

Q.1:

number:

0 1 2 3 2 1 2 3 4 5 6 5 4 3 2 1 0

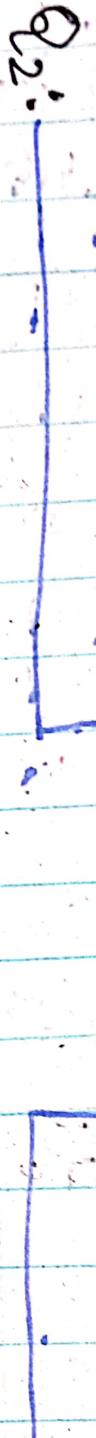
Q<sub>0</sub>:



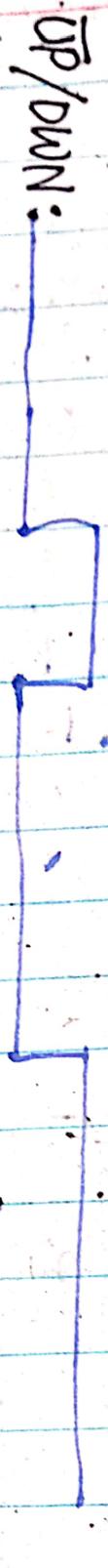
Q<sub>1</sub>:



Q<sub>2</sub>:



UP/DWN:



CLK:



Q.2:

Q<sub>3</sub>:

Q<sub>2</sub>:

Q<sub>1</sub>:

Q<sub>0</sub>:

0 1 2 1 0 0 9 9 8 9 0 1 0 1 2

Q<sub>0</sub>

+ starting with D

Present		D <sub>0</sub>	D <sub>1</sub>	D <sub>2</sub>	Next	
Q <sub>0</sub>	Q <sub>1</sub>	Q <sub>2</sub>	<u>Q<sub>1</sub>, Q<sub>2</sub></u>	Q <sub>0</sub>	Q <sub>1</sub>	Q <sub>0</sub>
0	0	0	1	0	0	1
1	0	0	1	1	0	1
1	1	0	1	1	1	1
1	1	1	0	1	1	1
0	1	1	0	0	1	0
0	0	1	1	0	0	1
1	0	0	1	1	0	1

Repeating ...

$Q_5$

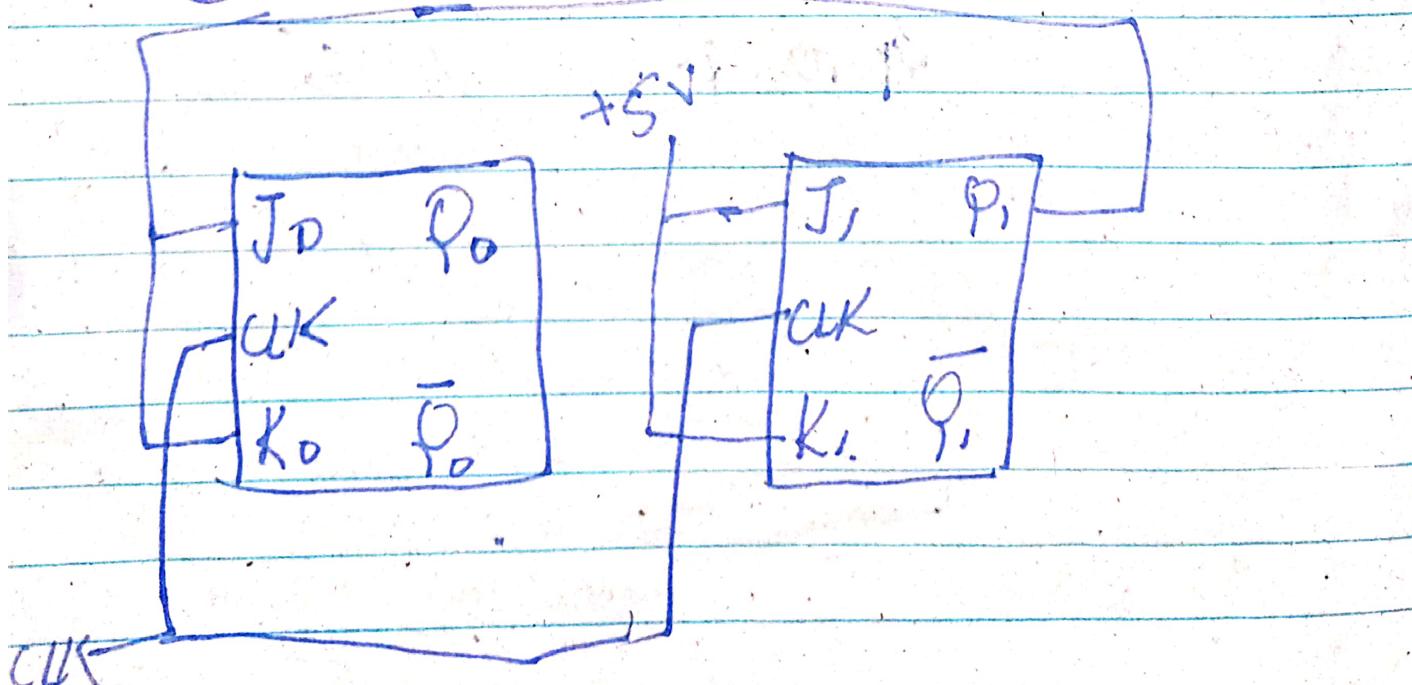
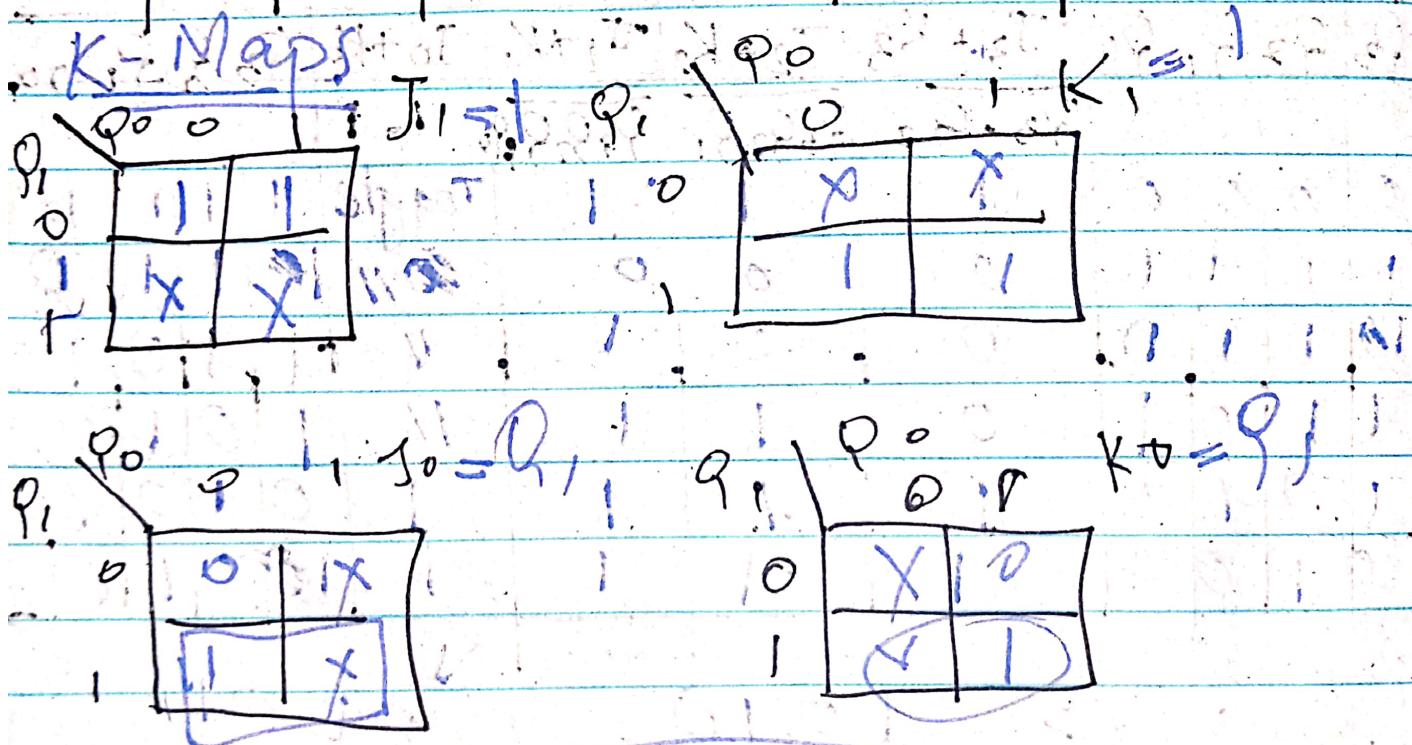
$Q_3$	$Q_2$	$Q_1$	$Q_0$	$J_3 + K_3$	$J_2 + K_2$	$J_1 + K_1$	$J_0 + K_0$	$Q_3$	$Q_2$	$Q_1$	$Q_0$
				$\overline{Q_3 \cdot Q_2}$	$\overline{Q_3 Q_2 Q_1}$	$\overline{Q_3 Q_2 Q_1 Q_0}$	1 - 1				
0	0	0	0	1	1	1	1	Toggle	1	1	1
1	1	1	1	0	0	0	0	11	10	1	1
10	1	1	0	0	0	1	1	11	11	0	1
1	1	0	1	0	1	1	1	11	1	0	1
10	1	0	0	1	1	1	1	1	0	1	0
01	0	1	1	1	1	1	1	1	10	0	1

$\Rightarrow 1010 \rightarrow 0101$

$\text{Ex } 10 R \rightarrow 15$

S.6 00, 10, 01, 11, 00

Present		Next		Inputs			
$Q_1$	$Q_0$	$Q_1$	$Q_0$	$J_0$	$K_1$	$J_0$	$K_0$
0	0	1	0	1	X	0	X
1	0	0	1	X	1	1	X
0	1	1	1	1	X	X	0
1	1	0	0	X	1	X	1
0	0	..	..				



Q<sub>0</sub> 7 1, 4, 3, 5, 7, 6, 2, 1

Present			Next			Inputs					
Q <sub>2</sub>	Q <sub>1</sub>	Q <sub>0</sub>	Q <sub>2</sub>	Q <sub>1</sub>	Q <sub>0</sub>	J <sub>2</sub>	K <sub>2</sub>	J <sub>1</sub>	K <sub>1</sub>	J <sub>0</sub>	K <sub>0</sub>
0	0	1	1	0	0	1	X	0	X	X	1
1	0	0	0	1	1	X	1	X	1	X	0
0	1	1	1	0	1	1	X	1	X	0	0
1	0	1	1	1	1	X	0	1	X	0	0
1	1	1	1	1	1	0	X	0	X	1	1
1	1	0	0	1	0	X	1	X	0	0	X
0	1	0	0	0	1	0	X	X	1	1	X
0	0	1	.	.	.	.	.	.	.	.	.

K = M <sub>1</sub> Q <sub>25</sub>		Q <sub>0</sub> Q <sub>2</sub>		0 1 1 1 1 0	
a	b	c	d	e	f
1	1	0	1	1	0
1	0	1	0	1	1
0	1	1	1	0	1
0	0	1	1	1	0
1	1	0	0	1	1
0	0	1	1	1	0

$$J_2 = Q_1 \oplus Q_0$$

$$K_2 = Q_1$$

X	1	1	0
X	X	X	X

X	V	V	X
1	0	0	1

Q <sub>0</sub> Q <sub>2</sub>	0 0	0 1	1 0	1 1	1 0
0 0	a	b	c	d	e

$$J_1 = Q_0$$

$$K_1 = Q_0$$

0	X	0	X	X
1	1	X	X	X

0	X	1	1
1	X	0	0

0	X	X	X	1
1	1	X	X	0

$$K_0 = \bar{Q}_2 \cdot \bar{Q}_0 + Q_2 \cdot Q_0$$

0	X	1	0	X
1	X	0	1	X

$Q_2 Q_1$	00	01	11	10
$J_2 = Q_0$	X	g	f	b
$J_1 = Q_2$	a	c	c	d

X	0	X	X
J	1	X	X

X	X	X	X
X	X	0	0

$$J_1 = Q_2$$

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

X	X	X	1
0	X	X	1

X	1	0	X
X	1	0	X

$$J_0 = \bar{Q}_2 Q_1 + \bar{Q}_1$$

$$K_0 = \bar{Q}_2 Q_1 + Q_2 Q_1$$

X	1	0	1
X	X	X	X

X	X	X	X
1	0	1	0

$$Q_8: 0, 9, 1, 8, 2, 7, 3, 6, 4, 5, 0$$

Present

Next

Inputs:

$Q_3 Q_2 Q_1 Q_0$	$Q_3 Q_2 Q_1 Q_0$	$J_3 K_3$	$J_2 K_2$	$J_1 K_1$	$J_0 K_0$
0 0 0 0	1 0 0 1	1 X	0 X	0 X	1 X
1 0 0 1	0 0 0 1	X 1	0 X	0 V	X 0
0 0 0 1	1 0 0 0	1 X	0 X	0 X	X 1
1 0 0 0	0 0 1 0	X 1	0 X	1 X	0 0
0 0 1 0	0 1 1 1	D X	1 X	Y D	X
0 1 1 1	0 0 1 1	0 X	X 1	V D	X D
0 0 1 1	0 1 1 0	0 X	1 X	X D	X 0 X
0 1 1 0	0 1 0 0	0 X	V D	X 1	0 X
0 1 0 0	0 1 0 1	0 X	X D	0 X	1 X
0 1 0 1	0 0 0 0	0 X	1 X	0 X	X 1

Q <sub>3</sub> Q <sub>2</sub> Q <sub>1</sub>	000	001	111	110
a	c	g	e	f
i	j	f	h	d
x	x	x	x	x

K-Map S = 01

Q <sub>3</sub> Q <sub>2</sub> Q <sub>1</sub>	000	001	111	110
a	c	g	e	f
i	j	f	h	d
x	x	x	x	x

$$J_3 = \bar{Q}_2 \cdot Q_1$$

1	1	0	0
0	0	0	0
x	x	x	x
x	x	x	x

$$K_3 = 1$$

K <sub>3</sub>	X	X	X	X
x	x	x	x	x
1	1	y	x	

$$J_1 = Q_3 \cdot Q_0$$

J <sub>1</sub>	0	0	x	x
0	0	x	x	x
x	x	x	x	x
1	0	x	x	x

$$J_0 = \bar{Q}_2 \bar{Q}_1 + Q_3 \bar{Q}_1$$

J <sub>0</sub>	x	x		
1	x	x	0	
x	x	x	x	
0	x	x	x	

$$K_2 = Q_1$$

K <sub>2</sub>	0	0	1	1
x	x	x	x	x
x	x	x	x	x
0	0	x	x	x

$$K_2 = Q_1 \cdot Q_0$$

K <sub>2</sub>	x	x	x	x
0	x	x	x	x
x	x	x	x	x
x	x	x	x	x

$$K_1 = \bar{Q}_0 \cdot Q_2$$

K <sub>1</sub>	x	y	0	0
y	x	0	0	
x	x	x	x	
x	x	x	x	

$$K_0 = Q_5 \bar{S}_0$$

K <sub>0</sub>	x	1	x	
y	1	0	x	
y	y	x	0	
x	0	x	x	

<u>Q<sub>3</sub></u>	Present	Next	Inputs
D	Q <sub>3</sub> Q <sub>2</sub> Q <sub>1</sub> Q <sub>0</sub>	D Q <sub>3</sub> Q <sub>2</sub> Q <sub>1</sub> Q <sub>0</sub>	D <sub>3</sub> D <sub>2</sub> D <sub>1</sub> D <sub>0</sub>
0	0 0 0 0	0 0 0 1	0 0 1 1
0	0 0 1 1	0 0 1 1	0 1 0 1
0	0 1 0 1	0 0 1 1	0 1 1 1
0	0 1 1 1	0 1 0 1	1 0 0 1
0	1 0 0 1	0 0 1 1	1 0 1 1
0	1 0 1 1	0 0 0 0	0 0 0 0
1	0 0 0 0	1 0 1 1	0 1 1 1
1	1 0 1 1	1 1 0 0	0 0 0 1
1	1 1 0 0	0 0 1 1	0 1 1 1
1	0 1 1 1	0 1 0 1	0 1 0 1
1	0 1 0 1	1 0 0 1	0 1 0 1
1	0 0 1 1	1 0 0 0	0 0 0 0

$$\bar{D}(\bar{Q}_3\bar{Q}_4Q_0 + \bar{Q}_3\bar{Q}_1Q_0) + D(Q_2Q_1 + \bar{Q}_2\bar{Q}_3\bar{Q}_1)$$

$$D_2 =$$

$$D=0$$

$$D=1$$

0	x	1	*
x	1	0	*
0	0	0	*
0	0	0	x

0	x	0	*
0	0	0	*
0	0	1	*
0	0	0	*

$$D_{21} = \bar{Q}_1$$

1	x	0	x
x	1	0	x
0	x	x	x
x	1	0	x

1	x	0	1	x
x	1	0	0	x
0	x	1	1	x
x	1	0	0	x

$$D_0 =$$

1	0	1	0
0	1	0	0
0	0	0	0
0	1	0	0

1	0	1	0
0	1	1	0
0	0	0	0
0	1	1	0

$$D_0 = Q_1 + D(Q_2 + Q_3) + \bar{D} \cdot \bar{Q}_3$$

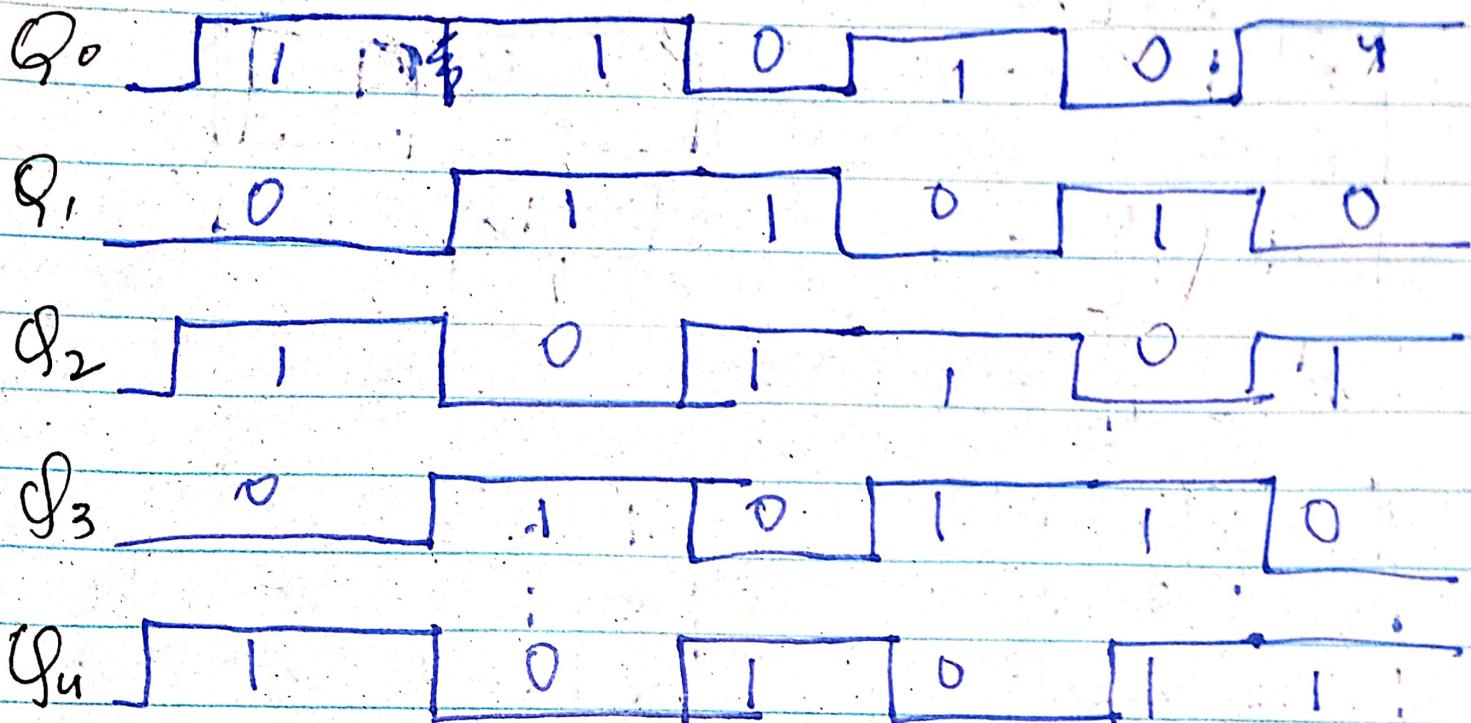
$$D_3 = \bar{D}(Q_2Q_1 + \bar{Q}_2\bar{Q}_1Q_0) + D(Q_3Q_1 + \bar{Q}_3\bar{Q}_2\bar{Q}_1)$$

0	0	0	0
0	0	1	0
0	0	0	0
0	1	0	0

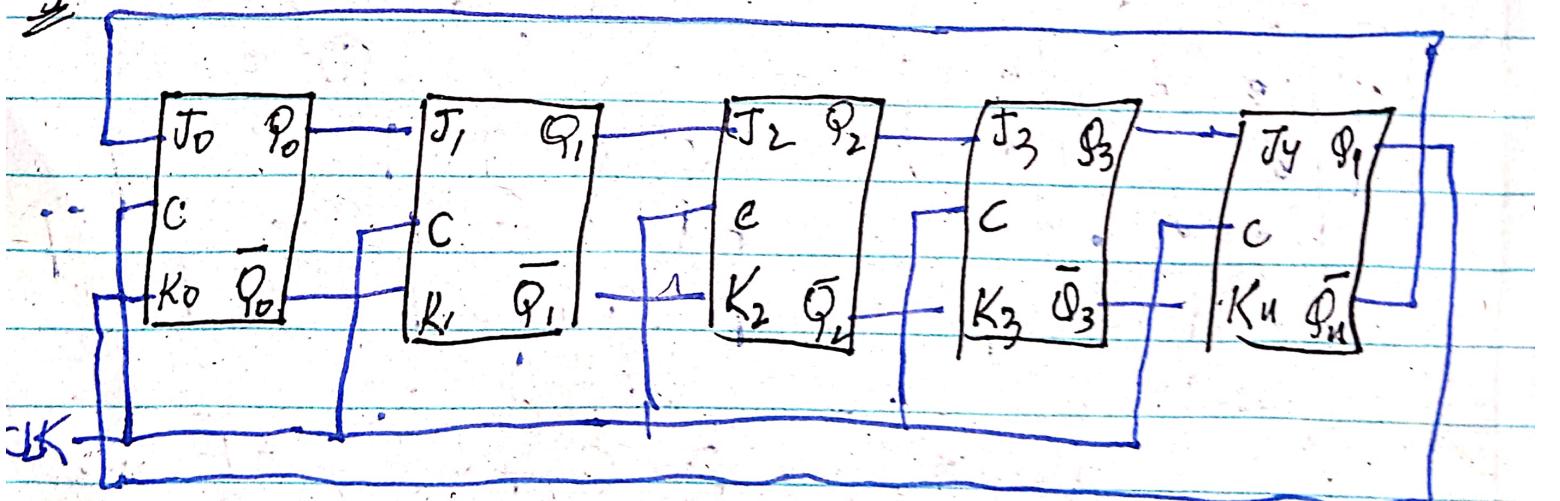
1	0	0	0
0	1	0	0
0	0	0	0
0	1	0	0

Q.11

CLK



Q.12



No.  $q_0$   $q_1$   $q_2$   $q_3$   $q_4$

0 0 0 0 0 0

1 1 0 0 0 0

2 1 1 0 0 0

3 1 1 1 0 0

4 1 ( ) 1 0

5 1 1 1 1 1

6 0 1 1 1 1 1

7 0 0 1 1 1 1

8 0 0 0 1 1 1

9 0 0 0 0 1 1