Shift Register Counters

Shift Registers can be arranged to form several types of Counters. Based on the type of feedback connection the shift register counters are classified as

1.) Ring or Standard Ring Counter.
2.) Twisted Ring or Johnson or Shift Counter.

Ring Counter

In Ring Counter the output Q of each stage is connected to the D input of the next stage and the output of last stage is fed back to the input of first stage. The $\overline{CLR}$ followed by $\overline{PRE}$ makes the output of first stage to '1' and remaining outputs to '0'. Thus $Q_A = 1$ and Q_B, Q_C, Q_D are 0.

$$Q_A\ Q_B\ Q_C\ Q_D = 1000$$

When the first clock pulse is triggered Q_B becomes 1 remaining output are 0.

$$Q_A\ Q_B\ Q_C\ Q_D = 0100$$

When the second clock pulse is triggered Q_C becomes 1 and remaining outputs are 0.

$$Q_A\ Q_B\ Q_C\ Q_D = 0010$$

When the third clock pulse is triggered Q_D become '1' and remaining outputs are 0

$$Q_A\ Q_B\ Q_C\ Q_D = 0001$$

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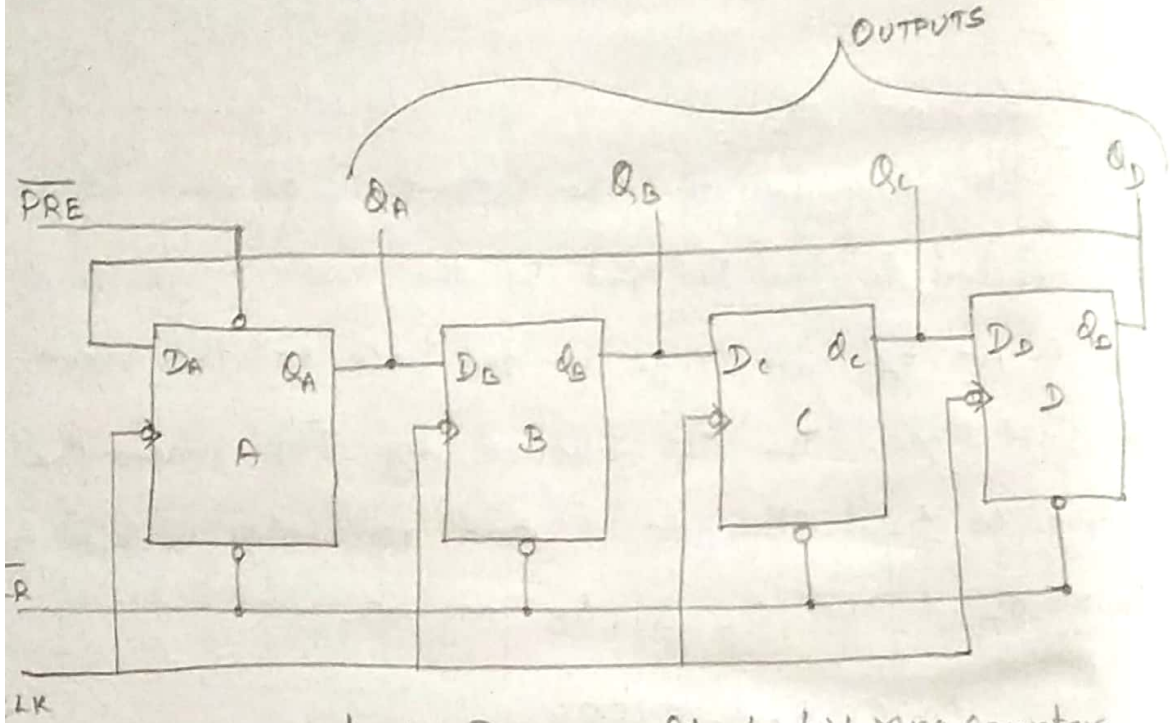
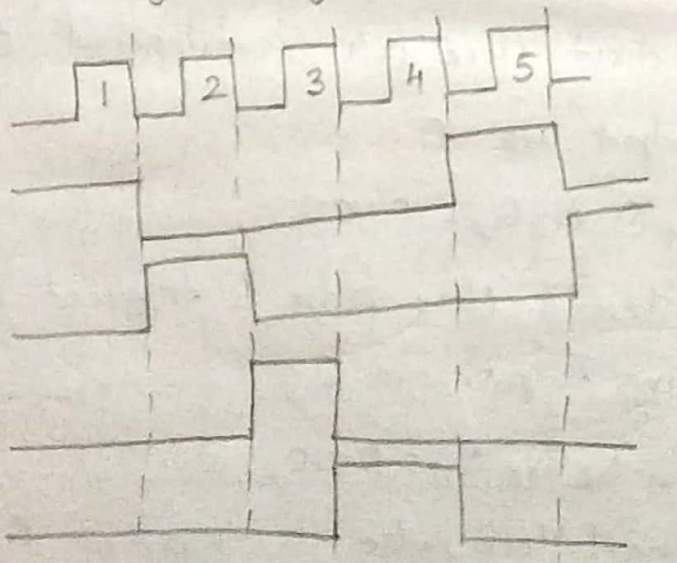
When the fourth clock pulse is triggered Q_A becomes 1 and remaining outputs are 0.

$Q_A Q_B Q_C Q_D = 1000$.

CLK	Q_A	Q_B	Q_C	Q_D
0	1	0	0	0
1	0	1	0	0
2	0	0	1	0
3	0	0	0	1



Logic Diagram of 4-bit ring counter



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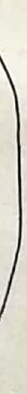
JOHNSON COUNTER (Twisted Ring Counter)

In Johnson Counter the $\bar{Q}$ output of each stage of Flip-Flop is connected to D input of the next stage and the complement output $\bar{Q}$ of the last stage is fed back to the input of first stage. The last stage output is fed back to the first stage input D_A. Initially the register is cleared. Therefore $Q_A Q_B Q_C Q_D = 0000$. Since $Q_D = 0$, $\bar{Q}_D = 1$, D_A will be 1. When the first clock pulse is triggered Q_A becomes 1 and the remaining outputs are Zero. Hence $Q_A Q_B Q_C Q_D = 1000$. When the second clock pulse is triggered Q_A and Q_B becomes 1 and the remaining outputs are 0. Hence $Q_A Q_B Q_C Q_D = 1100$. The change of states is shown.

CLK	Q_A	Q_B	Q_C	Q_D
0	0	0	0	0
1	1	0	0	0
2	1	1	0	0
3	1	1	1	0
4	1	1	1	1
5	0	1	1	1
6	0	0	1	1
7	0	0	0	1



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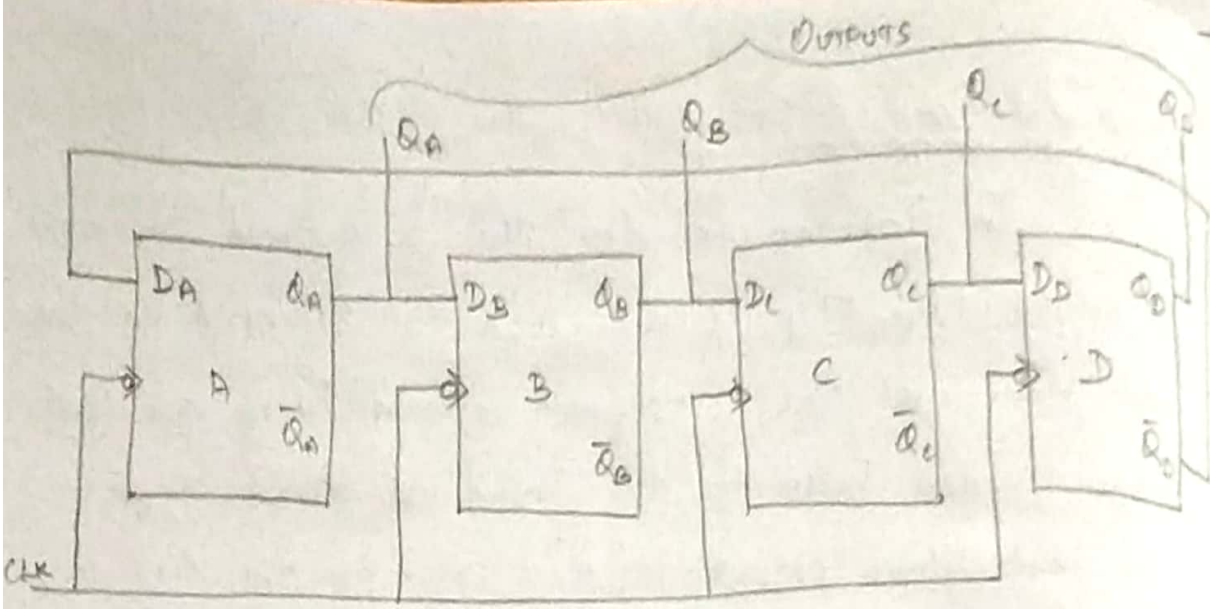

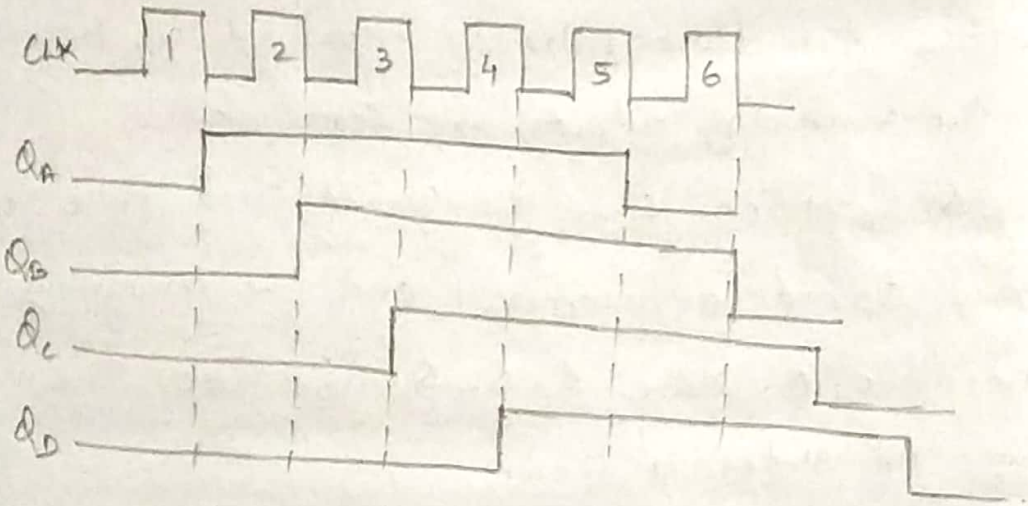

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