Q:-1
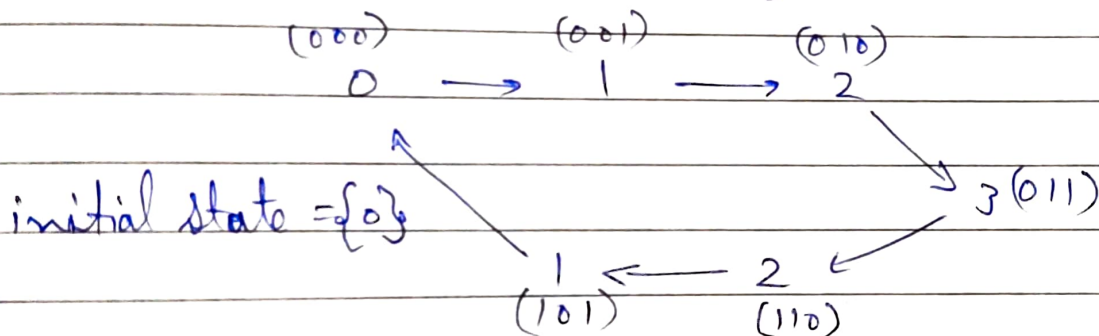
I = Input symbols - q_2 q_1 q_0,

This is extra to represent states distinctly.

O = output symbols = $\{0, 1\}$

States = $\{0, 1, 2, 3, 2', 1'\}$

These two can be considered as 2' and 1' & given different symbols from 2 and 1.

```
(000)        (001)        (010)
  0    →      1     →      2
```

initial state = $\{0\}$

```
                                    3 (011)
        1'   ←    2'   
       (101)     (110)
```

δ_1, δ_0 — state transition functions.

d_1, d_2 — output functions.

Mapping of states to symbols :-

	$q_2\ q_1\ q_0$	next state	δ_2	δ_1	δ_0
0	0 0 0	0 0 1	0	0	1
1	0 0 1	0 1 0	0	1	0
2	0 1 0	0 1 1	0	1	1
3	0 1 1	1 1 0	1	1	0
2	1 1 0	1 0 1	1	0	1
1	1 0 1	0 0 0	0	0	0

K-Map for δ_2 :-

q_2 \ $q_1 q_0$	00	01	11	10
0	0	0	1	0
1	X	0	X	1

$$\Rightarrow \delta_2 = q_1 . q_0 + q_2 . q_1$$

K-Map for δ_1 :-

q_2 \ $q_1 q_0$	00	01	11	10
0	0	1	1	1
1	X	0	X	0

$$\Rightarrow \delta_1 = \overline{q_2} . q_0 + \overline{q_2} . q_1$$
$$= \overline{q_2} . (q_1 + q_0)$$

K-Map for δ_0 :-

q_2 \ $q_1 q_0$	00	01	11	10
0	1	0	0	1
1	X	0	X	1

$$\Rightarrow \delta_0 = \overline{q_1} . \overline{q_0} + q_1 . \overline{q_0}$$
$$= \overline{q_0}$$

Outputs :- d_0 & d_1

K-Map for d_0 :-

q_2	q_1	q_0	y_1	y_0
0	0	0	0	0
0	0	1	0	1
0	1	0	1	0
0	1	1	1	1
1	1	0	1	0
1	0	1	0	1

d_1 d_0

K-Map for d_0 :-

q_2 \ $q_1 q_0$	00	01	11	10
0	0	1	1	0
1	X	1	X	0

$\Rightarrow d_0 = q_0$

K-Map for d_1 :-

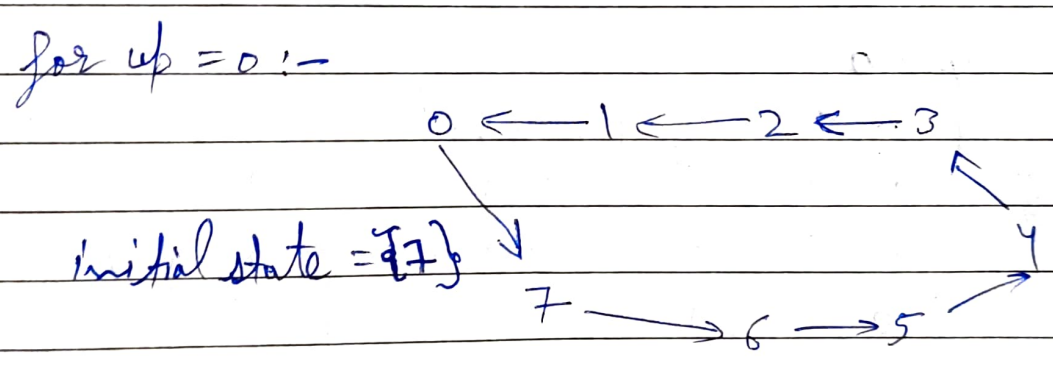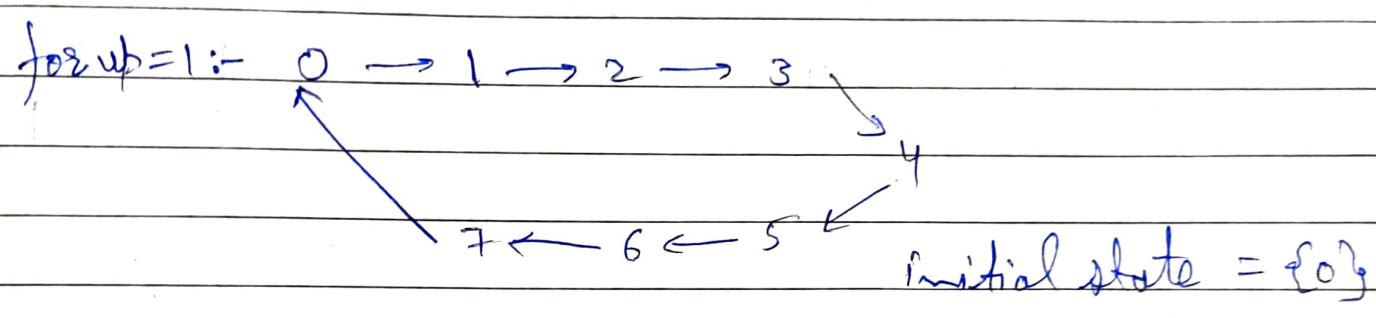| q_2 \ $q_1 q_0$	00	01	11	10
0	0	0	1	1
1	X	0	X	1

$\Rightarrow d_1 = q_1$

I = Input symbols = q_2, q, q_0

$\{000, 001, 010, 011, 100, 101, 110, 111\}$

O = output symbols = $\{0, 1\}$

states — $\{0, 1, 2, 3, 4, 5, 6, 7\}$

for up = 1 :-

initial state = $\{0\}$

for up = 0 :-

initial state = $\{7\}$

$\delta_2, \delta_1, \delta_0$ are state transition functions

$\lambda_2, \lambda_1, \lambda_0$ are outputs functions.

Mapping of states to symbols :-

for up = 1

	up q₂ q₁ q₀	next state	δ_2	δ_1	δ_0
0	1 0 0 0	001	0	0	1
1	1 0 0 1	010	0	1	0
2	1 0 1 0	011	0	1	1
3	1 0 1 1	100	1	0	0
4	1 1 0 0	101	1	0	1
5	1 1 0 1	110	1	1	0
6	1 1 1 0	111	1	1	1
7	1 1 1 1	000	0	0	0

~~K-Map for δ_2~~ :-

for up = 0

	up q₂ q₁ q₀	next state	δ_2	δ_1	δ_0
7	0 1 1 1	110	1	1	0
6	0 1 1 0	101	1	0	1
5	0 1 0 1	100	1	0	0
4	0 1 0 0	011	0	1	1
3	0 0 1 1	010	0	1	0
2	0 0 1 0	001	0	0	1
1	0 0 0 1	000	0	0	0
0	0 0 0 0	111	1	1	1

Let up = w

K-Map for δ_2 :-

wq_2 \ $q_1 q_0$	00	01	11	10
00	1	0	0	0
01	0	1	1	1
11	1	1	0	1
10	0	0	1	0

$$\Rightarrow \delta_2 = \overline{w}\,\overline{q_2}\,\overline{q_1}\,\overline{q_0} + \overline{w}\,q_2\,q_0 +$$
$$q_2\,q_1\,\overline{q_0} + w\,q_2\,\overline{q_1} +$$
$$w\,\overline{q_2}\,q_1\,q_0$$

K-Map for δ_1 :-

wq_2 \ $q_1 q_0$	00	01	11	10
00	1	0	1	0
01	1	0	1	0
11	0	1	0	1
10	0	1	0	1

$$\Rightarrow \delta_1 = \overline{w}\,\overline{q_1}\,\overline{q_0} + \overline{w}\,q_1\,q_0 +$$
$$w\,\overline{q_1}\,q_0 + w\,q_1\,\overline{q_0}$$
$$= w\cdot(q_1 \oplus q_0) + \overline{w}\cdot(\overline{q_1} \oplus q_0)$$
$$= \overline{w} \oplus q_1 \oplus q_0$$

K-Map for δ_0 :-

wq_2 \ $q_1 q_0$	00	01	11	10
00	1	0	0	1
01	1	0	0	1
11	1	0	0	1
10	1	0	0	1

$$\Rightarrow \delta_0 = \overline{q_0}$$

and finally,

$$N_0 = q_0$$
$$N_1 = q_1$$
$$d_2 = q_2$$