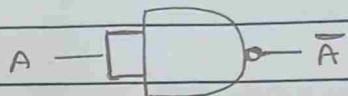


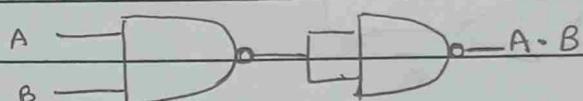
MISSION 1:-

(a) NOT gate



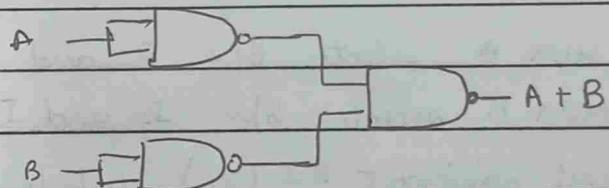
$$\bar{A} = \bar{A} \cdot A$$

(b) AND gate



$$A \cdot B = \overline{\overline{A} \cdot \overline{B}}$$

(c) OR gate



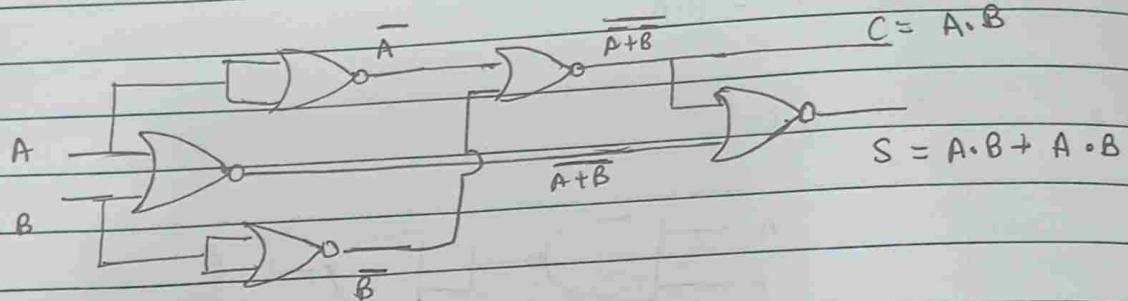
$$A + B = \overline{\overline{A} \cdot \overline{B}}$$

MISSION 2 :-

(a)	A	B	Sum	Carry
	0	0	0	0
	0	1	1	0
	1	0	1	0
	1	1	0	1

$$(b) \text{ sum bit (s)} = A \oplus B \\ = A \oplus B = A \cdot B + A \cdot \bar{B}$$

$$\text{carry bit (c)} = A \cdot B$$

(c)

### MISSION 3:

First level : MUX A selects b/w  $I_0$  and  $I_1$

(selection of b/w) MUX B selects b/w  $I_2$  and  $I_3$

Least significant Bit ( $s_0$ ) controls both MUX A & MUX B.

Second level : outputs of MUX A  $\Rightarrow$  inputs to third  
(final selection) and MUX B  $\Rightarrow$  2 to 1 MUX

$S_1, S_0$	MUX A output ( $Y_A$ )	MUX B $Y_B$	Y	Result
0 0	selects $I_0$	selects $I_1$	$Y_A$	$I_0$
0 1	selects $I_1$	" $I_3$	$Y_A$	$I_1$
1 0	selects $I_0$	" $I_2$	$Y_B$	$I_2$
1 1	selects $I_1$	" $I_3$	$Y_B$	$I_3$

MISSION 4:

(a) We need '2' D flip flops

Reasoning: A pattern detector for '111' needs to remember the sequence of the last few inputs. The state of the circuit should represent how much of the target pattern ("111") has been successfully matched so far.

- |                |                               |
|----------------|-------------------------------|
| S <sub>0</sub> | No 1s matched                 |
| S <sub>1</sub> | One consecutive '1' matched   |
| S <sub>2</sub> | Two consecutive '1's matched. |

This requires three distinct states (S<sub>0</sub>, S<sub>1</sub>, S<sub>2</sub>)

No. of flip flops for M states = N ;  $2^N \geq M$

(M=3)

$$\begin{array}{ll} 2^1 = 2 & (\times) \\ 2^2 = 4 & (\checkmark) \end{array}$$

Therefore N=2  $\Rightarrow$  Two D flip flops are required.

	state	Q <sub>1</sub> , Q <sub>0</sub>
S <sub>0</sub>		0 0
S <sub>1</sub>		0 1
S <sub>2</sub>		1 0
Unused		1 1

→

Q<sub>1</sub> (MSB), Q<sub>0</sub> (LSB) → outputs of two flip flops

state Table :

current state	$Q_1 Q_0$	Input X	Next state	$Q_1^+ Q_0^+$	output P
$S_0$	00	0	$S_0$	00	0
$S_0$	00	1	$S_1$	01	0
$S_1$	01	0	$S_0$	00	0
$S_1$	01	1	$S_2$	10	0
$S_2$	10	0	$S_0$	00	0
$S_2$	10	1	$S_2$	10	1
$S_3$	11	0	$S_0$	00	0
$S_3$	11	1	$S_0$	00	0

