Example 9.14 : *Design a non-sequential counter using J-K flip-flop; as per following state diagram.*

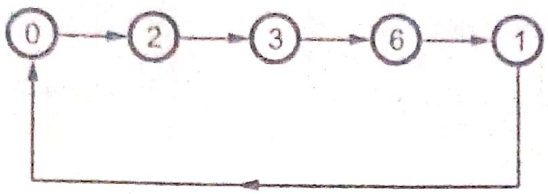

Fig. 9.69

Solution : Excitation table

Present state			Next state			Flip-flop inputs					
Q_A	Q_B	Q_C	Q'_A	Q'_B	Q'_C	J_A	K_A	J_B	K_B	J_C	K_C
0	0	0	0	1	0	0	x	1	x	0	x
0	0	1	0	0	0	0	x	0	x	x	1
0	1	0	0	1	1	0	x	x	0	1	x
0	1	1	1	1	0	1	x	x	0	x	1
1	0	0	x	x	x	x	x	x	x	x	x
1	0	1	x	x	x	x	x	x	x	x	x
1	1	0	0	0	1	x	1	x	1	1	x
1	1	1	x	x	x	x	x	x	x	x	x

K-map simplification

For J_A

Q_A \ Q_BQ_C	00	01	11	10
0	0	0	1	0
1	X	X	X	X

$J_A = Q_B Q_C$

For K_A

Q_A \ Q_BQ_C	00	01	11	10
0	X	X	X	X
1	X	X	X	1

$K_A = 1$

For J_B

Q_A \ Q_BQ_C	00	01	11	10
0	1	0	X	X
1	X	X	X	X

$J_B = \overline{Q}_C$

For K_B

Q_A \ Q_BQ_C	00	01	11	10
0	X	X	0	0
1	X	X	X	1

$K_B = Q_A$

For J_C

Q_A \ Q_BQ_C	00	01	11	10
0	0	X	X	1
1	X	X	X	1

$J_C = Q_B$

For K_C

Q_A \ Q_BQ_C	00	01	11	10
0	X	1	1	X
1	X	X	X	X

$K_C = 1$

Logic diagram

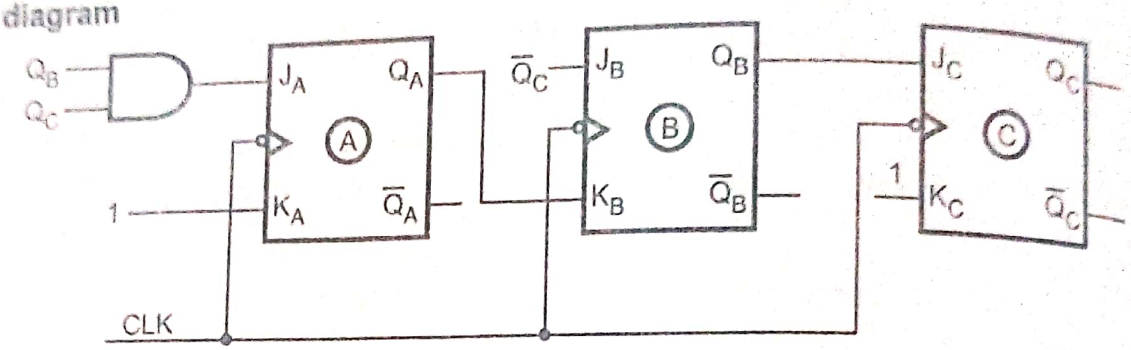

Fig. 9.70

Example 9.15 : *Design the circuit to generate the sequence :*

$0 \rightarrow 2 \rightarrow 5 \rightarrow 4 \rightarrow 7 \rightarrow 3.$

Solution : Excitation table

Present state			Next state			Flip-flop inputs					
Q_A	Q_B	Q_C	Q_{A+1}	Q_{B+1}	Q_{C+1}	J_A	K_A	J_B	K_B	J_C	K_C
0	0	0	0	1	0	0	X	1	X	0	X
0	0	1	X	X	X	X	X	X	X	X	X
0	1	0	1	0	1	1	X	X	1	1	X
0	1	1	0	0	0	0	X	X	1	X	1
1	0	0	1	1	1	X	0	1	X	1	X
1	0	1	1	0	0	X	0	0	X	X	1
1	1	0	X	X	X	X	X	X	X	X	X
1	1	1	0	1	1	X	1	X	0	X	0

K-map simplification

For J_A

Q_A \ Q_BQ_C	00	01	11	10
0	0 (0)	X (1)	0 (3)	1 (2)
1	X (4)	X (5)	X (7)	X (6)

$J_A = Q_B\overline{Q}_C$

For K_A

Q_A \ Q_BQ_C	00	01	11	10
0	X (0)	X (1)	X (3)	X (2)
1	0 (4)	0 (5)	1 (7)	X (6)

$K_A = Q_B$

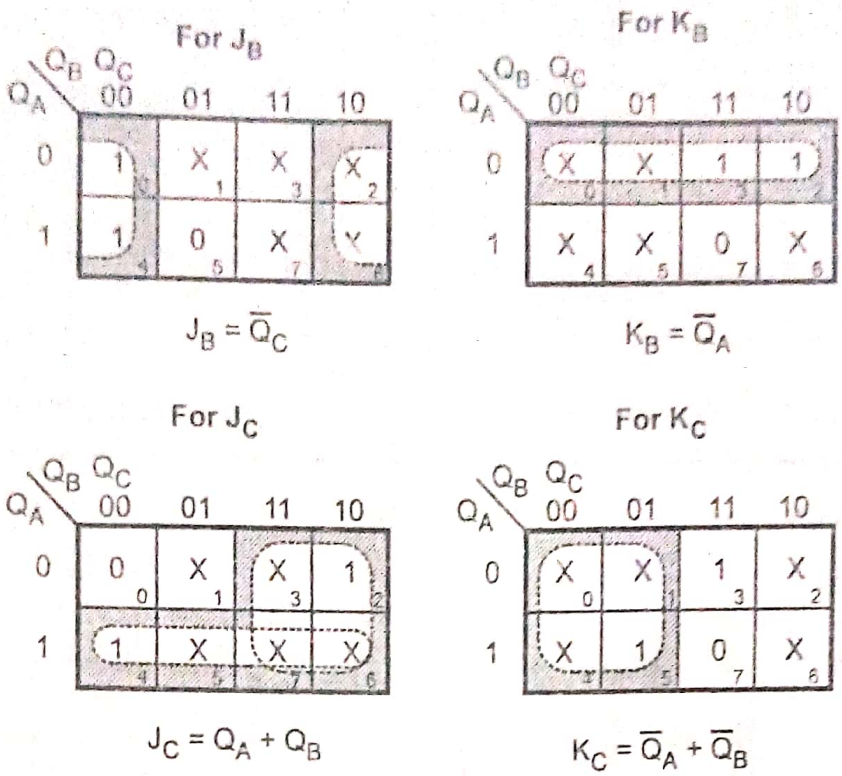

Fig. 9.71

Logic diagram

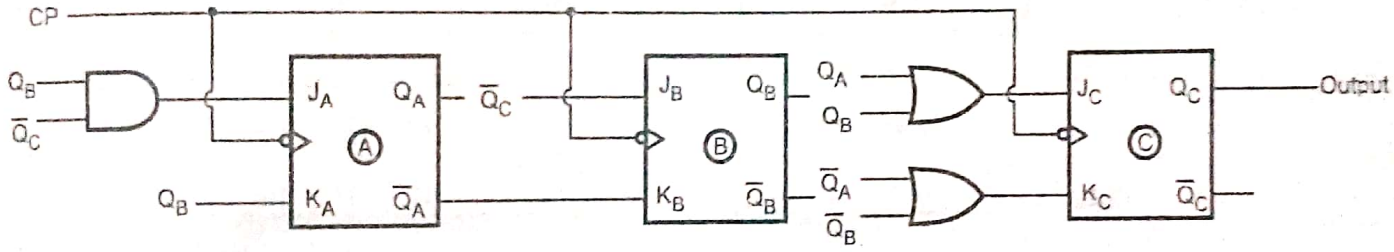

Fig. 9.72

Example 9.16 : *Design sequence generator to generate sequence 1-9-2-7-3-6 using JK flip-flop.*

Solution : Excitation table

Present state				Next state				Flip - flop inputs							
Q_A	Q_B	Q_C	Q_D	Q_{A+1}	Q_{B+1}	Q_{C+1}	Q_{D+1}	J_A	K_A	J_B	K_B	J_C	K_C	J_D	K_D
0	0	0	0	×	×	×	×	×	×	×	×	×	×	×	×
0	0	0	1	1	0	0	1	1	×	0	×	0	×	×	0
0	0	1	0	0	1	1	1	0	×	1	×	×	0	1	×
0	0	1	1	0	1	1	0	0	×	1	×	×	0	×	1
0	1	0	0	×	×	×	×	×	×	×	×	×	×	×	×
0	1	0	1	×	×	×	×	×	×	×	×	×	×	×	×
0	1	1	0	0	0	0	1	0	×	×	1	×	1	1	×

0	1	1	1	0	0	1	1	0	×	×	1	×	0	×	0
1	0	0	0	×	×	×	×	×	×	×	×	×	×	×	×
1	0	0	1	0	0	1	0	×	1	0	×	1	×	×	1
1	0	1	0	×	×	×	×	×	×	×	×	×	×	×	×
1	0	1	1	×	×	×	×	×	×	×	×	×	×	×	×
1	1	0	0	×	×	×	×	×	×	×	×	×	×	×	×
1	1	0	1	×	×	×	×	×	×	×	×	×	×	×	×
1	1	1	0	×	×	×	×	×	×	×	×	×	×	×	×
1	1	1	1	×	×	×	×	×	×	×	×	×	×	×	×

K-map simplification

For J_A

Q_AQ_B \ Q_CQ_D	00	01	11	10
00	X	1	0	0
01	X	X	0	0
11	X	X	X	X
10	X	X	X	X

$J_A = \overline{Q}_C$

For K_A

Q_AQ_B \ Q_CQ_D	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	X	X	X	X
10	X	1	X	X

$K_A = 1$

For J_B

Q_AQ_B \ Q_CQ_D	00	01	11	10
00	X	0	1	1
01	X	X	X	X
11	X	X	X	X
10	X	0	X	X

$J_B = Q_C$

For K_B

Q_AQ_B \ Q_CQ_D	00	01	11	10
00	X	X	X	X
01	X	X	1	1
11	X	X	X	X
10	X	X	X	X

$K_B = 1$

For J_C

Q_AQ_B \ Q_CQ_D	00	01	11	10
00	X	0	X	X
01	X	X	X	X
11	X	X	X	X
10	X	1	X	X

$J_C = Q_B$

For K_C

Q_AQ_B \ Q_CQ_D	00	01	11	10
00	X	X	0	0
01	X	X	0	1
11	X	X	X	X
10	X	X	X	X

$K_C = Q_B\overline{Q}_D$

For J_D

Q_AQ_B \ Q_CQ_D	00	01	11	10
00	X	X	X	1
01	X	X	X	1
11	X	X	X	X
10	X	X	X	X

$J_D = 1$

For K_D

Q_AQ_B \ Q_CQ_D	00	01	11	10
00	X	0	1	X
01	X	X	0	X
11	X	X	X	X
10	X	1	X	X

$K_D = Q_A + \overline{Q}_B Q_C$

Logic diagram