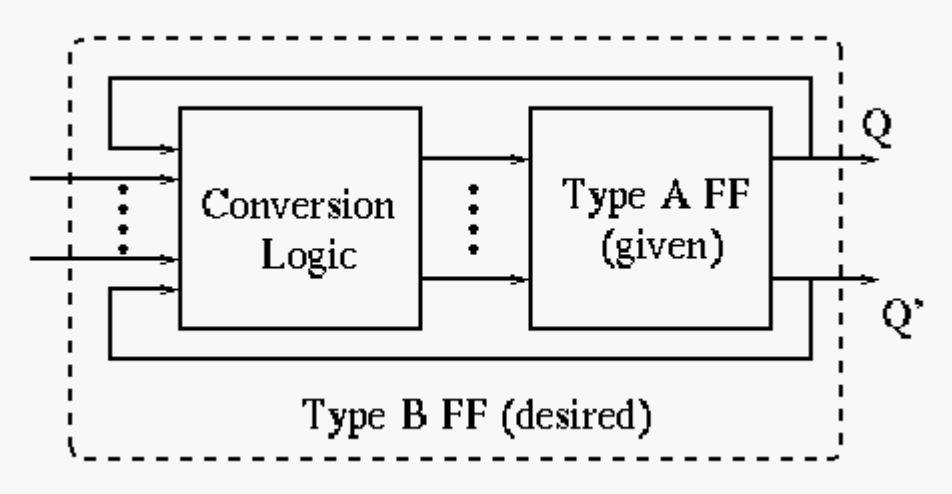
University of Babylon
College of Engineering
Department of Electrical Engineering

Flipflop Conversions

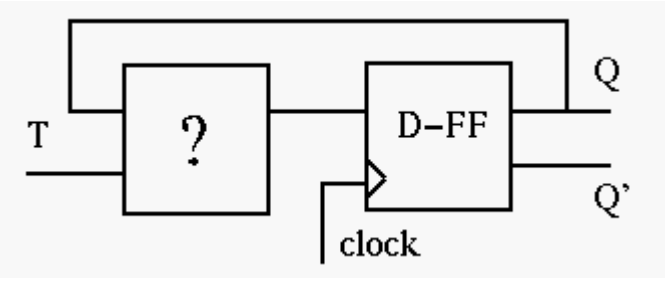
The purpose is to convert a given type A FF to a desired type B FF using some conversion logic.



The key here is to use the excitation table, which shows the necessary triggering signal (S,R, J,K, D and T) for a desired flipflop state transition $Q_t \rightarrow Q_{t+1}$:

Q_t	Q_{t+1}	S	R	J	K	D	T
0	0	0	x	0	x	0	0
0	1	1	0	1	x	1	1
1	0	0	1	x	1	0	1
1	1	x	0	x	0	1	0

Example 1: Convert a D-FF to a T-FF:



We need to design the circuit to generate the triggering signal D as a function of T and Q: $D = f(T, Q)$. Consider the excitation table:

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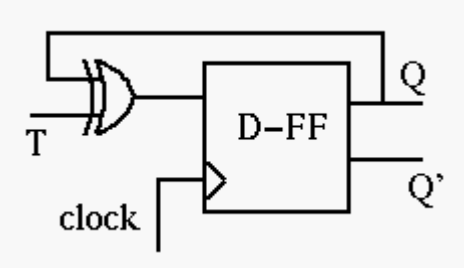
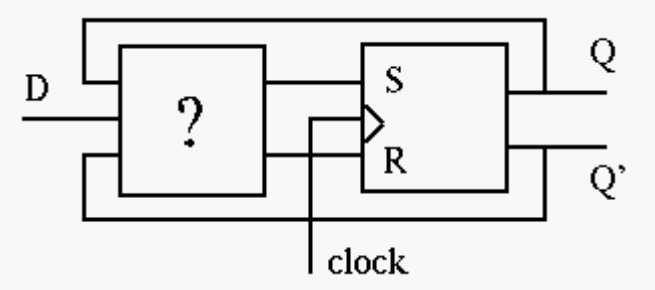
Q_t	Q_{t+1}	T	D
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	1

Treating D as a function of T and current FF state Q (Q_t), we have

$$D = T'Q + TQ' = T \oplus Q$$



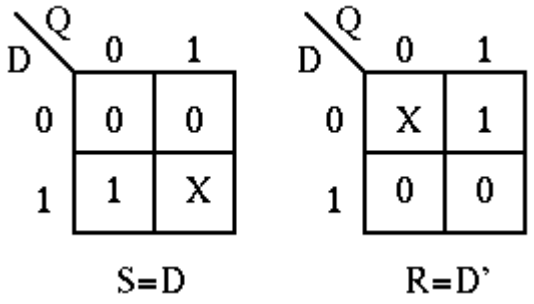
Example 2: Convert a RS-FF to a D-FF:



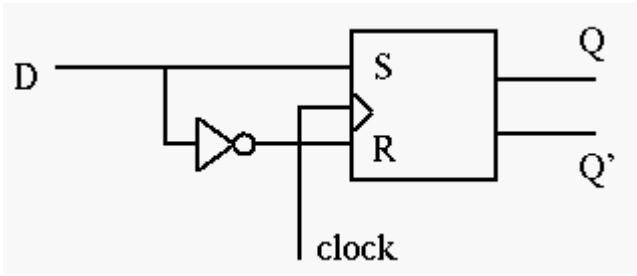
We need to design the circuit to generate the triggering signals S and R as functions of D and Q. Consider the excitation table:

Q_t	Q_{t+1}	D	S	R
0	0	0	0	x
0	1	1	1	0
1	0	0	0	1
1	1	1	x	0

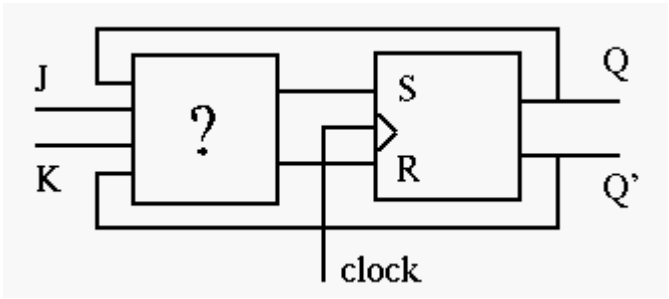
The desired signal S and R can be obtained as functions of T and current FF state Q from the Karnaugh maps:



$$S = D, \qquad R = D'$$



Example 3: Convert a RS-FF to a JK-FF:



We need to design the circuit to generate the triggering signals S and R as functions of J, K and Q. Consider the excitation table:

Q_t	Q_{t+1}	J	K	S	R
0	0	0	x	0	x
0	1	1	x	1	0
1	0	x	1	0	1
1	1	x	0	x	0

The desired signal S and R as functions of J, K and current FF state Q can be obtained from the Karnaugh maps:

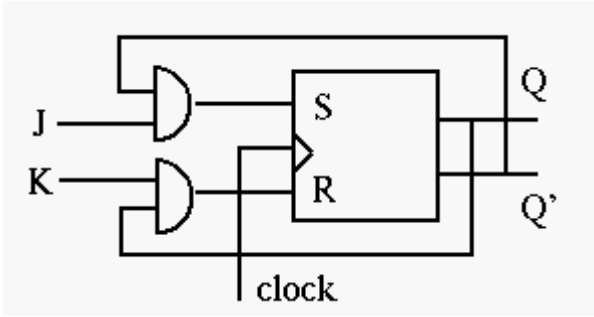
K \ QJ	00	01	11	10
0	0	1	X	X
1	0	1	0	0

S=Q'J

K \ QJ	00	01	11	10
0	X	0	0	0
1	X	0	1	1

R=QK

$$S = Q'J, \qquad R = QK$$



Example 4:

How about this conversion?