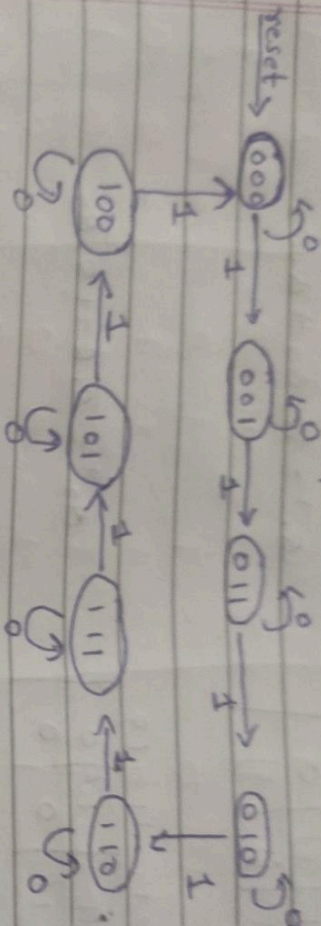


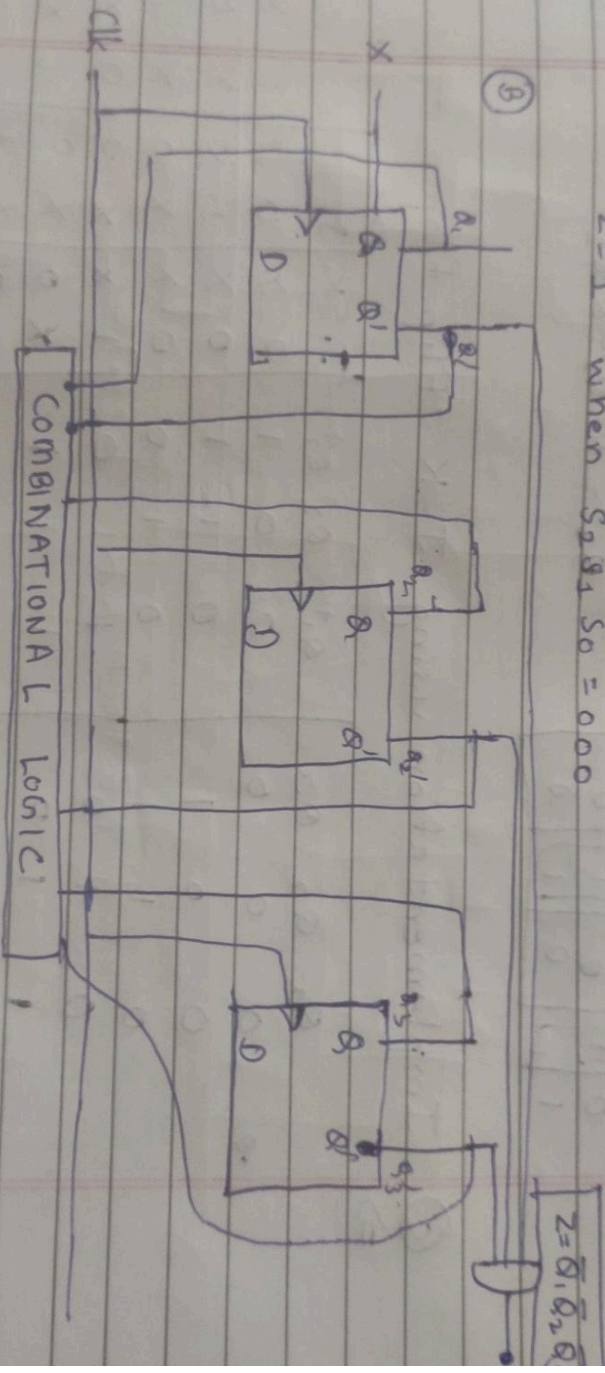
Q.1) a) Moore FSM:-

x-input, y-output



$Z=1$  when  $000$ ; else  $Z=0$ .

$Z=1$  when  $S_2 S_1 S_0 = 000$



Using DFF's

| $Q_1, Q_2, Q_3$ | $Q_1 + Q_2 + Q_3$ |
|-----------------|-------------------|
| 0 0 0           | 0                 |
| 0 0 1           | 0                 |
| 0 1 0           | 0                 |
| 0 1 1           | 0                 |
| 1 0 0           | 0                 |
| 1 0 1           | 1                 |
| 1 1 0           | 1                 |
| 1 1 1           | 1                 |



● K-map for  $Q_1^+, Q_2^+, Q_3^+$

(i)  $Q_3$   $Q_1, Q_2$

|   |    |    |    |    |
|---|----|----|----|----|
|   | 00 | 01 | 11 | 10 |
| 0 | 0  | 1  | 1  | 0  |
| 1 | 0  | 0  | 1  | 1  |

$$Q_1^+ = Q_2 \bar{Q}_3 + Q_1 Q_3$$

(ii)  $Q_3$   $Q_1, Q_2$

|   |    |    |    |    |
|---|----|----|----|----|
|   | 00 | 01 | 11 | 10 |
| 0 | 0  | 1  | 1  | 0  |
| 1 | 1  | 1  | 0  | 0  |

$$Q_2^+ = \bar{Q}_1 Q_3 + Q_2 \bar{Q}_3$$

(iii)  $Q_3$   $Q_1, Q_2$

|   |    |    |    |    |
|---|----|----|----|----|
|   | 00 | 01 | 11 | 10 |
| 0 | 1  | 0  | 1  | 0  |
| 1 | 1  | 0  | 1  | 0  |

$$Q_3^+ = \bar{Q}_1 \bar{Q}_2 + Q_1 Q_2$$

© Implementation using J-K Flip flops : -  
 $\Rightarrow$

| $Q_1$ | $Q_2$ | $Q_3$ | $Q_1^+$ | $Q_2^+$ | $Q_3^+$ | $J_1$ | $K_1$ | $J_2$ | $K_2$ | $J_3$ | $K_3$ |
|-------|-------|-------|---------|---------|---------|-------|-------|-------|-------|-------|-------|
| 0     | 0     | 0     | 0       | 0       | 1       | 0     | X     | 0     | X     | 1     | X     |
| 0     | 0     | 1     | 0       | 1       | 1       | 0     | X     | 1     | X     | X     | 0     |
| 0     | 1     | 1     | 0       | 1       | 0       | 0     | X     | X     | 0     | X     | 1     |
| 0     | 1     | 0     | 1       | 1       | 0       | 1     | X     | X     | 0     | 0     | X     |
| 1     | 1     | 0     | 1       | 1       | 1       | X     | 0     | X     | 0     | 1     | X     |
| 1     | 1     | 1     | 1       | 0       | 1       | X     | 0     | X     | 1     | X     | 0     |
| 1     | 0     | 1     | 1       | 0       | 0       | X     | 0     | 0     | X     | X     | 1     |
| 1     | 0     | 0     | 0       | 0       | 0       | X     | 1     | 0     | X     | 0     | X     |

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$$J_1 = Q_2 \bar{Q}_3$$

$$J_2 = \bar{Q}_1 Q_3$$

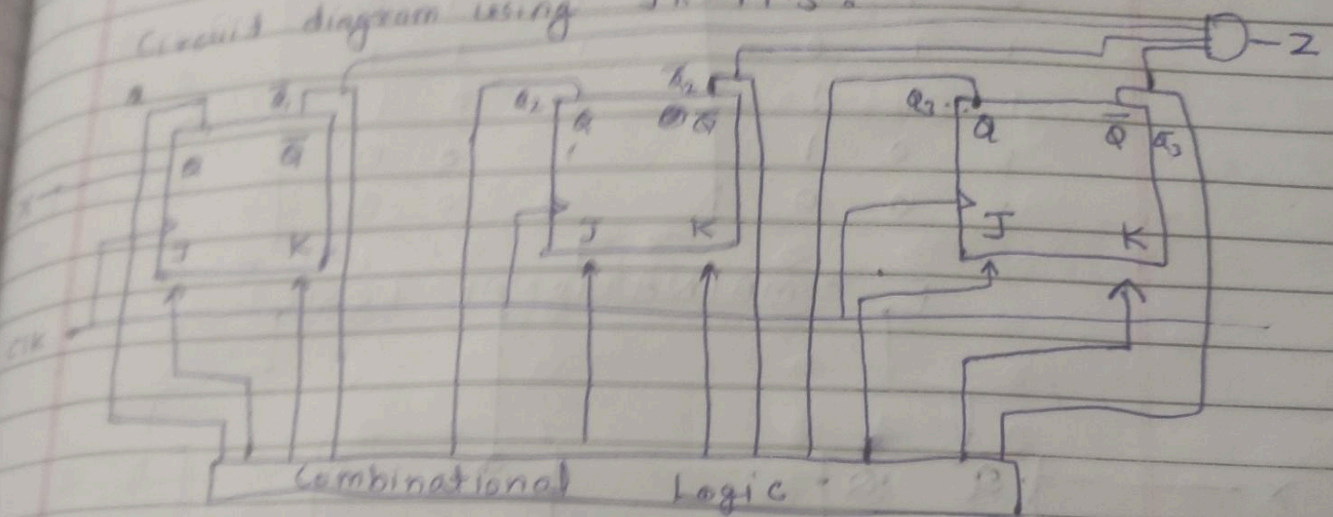
$$J_3 = \bar{Q}_1 \bar{Q}_2 + Q_1 Q_2$$

$$K_1 = \bar{Q}_2 \bar{Q}_3$$

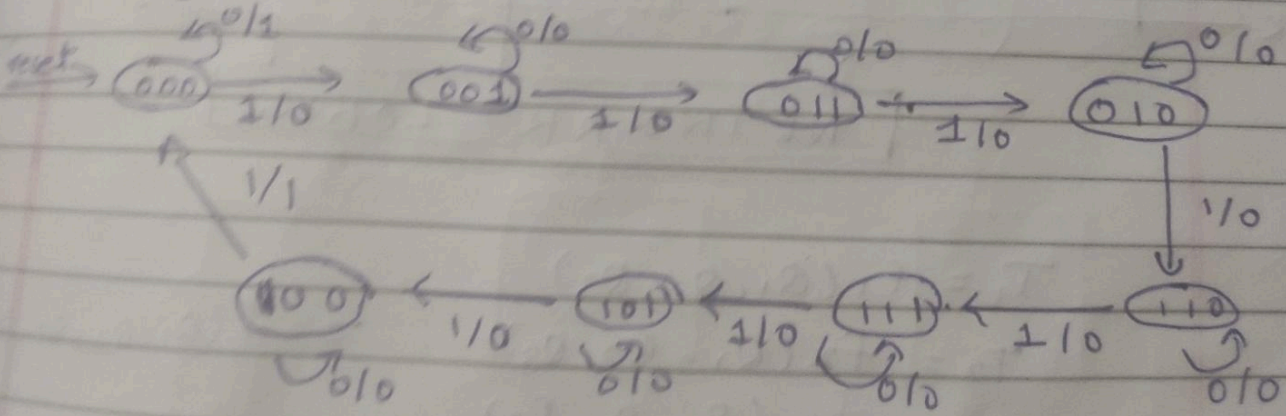
$$K_2 = Q_1 Q_3$$

$$K_3 = \bar{Q}_1 Q_2 + Q_1 \bar{Q}_2$$

Circuit diagram using JK FF's :-



Melay FSM

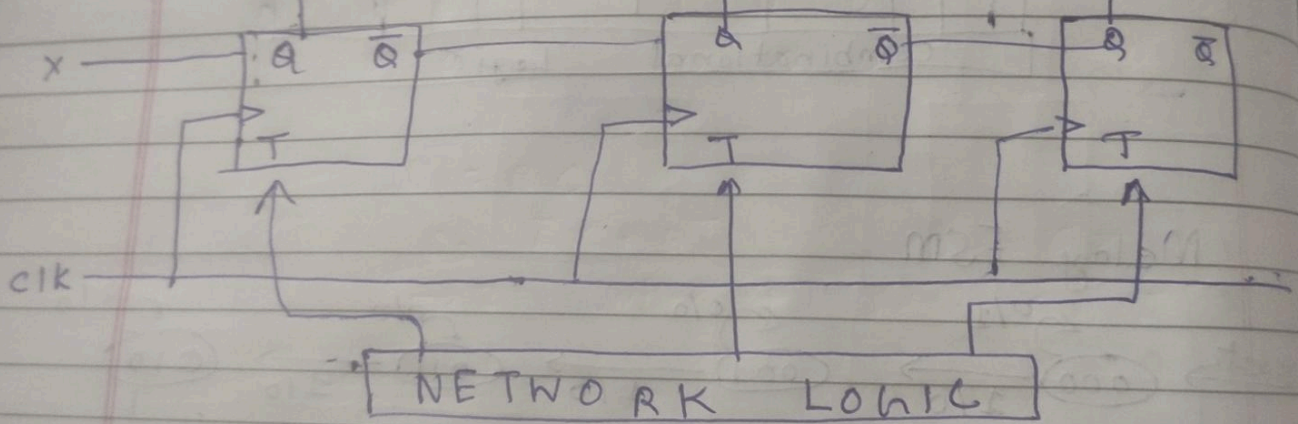




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| $Q_1^+$ | $Q_2^+$ | $Q_3^+$ | $T_1$ | $T_2$ | $T_3$ |
|---------|---------|---------|-------|-------|-------|
| 0       | 0       | 1       | 0     | 0     | 1     |
| 0       | 1       | 1       | 0     | 1     | 0     |
| 0       | 1       | 0       | 0     | 0     | 1     |
| 1       | 1       | 0       | 1     | 0     | 0     |
| 1       | 1       | 1       | 0     | 0     | 1     |
| 1       | 0       | 1       | 0     | 1     | 0     |
| 1       | 0       | 0       | 1     | 0     | 0     |

COMBINATIONAL LOGIC



$$T_1 = f_1(Q_1, Q_2, Q_3)$$

$$T_2 = f_2(Q_1, Q_2, Q_3)$$

$$T_3 = f_3(Q_1, Q_2, Q_3)$$

$$z = f(Q_1, Q_2, Q_3, x)$$

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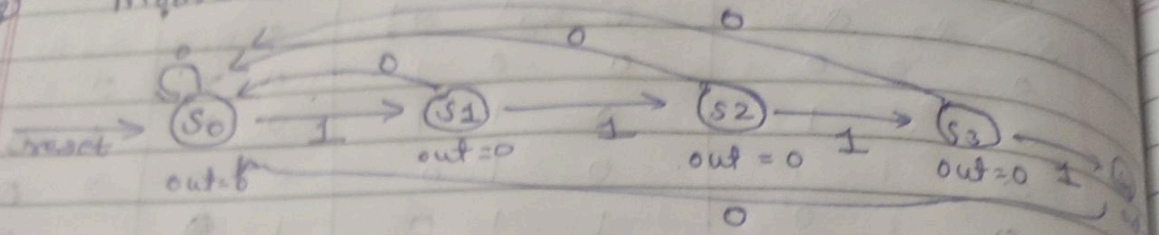
RS FF's :-

| $Q_1$ | $Q_2$ | $Q_3$ | $Q_1^+$ | $Q_2^+$ | $Q_3^+$ | $S_1 R_1$ | $S_2 R_2$ | $S_3 R_3$ |
|-------|-------|-------|---------|---------|---------|-----------|-----------|-----------|
| 0     | 0     | 0     | 0       | 0       | 1       | 0 X       | 0 X       | 1 0       |
| 0     | 0     | 1     | 0       | 1       | 1       | 0 X       | 1 0       | X 0       |
| 0     | 1     | 1     | 0       | 1       | 0       | 0 X       | X 0       | 0 1       |
| 0     | 1     | 0     | 1       | 1       | 0       | 1 0       | X 0       | 0 X       |
| 1     | 1     | 0     | 1       | 1       | 1       | X 0       | X 0       | 1 0       |
| 1     | 1     | 1     | 1       | 0       | 1       | X 0       | 0 1       | X 0       |
| 1     | 0     | 1     | 1       | 0       | 0       | X 0       | 0 X       | 0 1       |
| 1     | 0     | 0     | 0       | 0       | 0       | X 0       | 0 X       | 0 X       |

| S | R | $Q^+$ | S | R |
|---|---|-------|---|---|
| 0 | 0 | 0     | 0 | X |
| 0 | 1 | 0     | 1 | 0 |
| 1 | 0 | 1     | 0 | 1 |
| 1 | 1 | 1     | X | 0 |



Q.2) Moore FSM state diagram :-



Using D FFs :-

| A | B | C | A <sup>+</sup> | B <sup>+</sup> | C <sup>+</sup> | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> |
|---|---|---|----------------|----------------|----------------|----------------|----------------|----------------|
| 0 | 0 | 0 | 0              | 0              | 1              | 0              | 0              | 1              |
| 0 | 0 | 1 | 0              | 1              | 0              | 0              | 1              | 0              |
| 0 | 1 | 0 | 0              | 1              | 1              | 0              | 1              | 1              |
| 0 | 1 | 1 | 1              | 0              | 0              | 1              | 0              | 0              |
| 1 | 0 | 0 | 0              | 0              | 0              | 0              | 0              | 0              |

$$D_1 = B C$$

$$D_2 = \bar{B} C + B \bar{C}$$

$$D_3 = A \bar{C}$$

→ Z = 1 (when S4) i.e.  $A \bar{B} \bar{C}$

Combinational Logic

