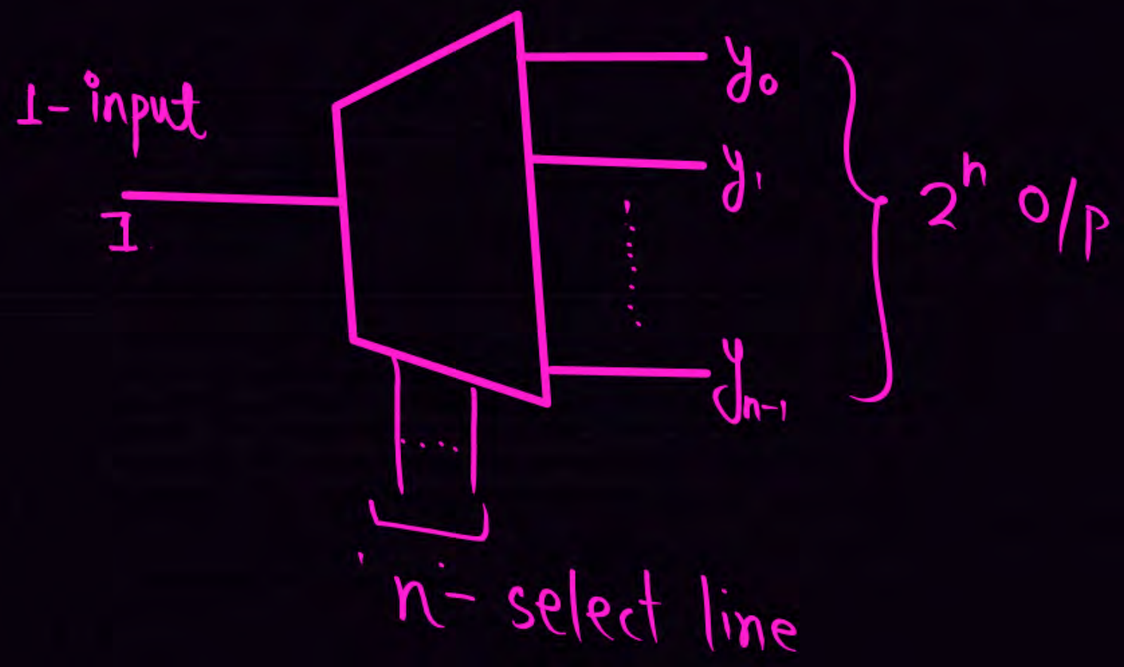
HALF Adder को बनाने के लिये कितने 2X1 MUX?

Sum = $A \oplus B = \bar{A}B + A\bar{B}$ ⟶ (2)

Carry = AB ⟶ (1)

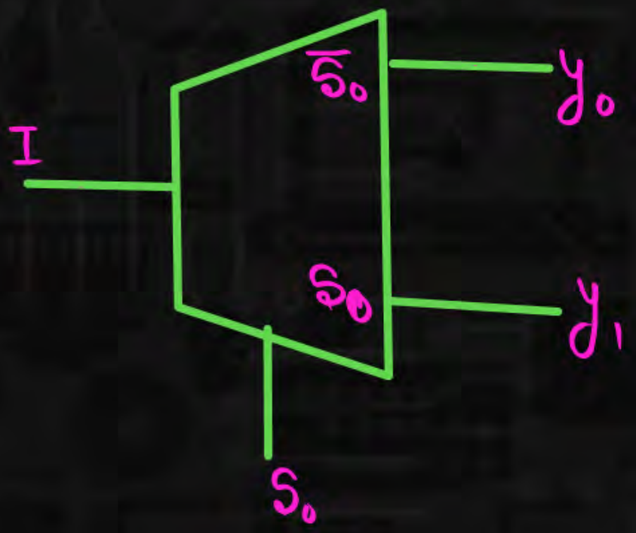
(2+1) = = = (3)

D-MUX



Q. Design a 1 × 2 DE-MUX?

Step 1 :-



Step 2 :

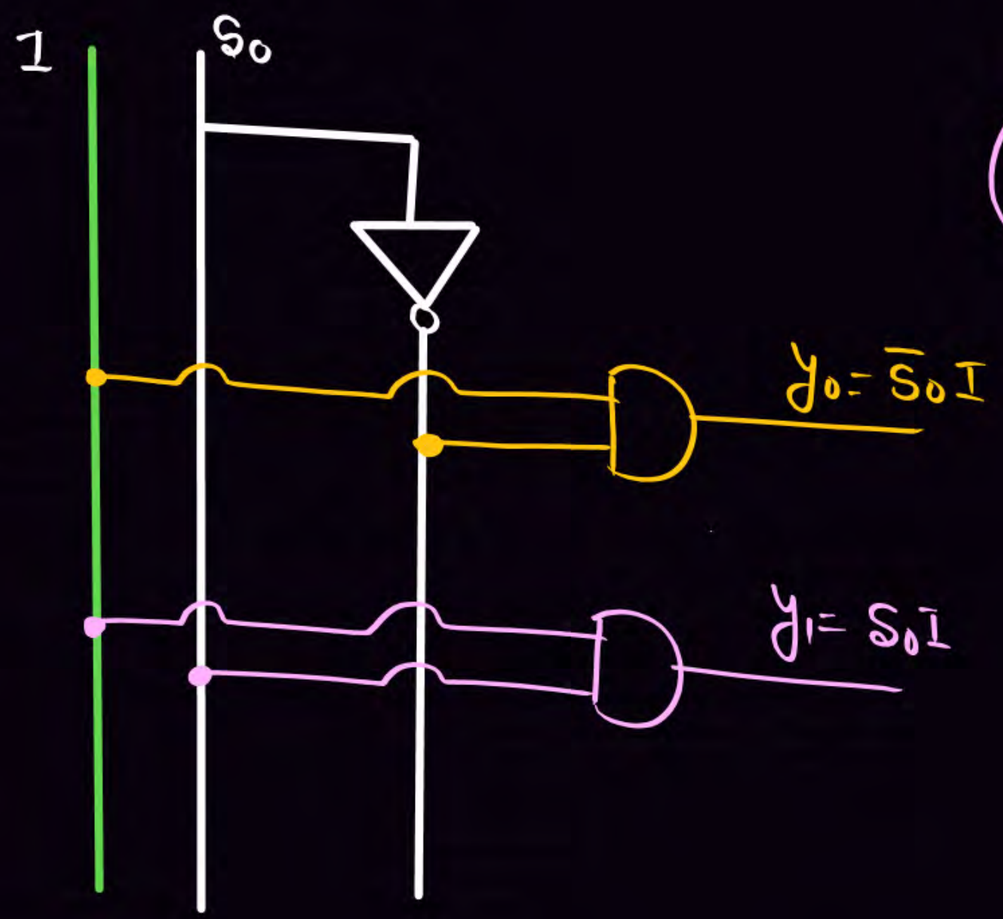
S_0	y_0	y_1
0	I	0
1	0	I

Step 3. $y_0 = \bar{S}_0 I$

$y_1 = S_0 I$

Step 4 : Minimization.

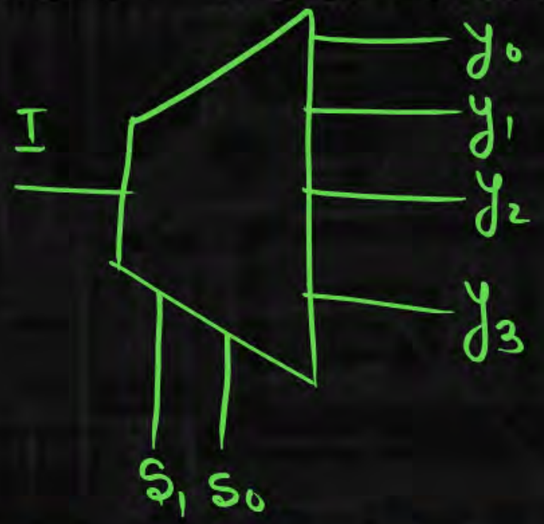
Step 5 $y_0 = \bar{S}_0 I$ $y_1 = S_0 I$



AND Logic

Q. Design a 1 × 4 DE-MUX?

Step 1 :→



Step 2.

S_1	S_0	y_0	y_1	y_2	y_3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

Step 3 : $y_0 = \bar{S}_1 \bar{S}_0 I$

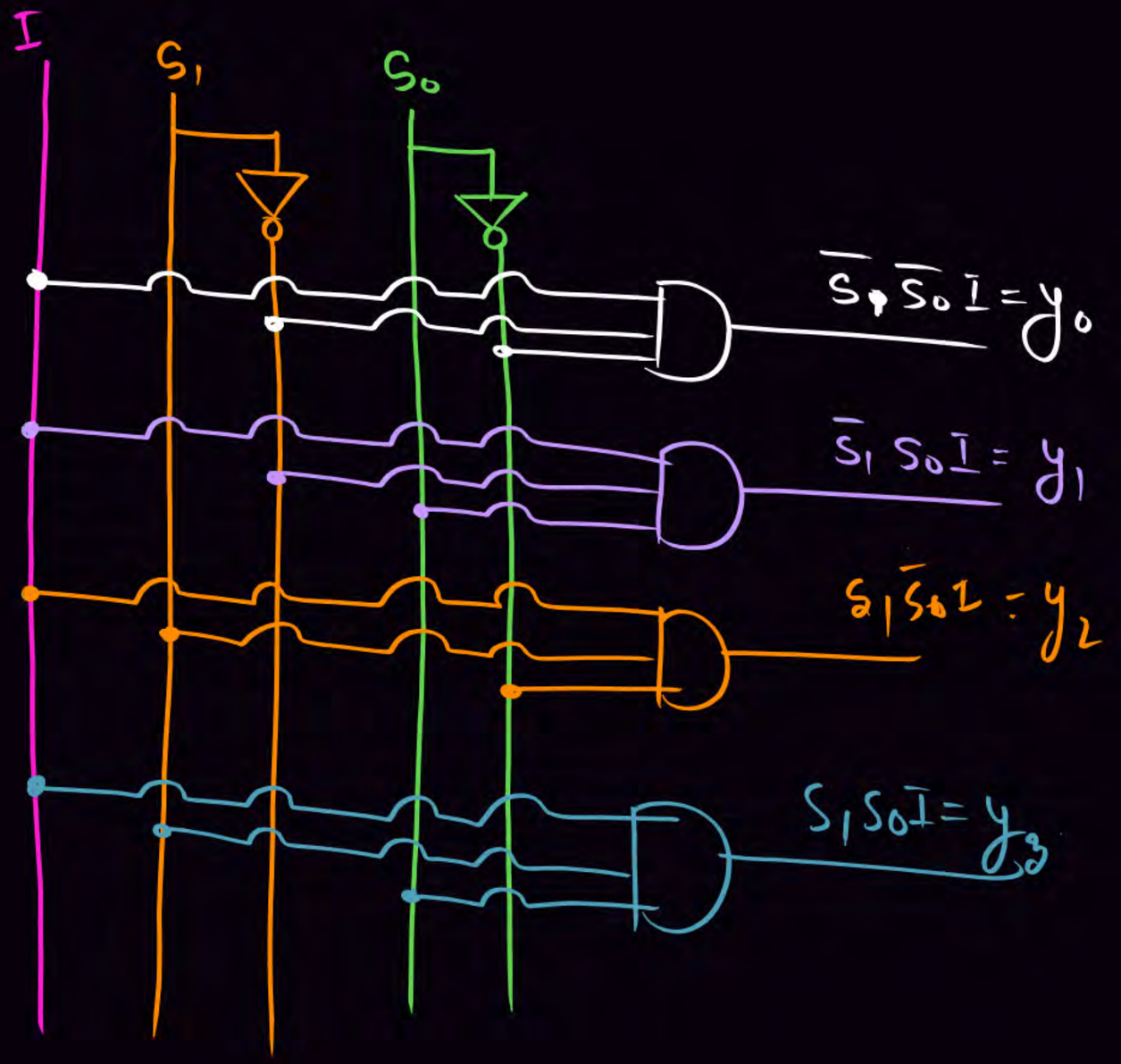
$y_1 = \bar{S}_1 S_0 I$

$y_2 = S_1 \bar{S}_0 I$

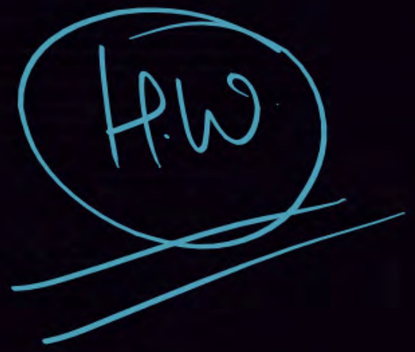
$y_3 = S_1 S_0 I$

Step 4.

Step 5:



- 1 x 8 De-MUX
- 1 x 16 De-MUX




THANK YOU GW
SOLDIERS !