Flip-flop Conversion

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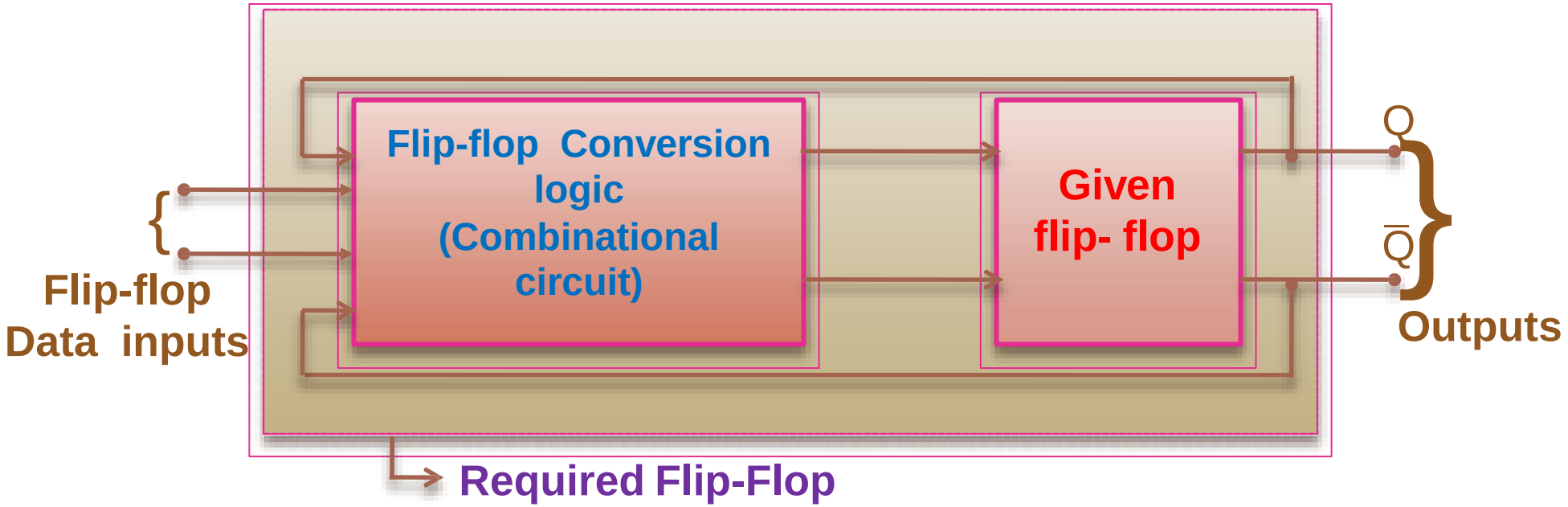
FLIP FLOP CONVERSIONS

- SR to D
- SR to JK
- SR to T
- JK to T
- JK to D
- JK to SR
- D to T
- D to SR
- T to D

CONVERSION OF FLIP FLOPS

The conversion from one type of flip flop to the other (say SR FF to JK FF) needs a systematic approach using the excitation tables and K map simplifications.



General model used to convert one type of FF to the other

PROCEDURE FOR CONVERSION

1. Draw the block diagram of the target flip flop from the given problem.
2. Write truth table for the target flip-flop.
3. Write excitation table for the available flip-flop.
4. Draw k-map for target flip-flop.
5. Draw the block diagram.

SR(Available) to D(Target) Flip flop Conversion

- **Truth table of D Flip flop**

Input	Present state	Next State
D	Q n	Qn+1
0	0	0
0	1	0
1	0	1
1	1	1

Flip-flop inputs		*Present output*	*Next output*
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	0	X
1	1	1	X

- **Excitation table SR Flip Flop**

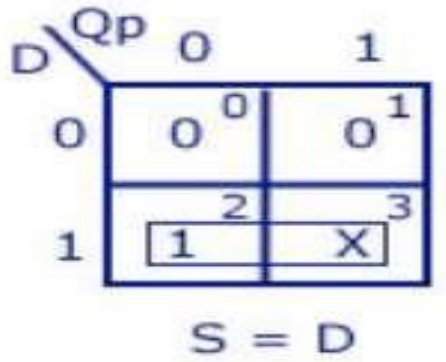
Present state	Next state	Flip flop Inputs	
Q n	Qn+1	S	R
0	0	0	X
0	1	1	0
1	0	0	1
1	1	X	0

SR to D Flip flop Conversion

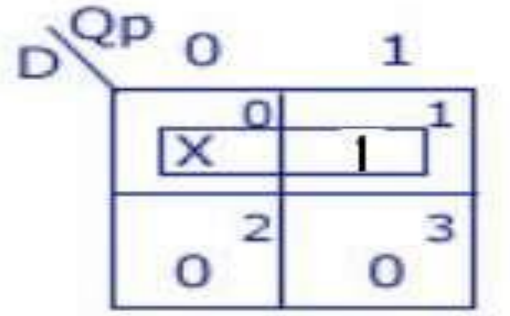
Conversion Table

Input	Present state	Next state	Flip flop Inputs	
D	Q n	Qn+1	S	R
0	0	0	0	X
0	1	0	0	1
1	0	1	1	0
1	1	1	X	0

K- MAP SIMPLIFICATION

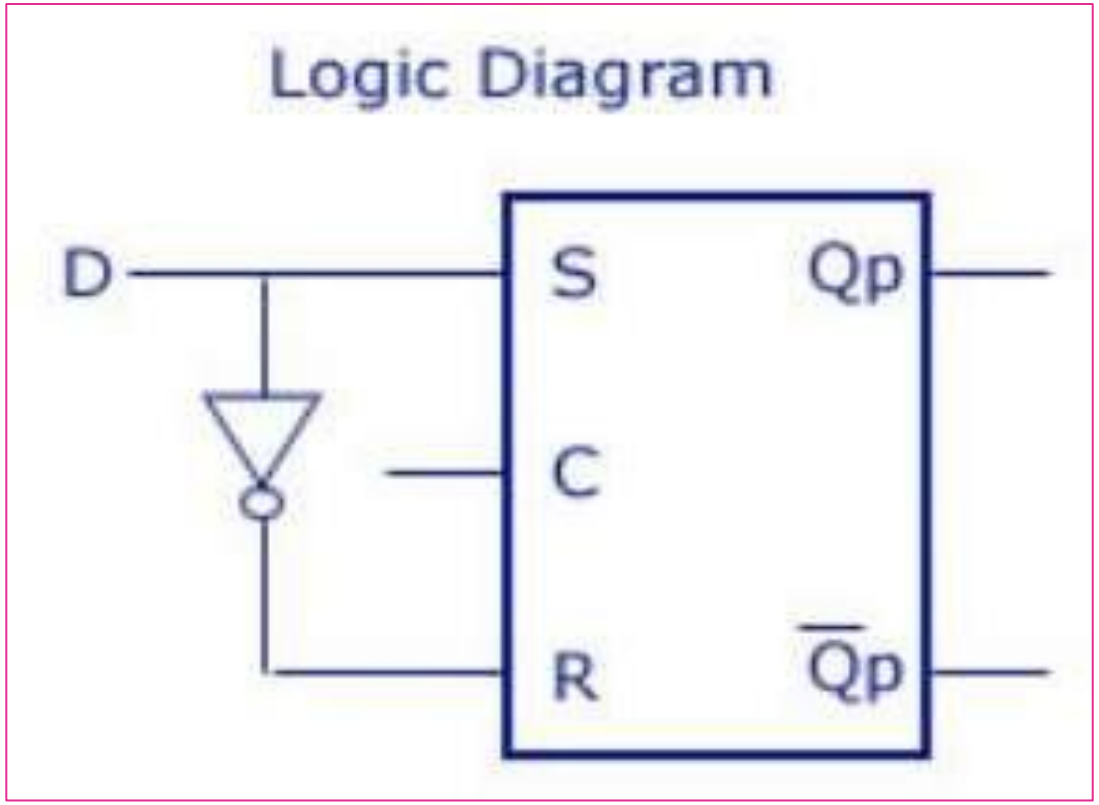


S = D



$R = \overline{D}$

SR to D Flip Flop



SR(Available) to JK(Target) Flip-Flop

- **Truth table of JK Flip flop**

Input		Present State	Next State
J	K	Q n	Qn+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

- **Excitation table SR Flip Flop**

Present state	Next state	Flip flop Inputs	
Q n	Qn+1	S	R
0	0	0	X
1	0	0	1
0	1	1	0
1	1	X	0

Flip-flop inputs		*Present output*	*Next output*
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	0	X
1	1	1	X

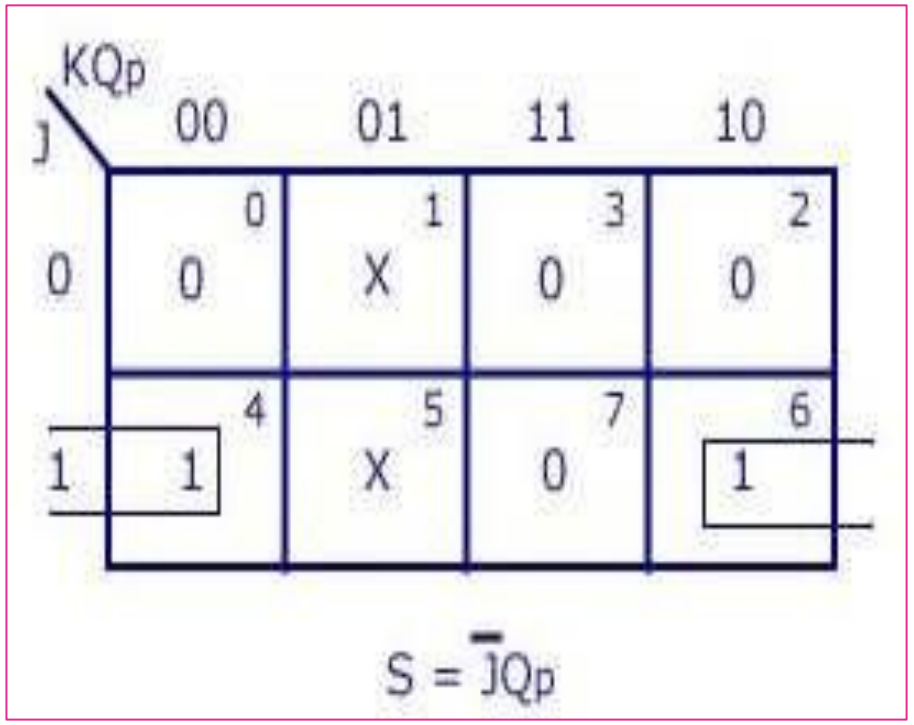
SR(Available) to JK(Target) Flip-Flop

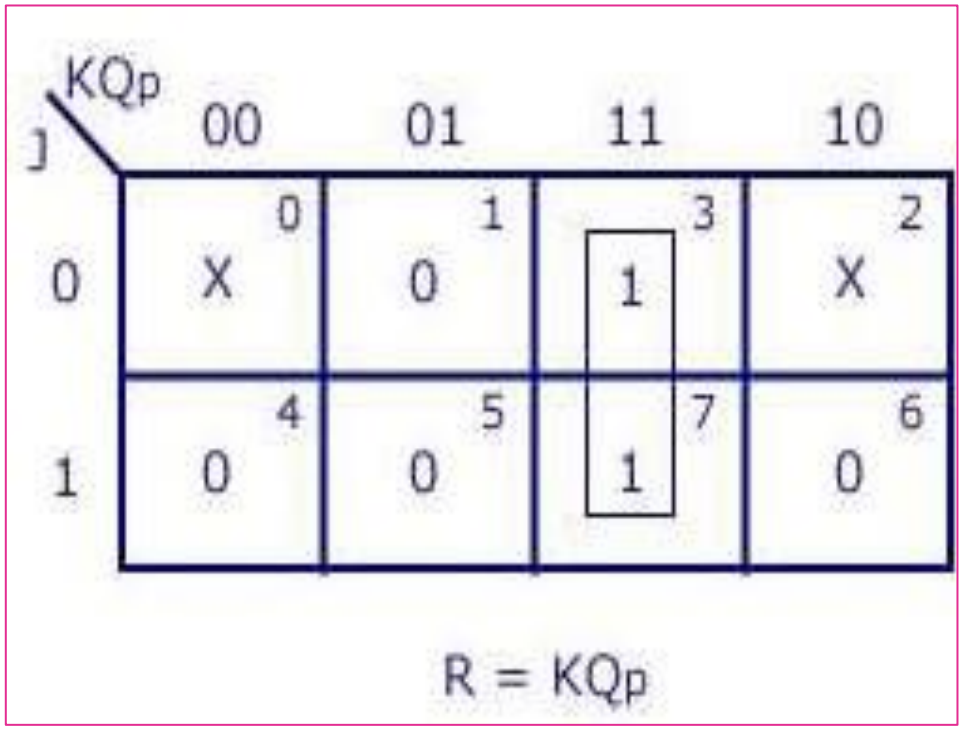
Conversion Table

Input		Present State	Next State	Flip-Flop Inputs	
J	K	Q n	Qn+1	S	R
0	0	0	0	0	X
0	0	1	1	X	0
0	1	0	0	0	X
0	1	1	0	0	1
1	0	0	1	1	0
1	0	1	1	X	0
1	1	0	1	1	0
1	1	1	0	0	1

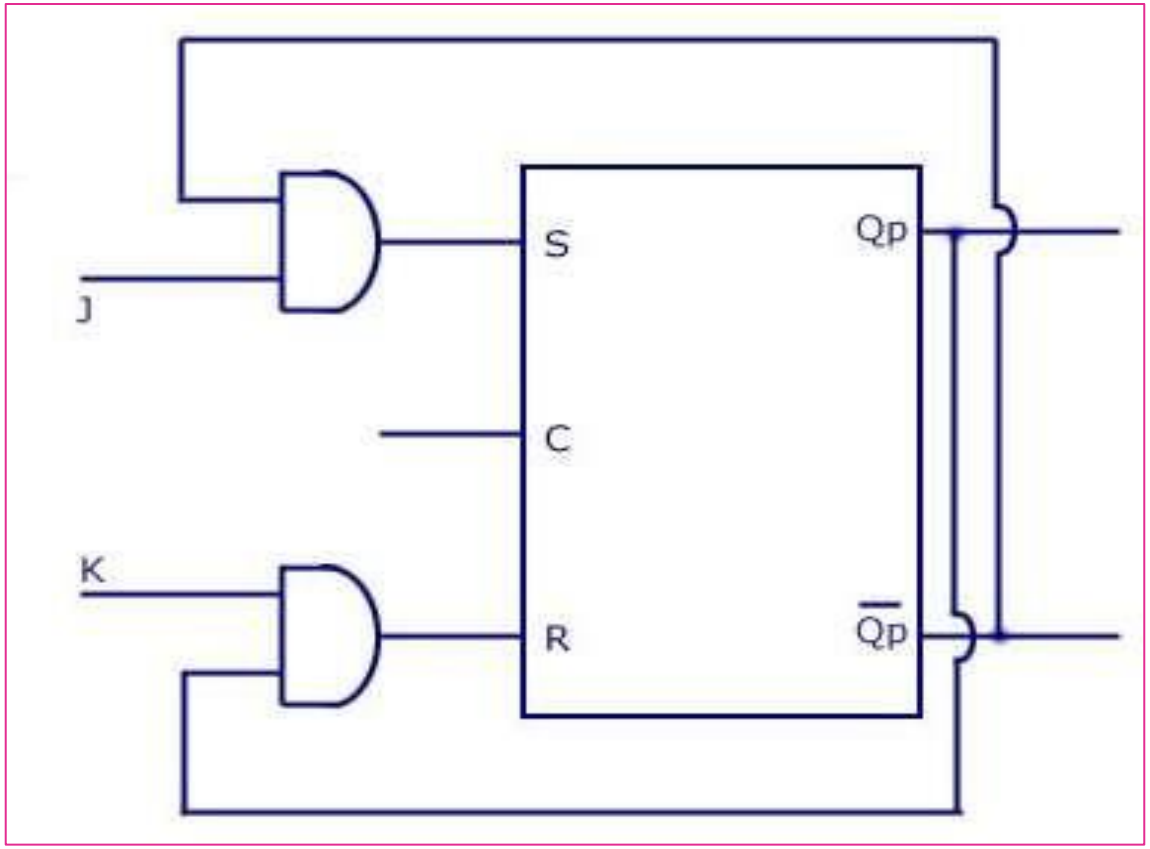
SR to JK Flip- Flop

- K-map Simplification





Logic Diagram (SR to JK)

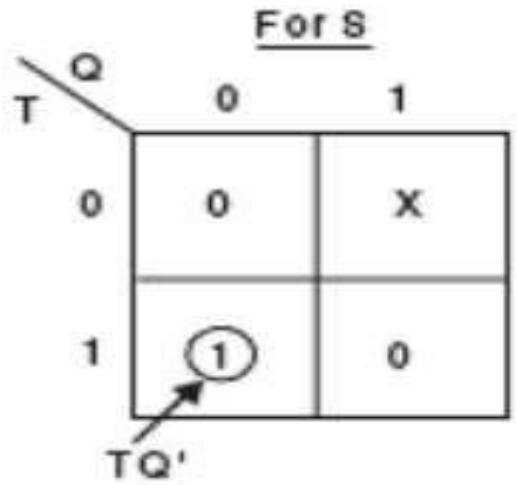


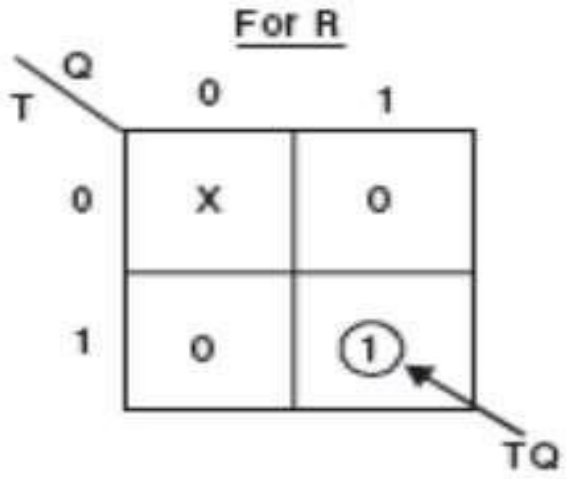
SR(Available) to T(Target) Flip Flop

Conversion Table

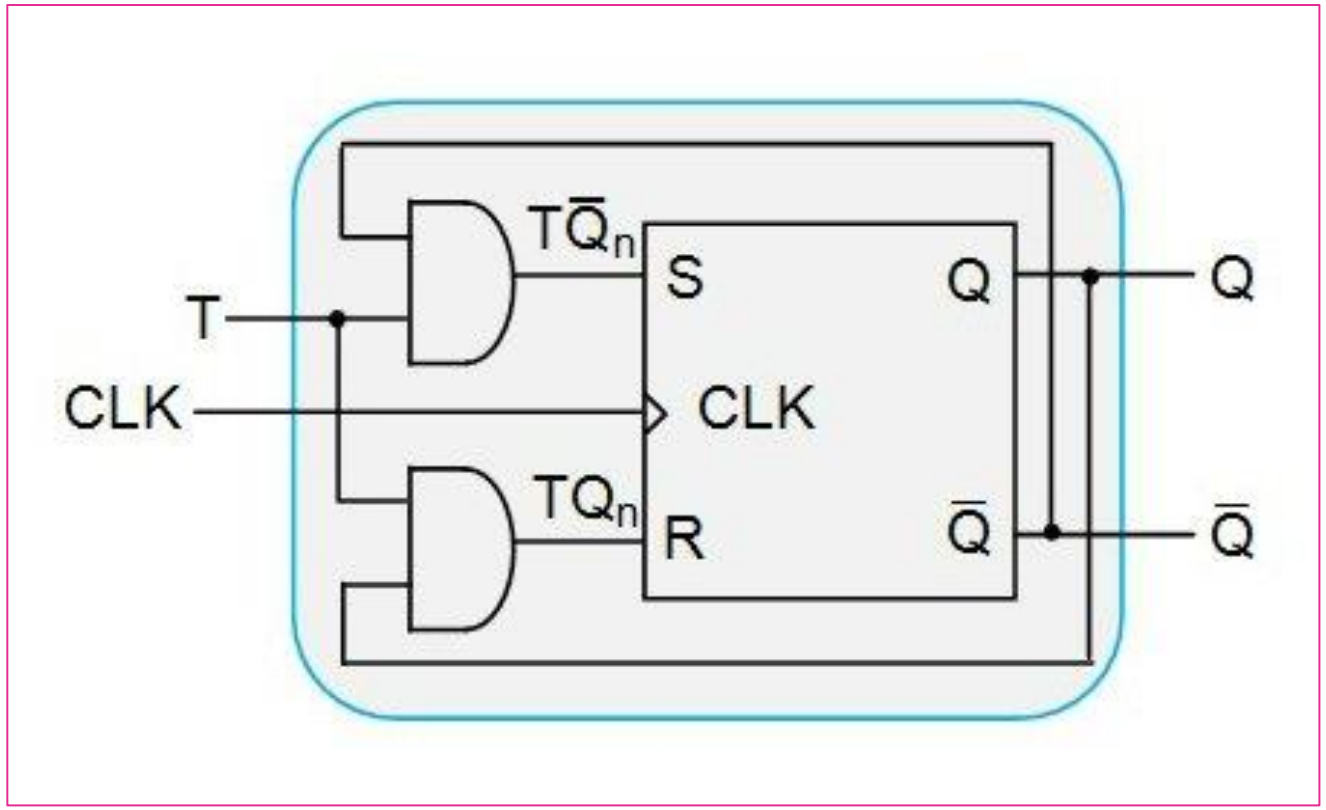
Input	Present state	Next state	Flip flop Inputs	
T	Q n	Qn+1	S	R
0	0	0	0	X
0	1	1	X	0
1	0	1	1	0
1	1	0	0	1

K- MAP SIMPLIFICATION





Logic Diagram (SR to T)



JK(Available) to T (Target) Flip-Flop

Input	Present state	Next state
T	Q n	Qn+1
0	0	0
0	1	1
1	0	1
1	1	0

Flip-flop inputs		*Present output*	*Next output*
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

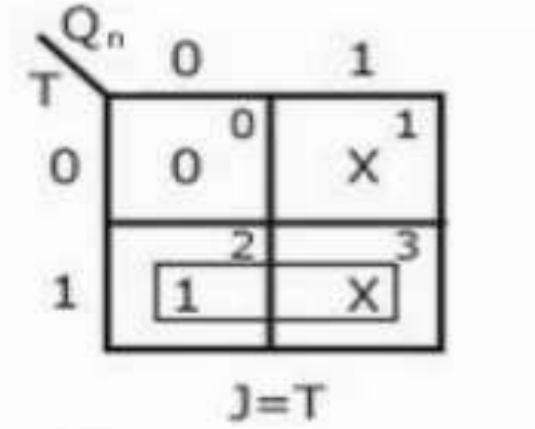
Excitation Table of JK Flip-Flop

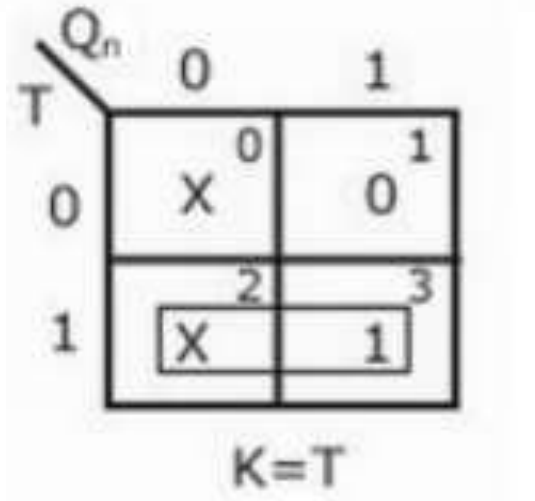
Qn	Qn+1	J	K
0	**0**	**0**	**x**
0	**1**	**1**	**x**
1	**0**	**x**	**1**
1	**1**	**x**	**0**

JK(Available) to T (Target) Flip-Flop

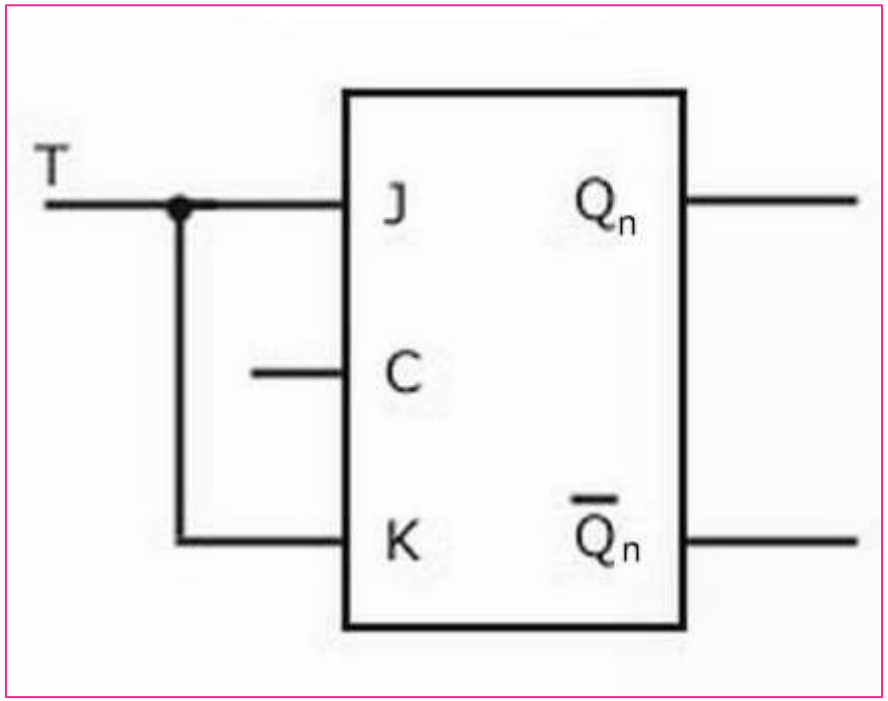
Input	Present state	Next state	Flip flop Inputs	
T	Q n	Qn+1	J	K
0	0	0	0	X
0	1	1	X	0
1	0	1	1	x
1	1	0	x	1

K- MAP SIMPLIFICATION





Logic Diagram (JK to T) Flip- Flop



JK(Available) to D(Target)Flip-flop

Input	Present state	Next state
D	Q n	Qn+1
0	0	0
0	1	0
1	0	1
1	1	1

Flip-flop inputs		*Present output*	*Next output*
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

Excitation Table of JK Flip-Flop

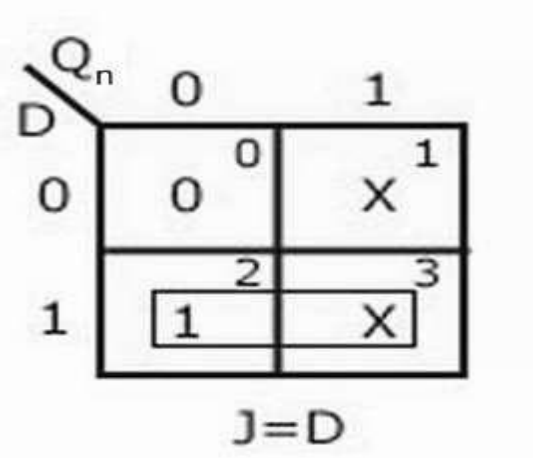
Qn	Qn+1	J	K
0	**0**	**0**	**x**
0	**1**	**1**	**x**
1	**0**	**x**	**1**
1	**1**	**x**	**0**

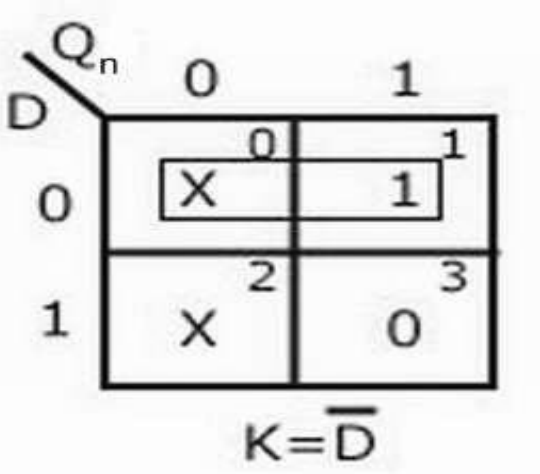
JK(Available) to D(Target)Flip-flop

Conversion Table

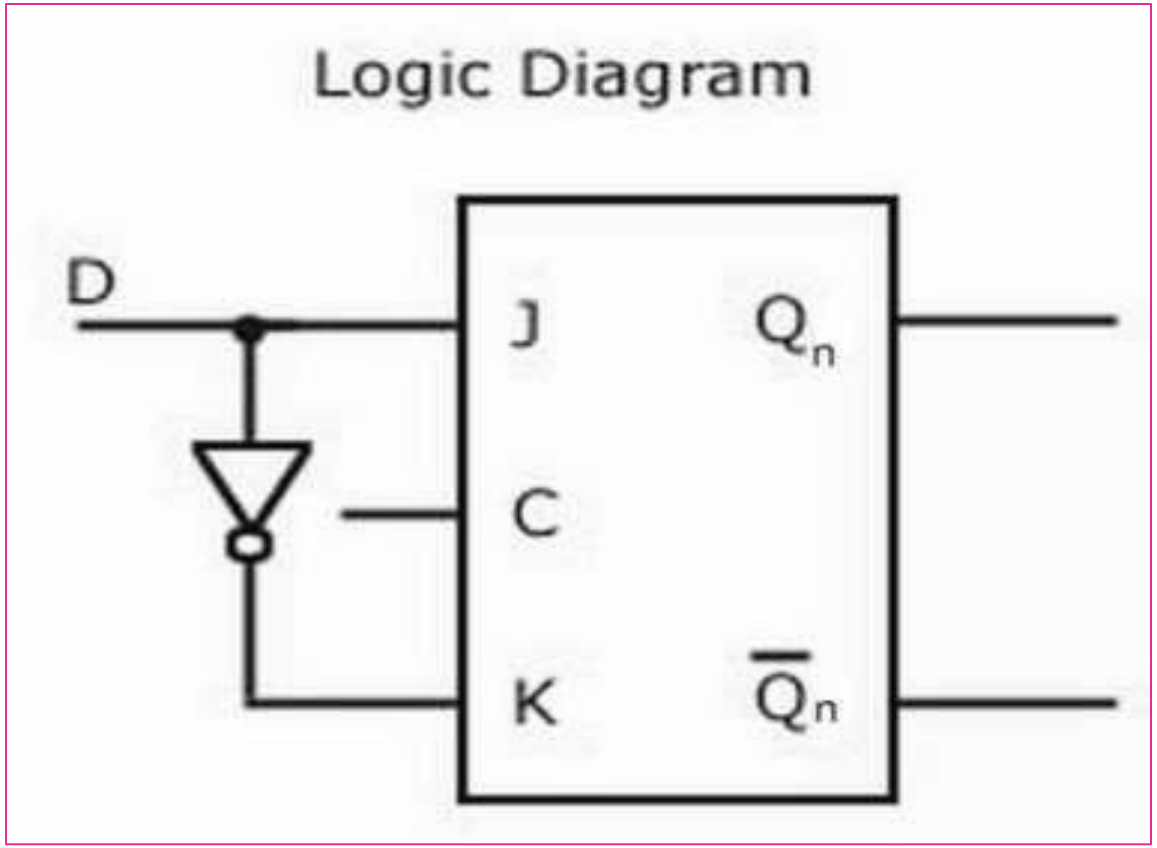
Input	Present state	Next state	Flip flop Inputs	
D	Q n	Qn+1	J	K
0	0	0	0	X
0	1	0	X	1
1	0	1	1	x
1	1	1	x	0

K- MAP SIMPLIFICATION





Logic Diagram (JK to D)



D(Available) to T(Target)Flip-Flop

Input	Present state	Next state
T	Q n	Qn+1
0	0	0
0	1	1
1	0	1
1	1	0

Excitation Table of D Flip-Flop

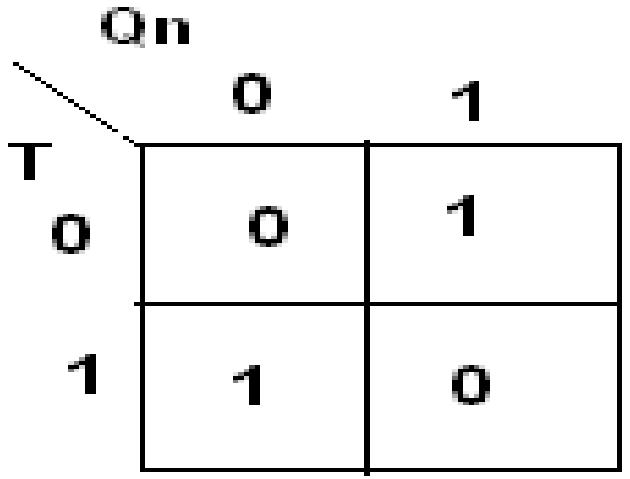
Q n	Qn+1	D
0	0	0
0	1	1
1	0	0
1	1	1

D(Available) to T(Target)Flip-Flop

Conversion Table

Input	Present State	Next state	Flip flop Inputs
T	Q n	Qn+1	D
0	0	0	0
0	1	1	1
1	0	1	1
1	1	0	0

K- MAP SIMPLIFICATION

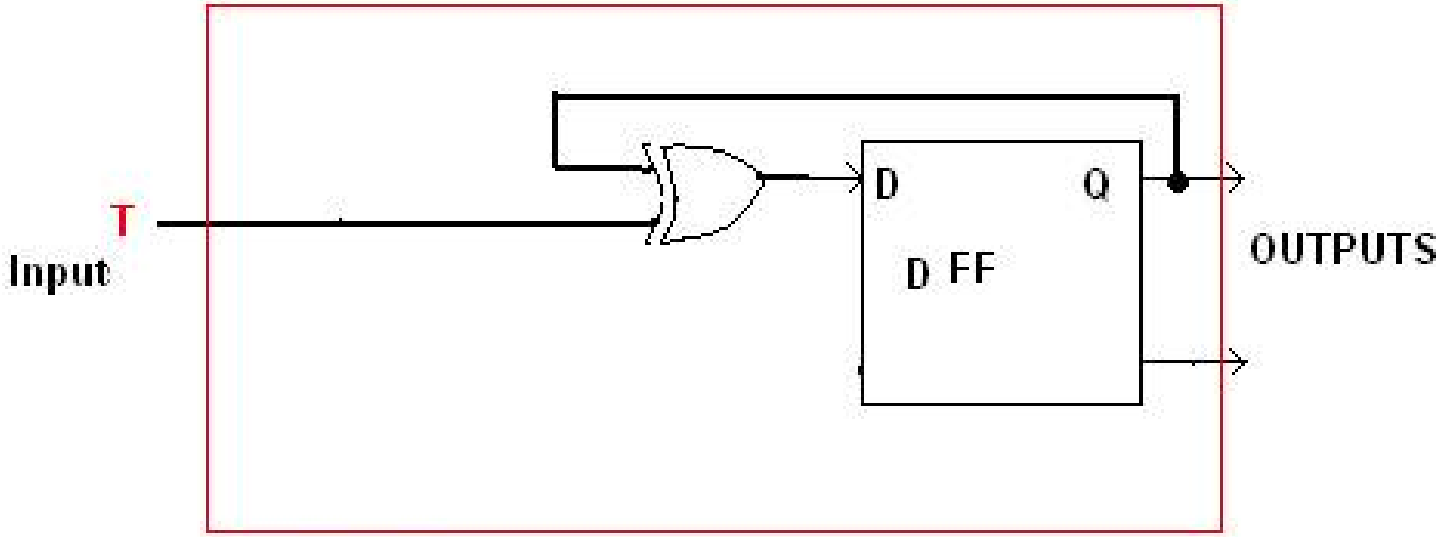


$D = T'Q_n + TQ_n'$

Logic Diagram(D to T) Flip-Flop Conversion

T \ Qn	0	1
0	0	1
1	1	0

D=T'Qn+TQn'



T (Available) to D(Target) Flip-Flop

Input	Present state	Next state
D	Q n	Qn+1
0	0	0
0	1	0
1	0	1
1	1	1

Excitation Table of T Flip-Flop

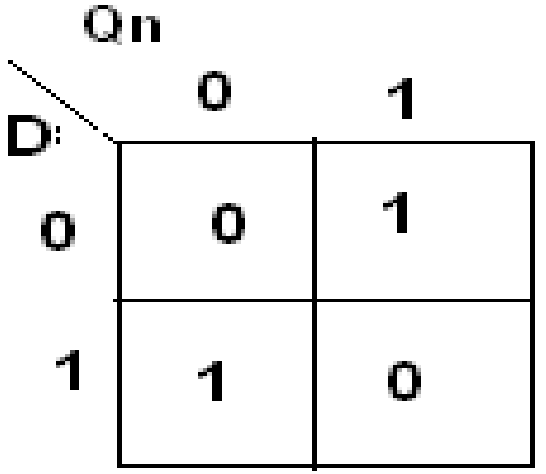
Q n	Qn+1	T
0	0	0
0	1	1
1	0	1
1	1	0

T (Available) to D(Target) Flip-flop

Conversion Table

Input	Present state	Next state	Flip flop Inputs
D	Q n	Qn+1	T
0	0	0	0
0	1	0	1
1	0	1	1
1	1	1	0

K- MAP SIMPLIFICATION

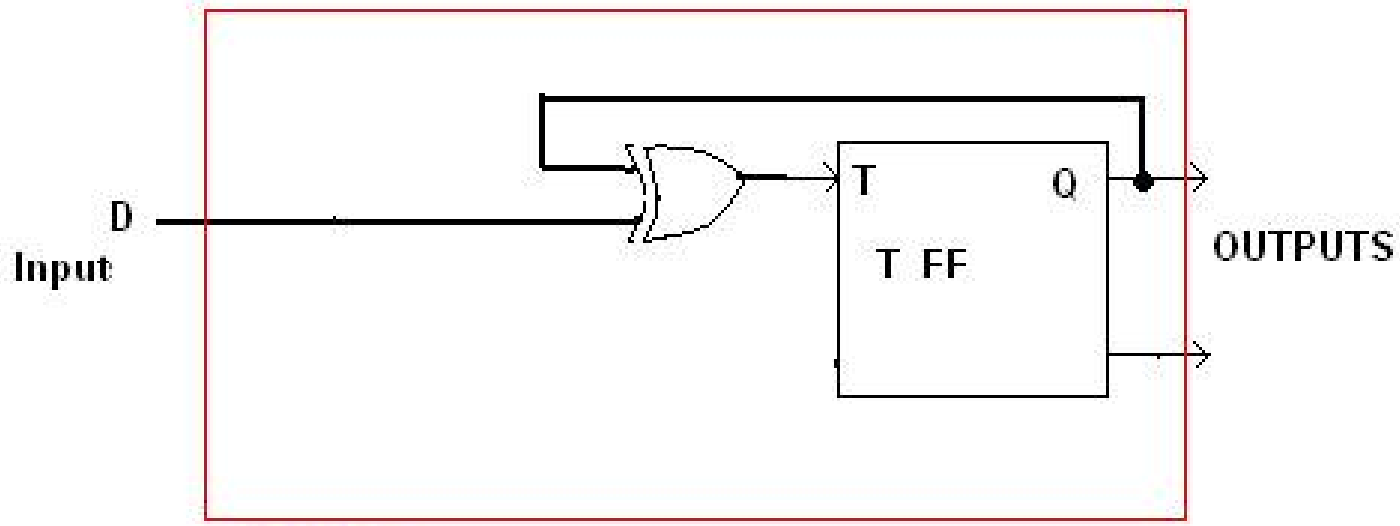


$T = DQn' + D'Qn$

Logic Diagram(T to D) Flip-Flop Conversion

D \ Qn	0	1
0	0	1
1	1	0

$T = DQn' + D'Qn$



JK(Available) to SR(Target)Flip-flop

Input		Present State	Next State
S	R	Q n	Qn+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	X
1	1	1	X

Flip-flop inputs		*Present output*	*Next output*
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

Excitation Table of JK Flip-Flop

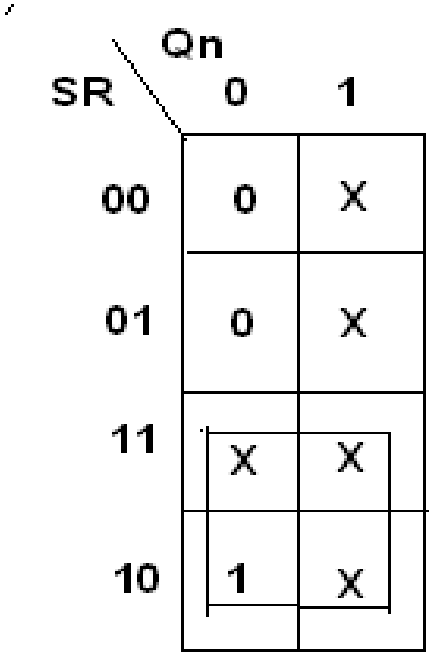
Qn	Qn+1	J	K
0	0	0	x
0	1	1	x
1	0	x	1
1	1	x	0

JK(Available) to SR(Target)Flip-flop

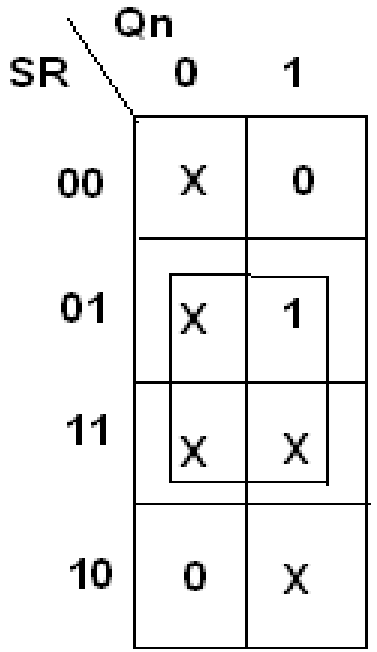
Conversion Table

Input		Present State	Next State	Flip-Flop Inputs	
S	R	Q n	Qn+1	J	K
0	0	0	0	0	X
0	0	1	1	X	0
0	1	0	0	0	X
0	1	1	0	X	1
1	0	0	1	1	X
1	0	1	1	X	0
1	1	0	X	X	X
1	1	1	X	X	X

JK(Available) to SR(Target)Flip-flop conversion

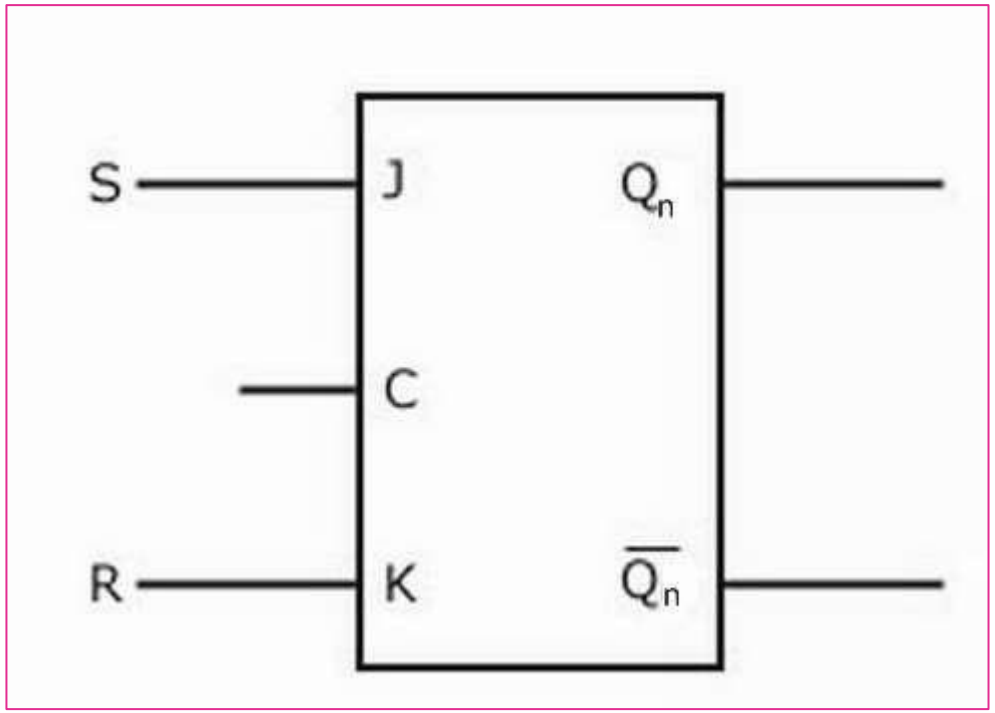


J=S



K=R

JK to SR Flip-Flop Logic Diagram



D(Available) to SR(Target) Flip-Flop

Input		Present State	Next State
S	R	Q n	Qn+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	X
1	1	1	X

Excitation Table of D Flip-Flop

Q n	Qn+1	D
0	0	0
0	1	1
1	0	0
1	1	1

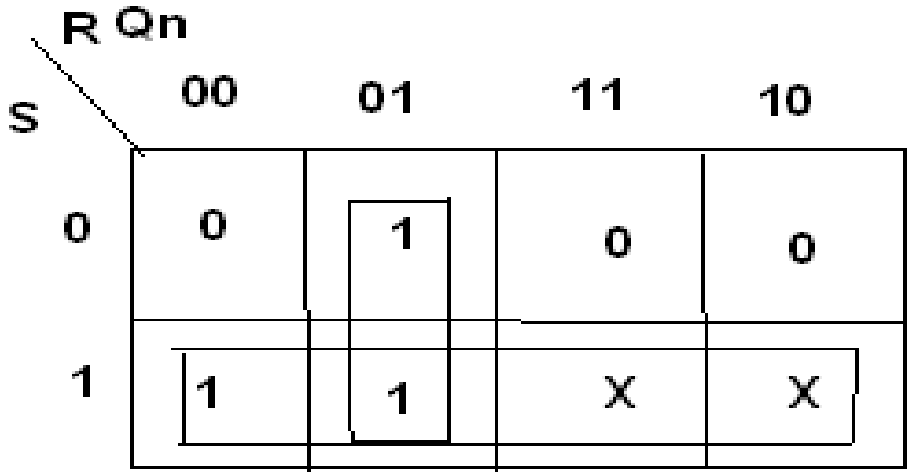
D(Available) to SR(Target) Flip-Flop

Conversion Table

Input		Present State	Next State	Flip-Flop Inputs
S	R	Q n	Qn+1	D
0	0	0	0	0
0	0	1	1	1
0	1	0	0	0
0	1	1	0	0
1	0	0	1	1
1	0	1	1	1
1	1	0	X	x
1	1	1	X	x

D to SR Flip Flop

K- MAP SIMPLIFICATION



D=R'Qn+S