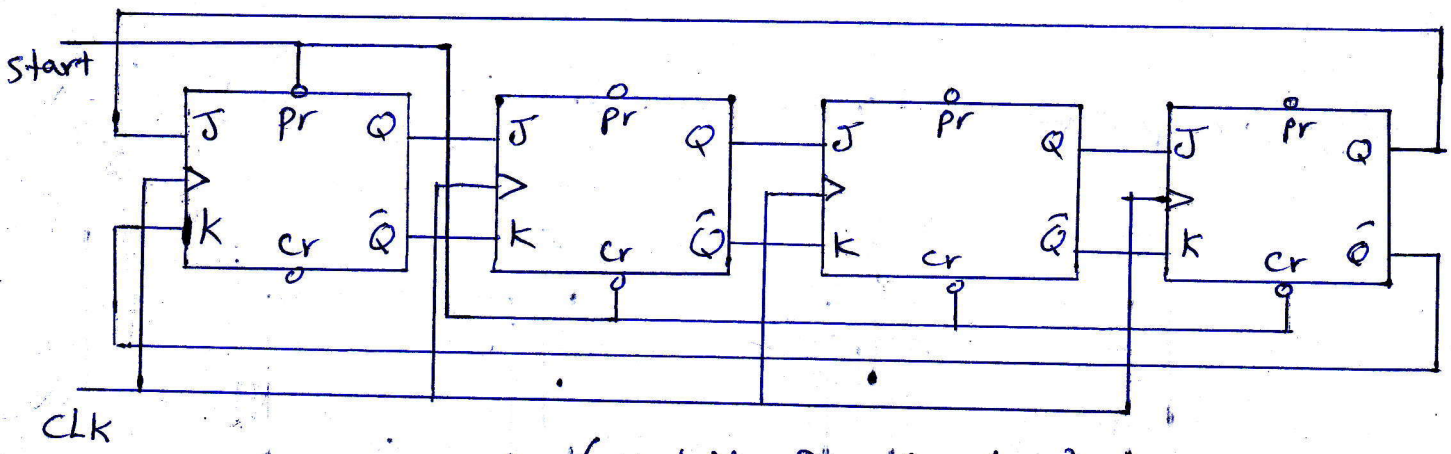
Shift Register Counters:

A shift register counters is basically a shift register with serial o/p is connected to the serial i/p to produce special sequence. Two of the most common types of shift register counters are :-

1- Ring Counter:-

This type of counter has the characteristic that in most instances only a single 1 is in the register and it is made to circulates around the register as long as clock pulses are applied. This type of counter is constructed as shown below:-



(4-bit Ring Counter)

D	C	B	A
0	0	0	1
0	0	1	0
0	0	0	0
1	0	0	0

or

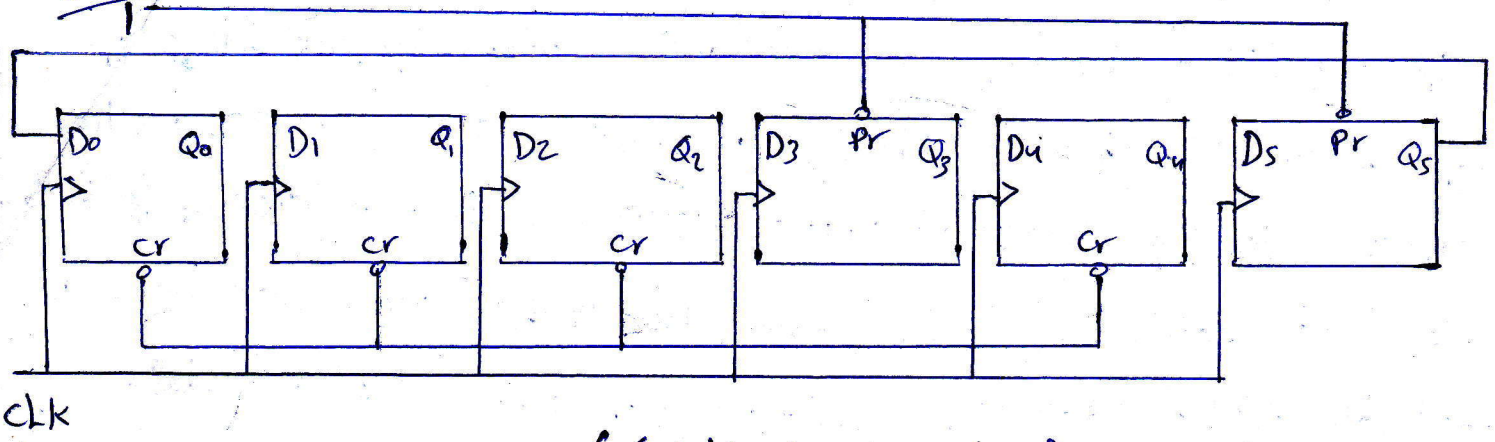
A	B	C	D
1	0	0	0
0	1	0	0
0	0	1	0
0	0	0	1

Notes:-

The maximum length of the code patterns generated by this type of counter is N, where N is the number of flip-flop in the ring counter.

Ex) If a 6-bit ring counter has the initial state 101000, determine the waveform for each of Q-output?

Sol.)

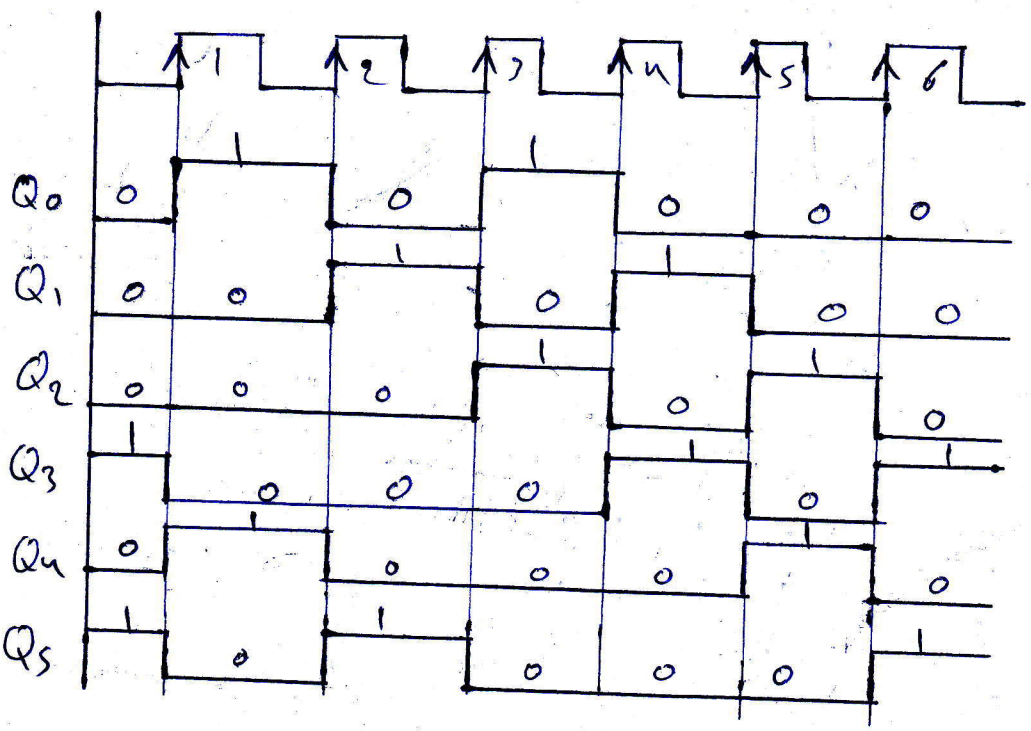


(6-bit ring counter)

Q_5	Q_4	Q_3	Q_2	Q_1	Q_0
1	0	1	0	0	0
0	1	0	0	0	1
1	0	0	0	1	0
0	0	0	1	0	1
0	0	1	0	1	0
0	1	0	1	0	0
1	0	1	0	0	0

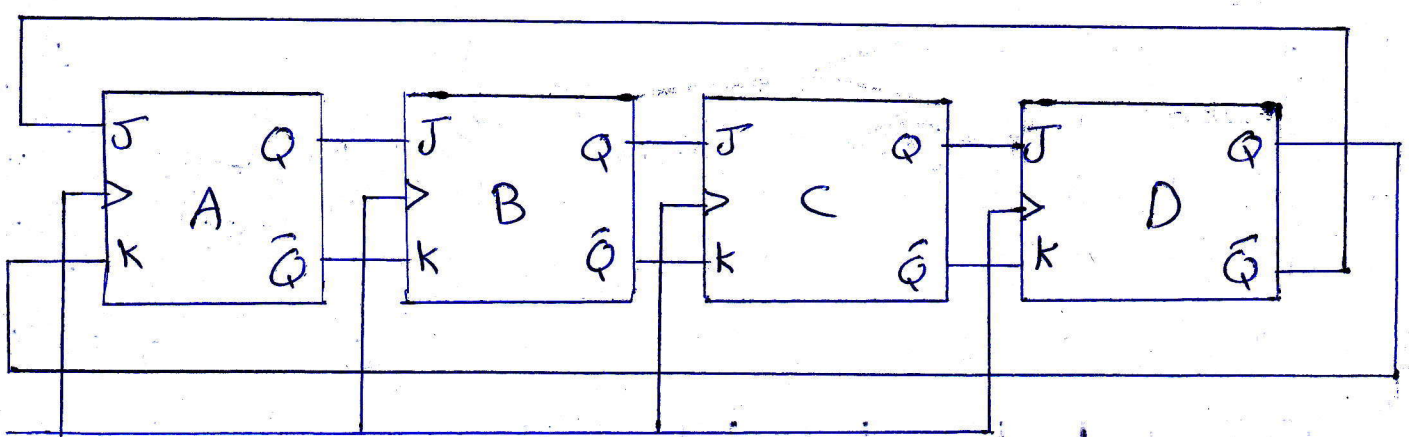
or

Q_0	Q_1	Q_2	Q_3	Q_4	Q_5	
0	0	0	1	0	1	1
1	0	0	0	1	0	
0	1	0	0	0	1	2
1	0	1	0	0	0	3
0	1	0	1	0	0	4
0	0	1	0	1	0	5
0	0	0	1	0	1	6



The Johnson Counters.

In a Johnson Counter the complement of the output of the last flip-flop is connected back to the D input of the first flip-flop (it can be implemented with other types of flip-flops as will). This feedback arrangement produces a characteristic sequence of states as shown in the example below for a 4-bit device. Notice that the 4-bit sequence has a total of eight states, or bit patterns, and the 5-bit sequence has a total of ten states. In general, a Johnson counter will produce a modulus of $2N$, when N is the number of stages (Flip-Flop) in the counter.



(4-bit Johnson Counter).

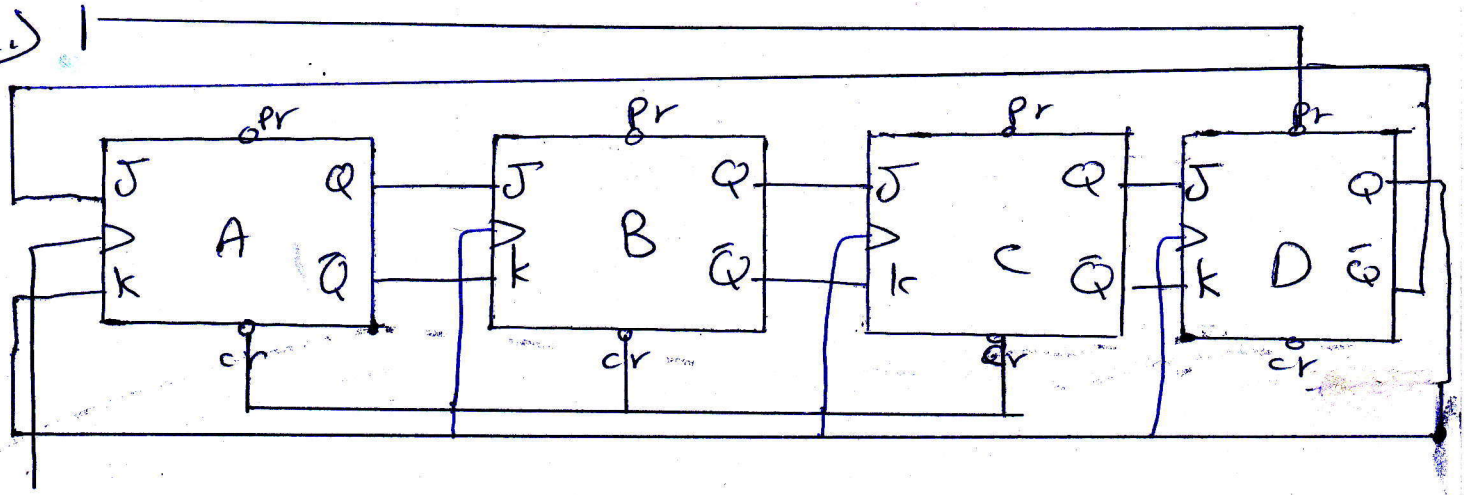
A	B	C	D
0	0	0	0
1	0	0	0
1	1	0	0
1	1	1	0
1	1	1	1
0	1	1	1
0	0	1	1
0	0	0	1
0	0	0	0

or

D	C	B	A
0	0	0	0
0	0	0	1
0	0	1	1
0	1	1	1
1	1	1	1
1	1	1	0
1	1	0	0
1	0	0	0
0	0	0	0

Ex) If a 4-bit Johnson Counter has the initial state 1000, determine the waveform for each of Q-output?

Sol:)



clk ↓

D	C	B	A
1	0	0	0
0	0	0	0
0	0	0	1
0	0	1	1
0	1	1	1
1	1	1	1
1	1	1	0
1	1	0	0
1	0	0	0

H.W Draw the waveform?