Conversion of One flip-flop to other

SR Flip-flop

Inputs		Outputs	
		Present State	Next State
S	R	Q_n	Q_{n+1}
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	invalid	
1	1	invalid	

Outputs		Inputs	
Present State	Next State		
Q_n	Q_{n+1}	S	R
0	0	0	X
0	1	1	0
1	0	0	1
1	1	X	0

Characteristic Table

Table

Excitation

JK Flip-flop

Inputs		Outputs	
		Present State	Next State
J	K	Q_n	Q_{n+1}
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

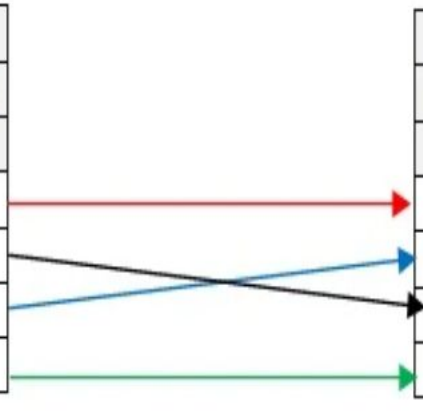
Characteristic Table

Outputs		Inputs	
Present State	Next State		
Q_n	Q_{n+1}	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

Excitation Table

D Flip-flop

Input	Outputs	
	Present State	Next State
D	Q_n	Q_{n+1}
0	0	0
0	1	0
1	0	1
1	1	1



Outputs		Input
Present State	Next State	
Q_n	Q_{n+1}	D
0	0	0
0	1	1
1	0	0
1	1	1

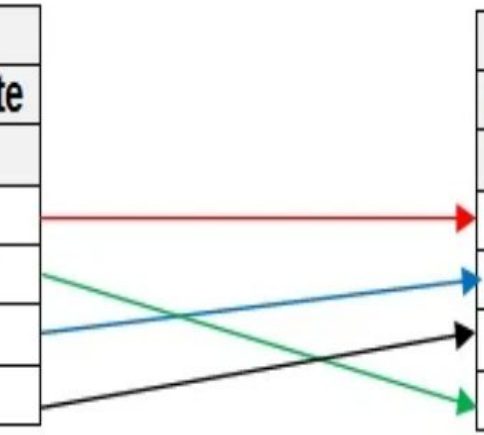
Characteristic Table

Table

Excitation

T Flip-flop

Input	Outputs	
	Present State	Next State
T	Q_n	Q_{n+1}
0	0	0
0	1	1
1	0	1
1	1	0



Outputs		Input
Present State	Next State	
Q_n	Q_{n+1}	T
0	0	0
0	1	1
1	0	1
1	1	0

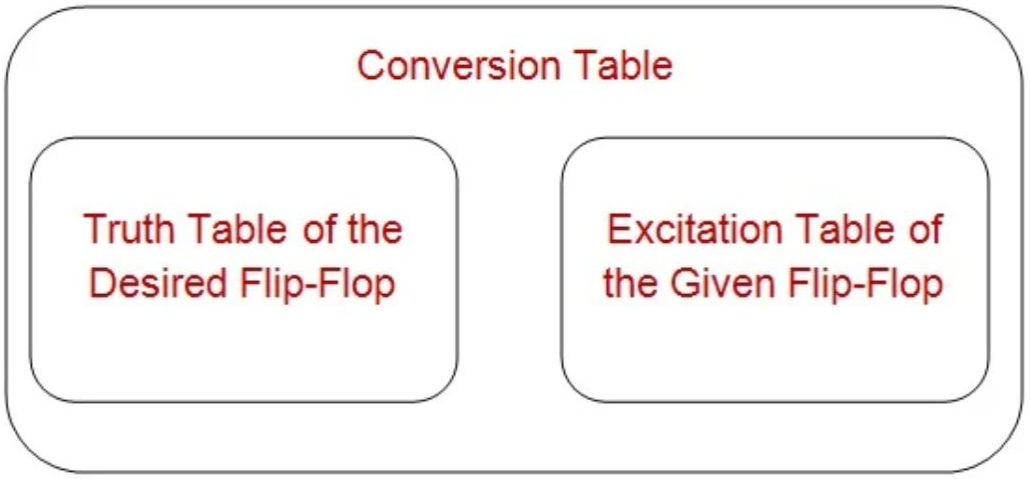
Characteristic Table

Table

Excitation

Conversion of One flip-flop to another

Structure of a conversion table



- This can be done by filling the entries from the excitation table of the given flip-flop into the appropriate rows of the truth table corresponding to the desired flip-flop by adding additional column(s) which represent the input(s) of the given flip-flop.

- When done so, we will get a new table which we can refer to as a "Conversion Table":

Conversion of SR flip-flop to JK flip-flop

i. For example, the conversion process of the SR flip-flop into a JK flip-flop is initiated by writing the truth table for the JK flip-flop as shown by the yellowish enclosure in Figure 6.

ii. Here, it is seen that the first row has the present- and the next-states of the flip-flop as 0 and 0 (the red entries in the truth table).

iii. Now we look at the excitation table of the SR flip-flop (shown in the right-side of Figure 6) which has a row indicating the present- and the next-states of the SR flip-flop to be 0 and 0.

iv. As seen by the red entries in the excitation table, this corresponds to the first row for which the inputs are S = 0 and R = X.

v. The same information is placed into the first row of the JK flip-flop's truth table by adding two more columns, S and R (as shown by the pink enclosure in Figure 6), to result in an SR-to-JK Conversion Table:

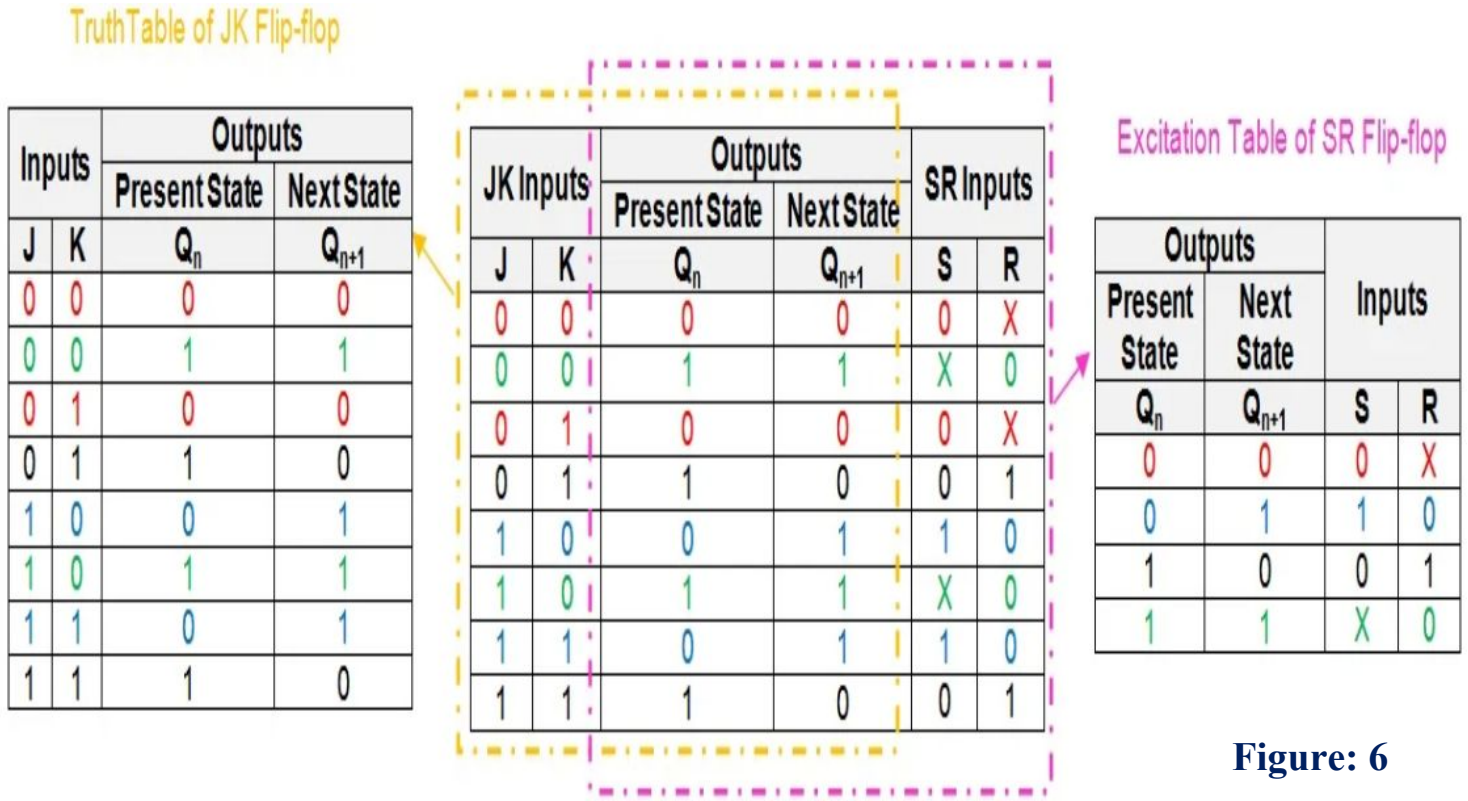


Figure: 6

Conversion of SR flip-flop to JK flip-flop

Using a K-Map to Obtain Logical Expressions

According to this, for the example under consideration, we need to obtain the expressions for the inputs S and R in terms of J, K, and Q_n. This can be done by employing the K-map simplification technique as shown in Figure 7:

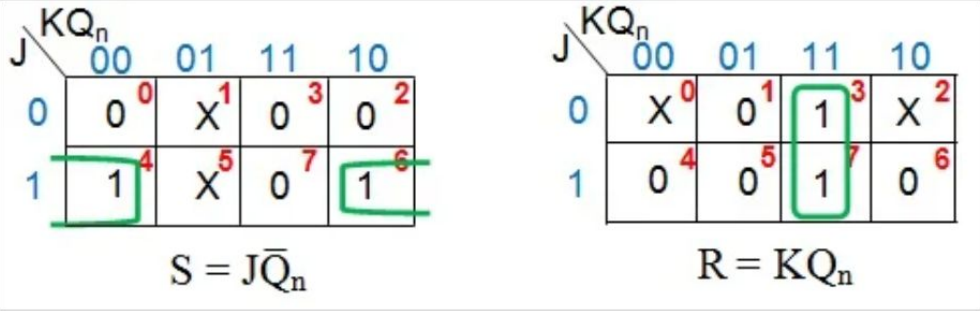


Figure 7: K-map simplification for the inputs of the SR flip-flop in terms of J, K, and Q_n