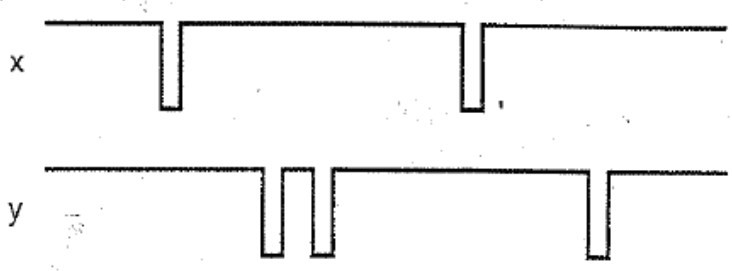
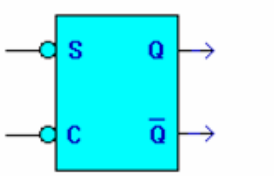
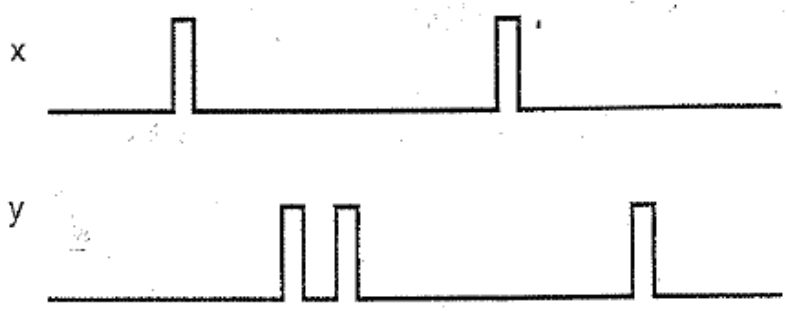
5-1. Assuming that $Q = 0$ initially, apply the x and y waveforms of Figure 5-73 to the SET and CLEAR inputs of a NAND latch, and determine the Q and $\overline{Q}$ waveforms.

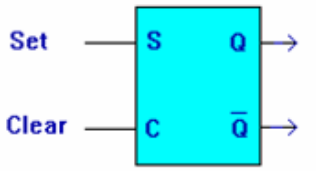




Nand Latch Symbol

5-2. Invert the x and y waveforms of Figure 5-73, apply them to the SET and CLEAR inputs of a NOR latch, and determine the Q and $\overline{Q}$ waveforms. Assume that $Q = 0$ initially.

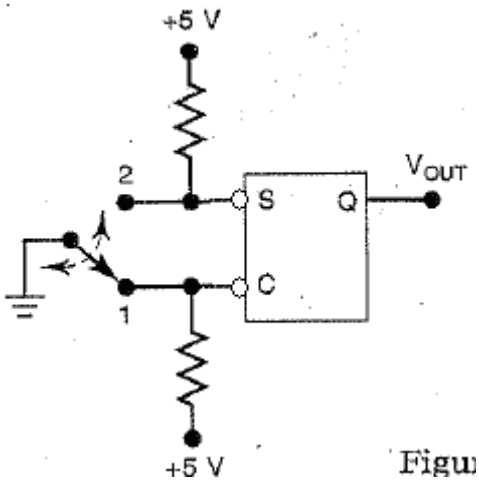




NOR Latch Symbol

P.182 : Debounced switch using NAND latch

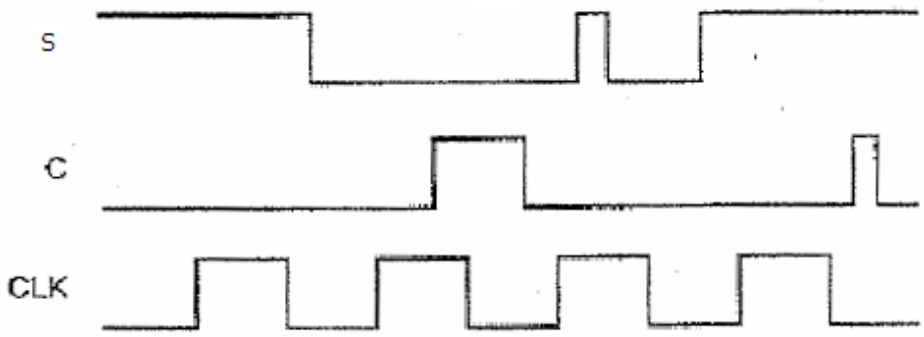
→ 5-4. Modify the circuit of Figure 5-9 to use a NOR gate latch.



Figu

5-9. Apply the waveforms of Figure 5-76 to the FF of Figure 5-17 and determine the waveform at Q. Assume $Q = 0$ initially.

Figure 5-76



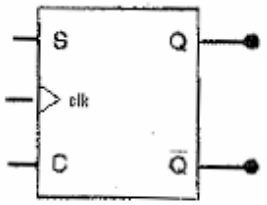
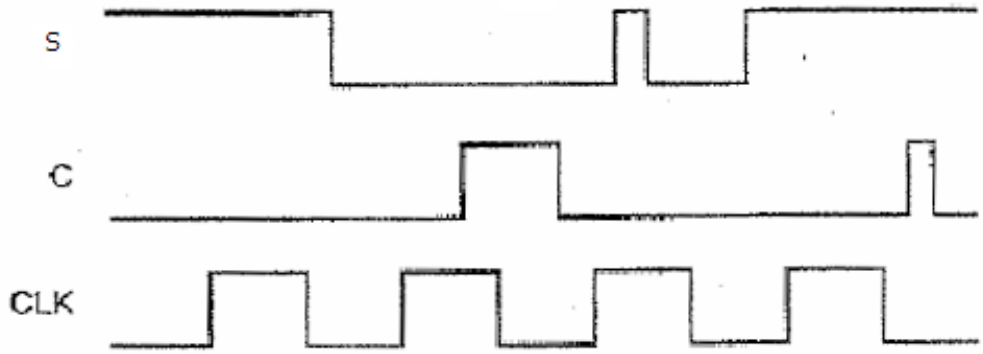


Fig 5.17

Repeat for the FF of Figure 5-18. Assume $Q = 0$ initially.



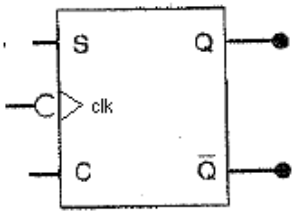
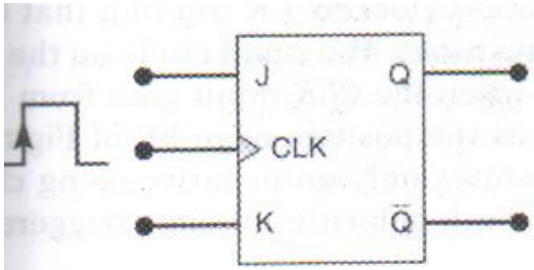


Fig. 5.18

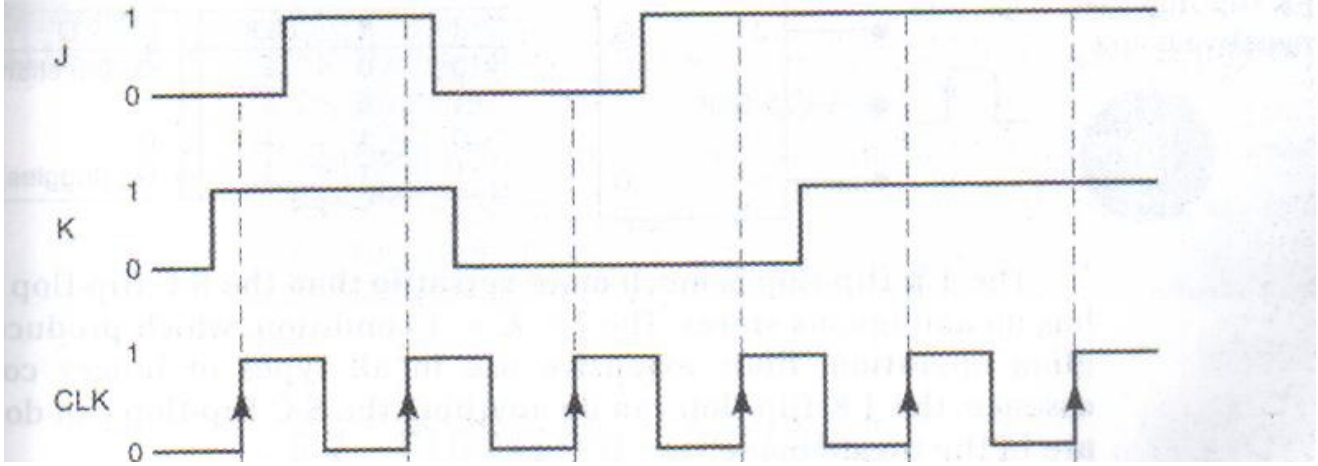
P-193 J-K (NGT)

→5-10. Apply the *J*, *K*, and *CLK* waveforms of Figure 5-21 to the FF of Figure 5-22. Assume that $Q = 1$ initially, and determine the Q waveform.



J	K	CLK	Q
0	0	↑	Q_0 (no change)
1	0	↑	1
0	1	↑	0
1	1	↑	$\overline{Q}_0$ (toggles)

(a)



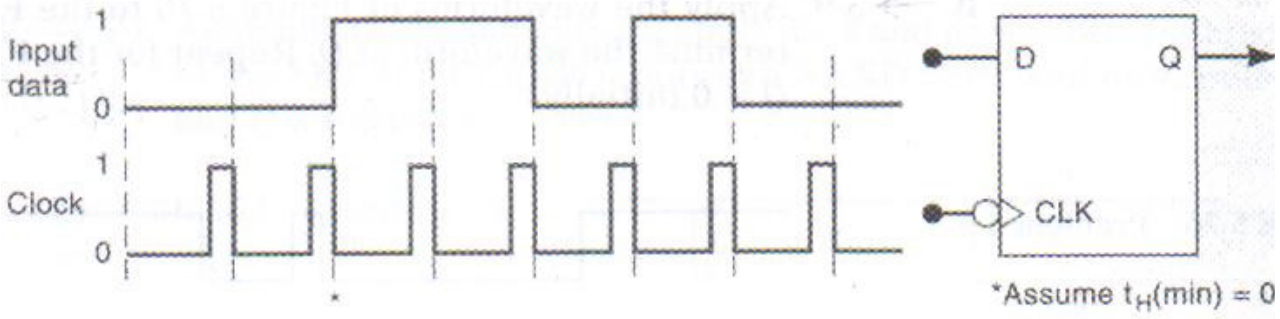
5-11. (a) Show how a J-K flip-flop can operate as a *toggle* FF (changes states on each clock pulse). Then apply a 10-kHz clock signal to its *CLK* input and determine the waveform at *Q*.

(b) Connect *Q* from this FF to the *CLK* input of a second J-K FF that also has $J = K = 1$. Determine the frequency of the signal at this FF's output.

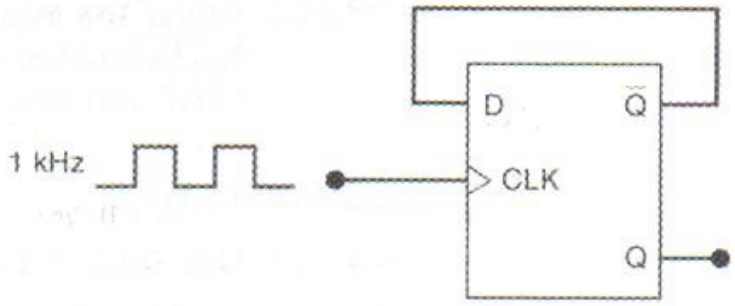
5-13. A D FF is sometimes used to *delay* a binary waveform so that the binary information appears at the output a certain amount of time after it appears at the *D* input.

(a) Determine the *Q* waveform in Figure 5-78, and compare it with the input waveform. Note that it is delayed from the input by one clock period. (below)

(b) How can a delay of two clock periods be obtained?



5-15. An edge-triggered D flip-flop can be made to operate in the toggle mode by connecting it as shown in Figure 5-79. Assume that $Q = 0$ initially, and determine the Q waveform. (below)



→ 5-18. Compare the operation of the *D* latch with a negative-edge-triggered D flip-flop by applying the waveforms of Figure 5-80 to each and determining the *Q* waveforms. (below)