Digital Electronics and Microprocessors

Class 12

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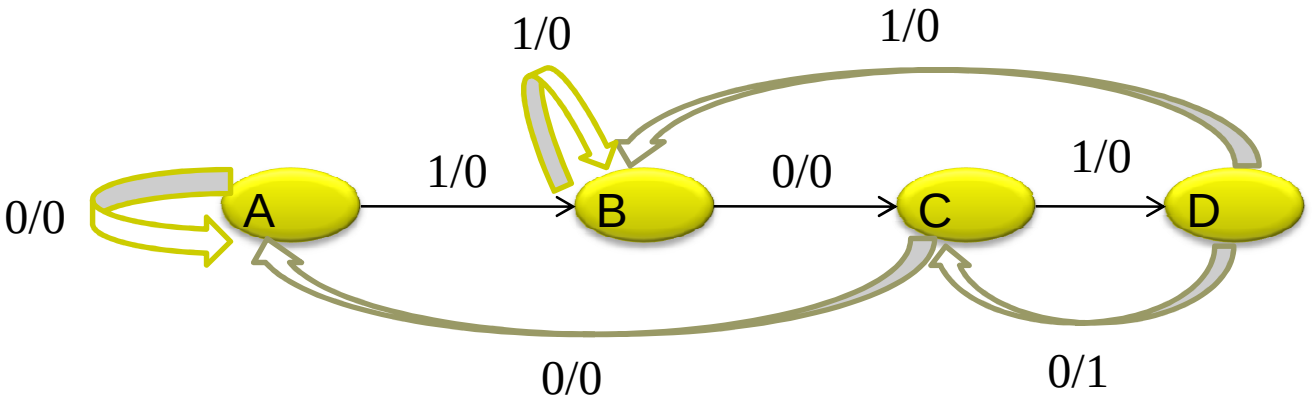
Synthesis of a sequential circuits(Design Procedure)

- Design Procedure for sequential circuit
  - The word description of the circuit behavior to get a state diagram;
  - State reduction if necessary;
  - Assign binary values to the states;
  - Obtain the binary-coded state table;
  - Choose the type of flip-flops;
  - Derive the simplified flip-flop input equations and output equations;
  - Draw the logic diagram;

Design 1:- design a sequence detector to detect the sequence 1010 and say that overlapping is permitted i.e if input sequence is 01101010 the corresponding output is 00000101

- Step1:-word statement of a problem
  - Suppose we want to design a sequence detector to detect the sequence 1010 and say that overlapping is permitted i.e if input sequence is 01101010 the corresponding output is 00000101
- Step 2 and 3:- state diagram and state table

State diagram



State table

PS	NS,Z	
	X=0	X=1
A	A,0	B,0
B	C,0	B,0
C	A,0	D,0
D	C,1	B,0

Step 4:-state reduction

- this machine is already in reduced standard form

Step 5:-state assignment and transition and o/p table

PS	NS		O/P	
	X=0	X=1	X=0	X=1
A→00	00	01	0	0
B→01	10	01	0	0
C→10	00	11	0	0
D→11	10	01	1	0

Step6:-Choose type of flip flop and form the excitation table

PS		I/P	NS		I/P toFF		O/P
Y1	Y2	X	Y1	Y2	D1	D2	Z
0	0	0	0	0	0	0	0
0	0	1	0	1	0	1	0
0	1	0	1	0	1	0	0
0	1	1	0	1	0	1	0
1	0	0	0	0	0	0	0
1	0	1	1	1	1	1	0
1	1	0	1	0	1	0	1
1	1	1	0	1	0	1	0

expression

Y1 \ Y2X				
				1
		1		**1**

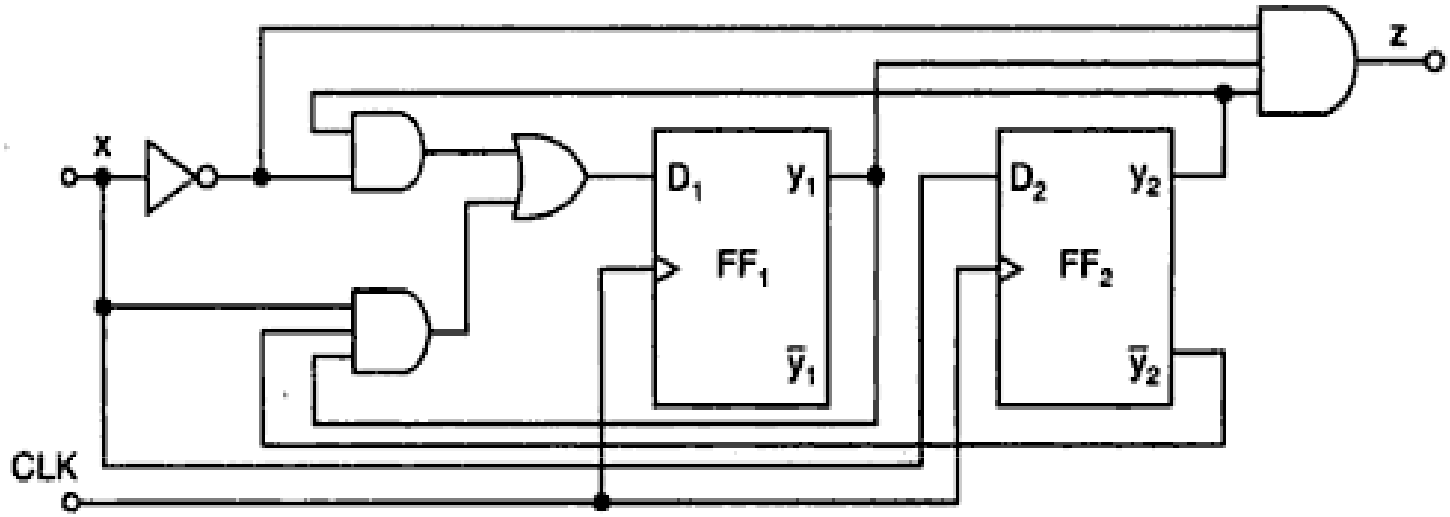
D1=Y2X’+Y1Y2’X

Y1 \ Y2X				
		1	**1**	
		1	**1**	

D2=X

Z=Y1Y2X’

Step8:- implementation



Mealy machine

Shift register counters(7-21 T1)

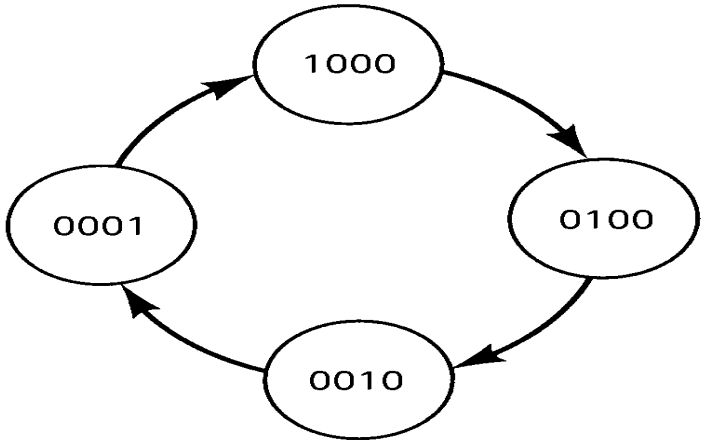
- Ring counter
- Johnson counter

Ring counter

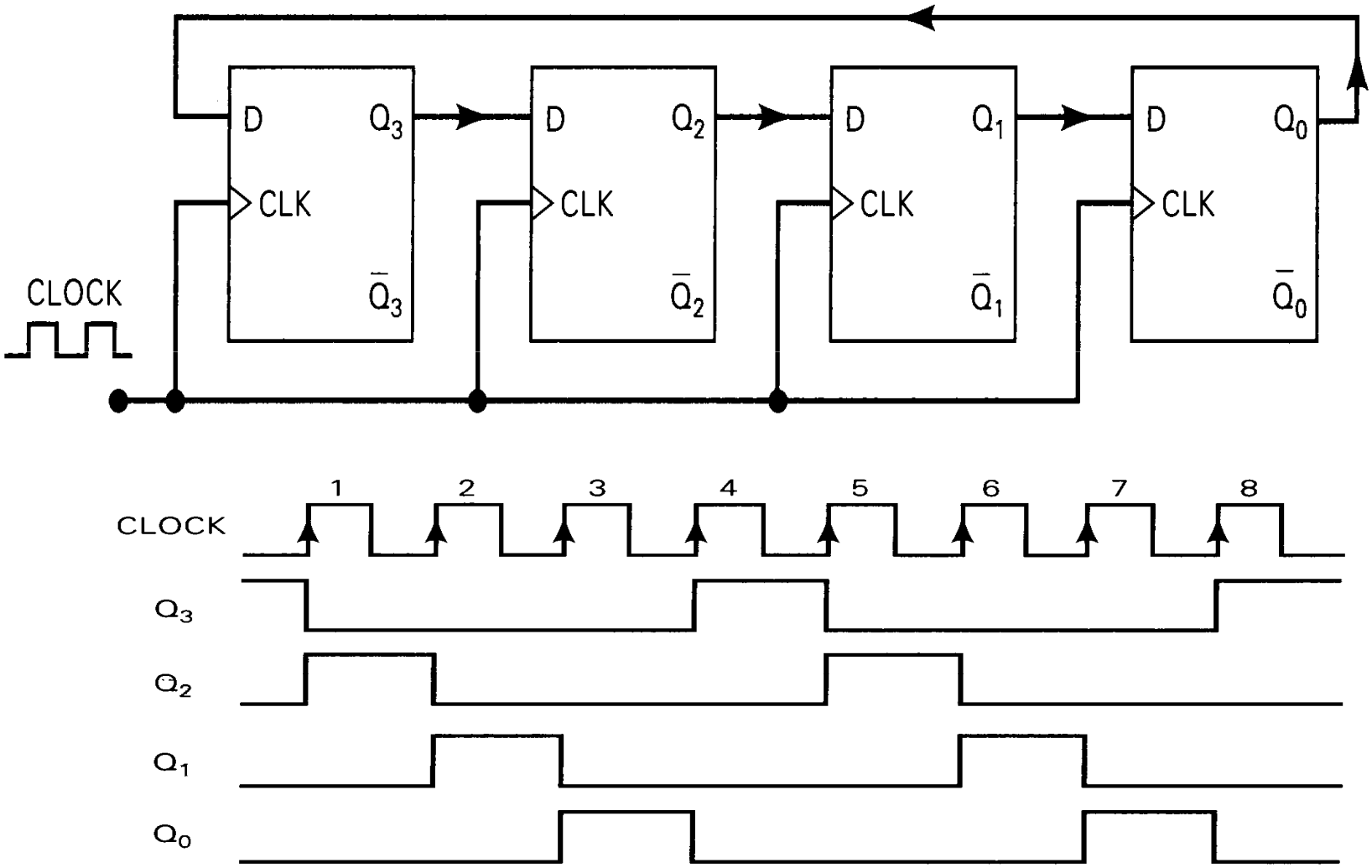
- a circular shift register w/ only one flip-flop being set at any particular time, all others are cleared

  (initial value = 1 0 0 … 0)
- The single bit is shifted from one flip-flop to the next to produce the sequence of timing signals.

A_2	A_2	A_1	A_0
1	0	0	0
0	1	0	0
0	0	1	0
0	0	0	1
1	0	0	0



Ring counter

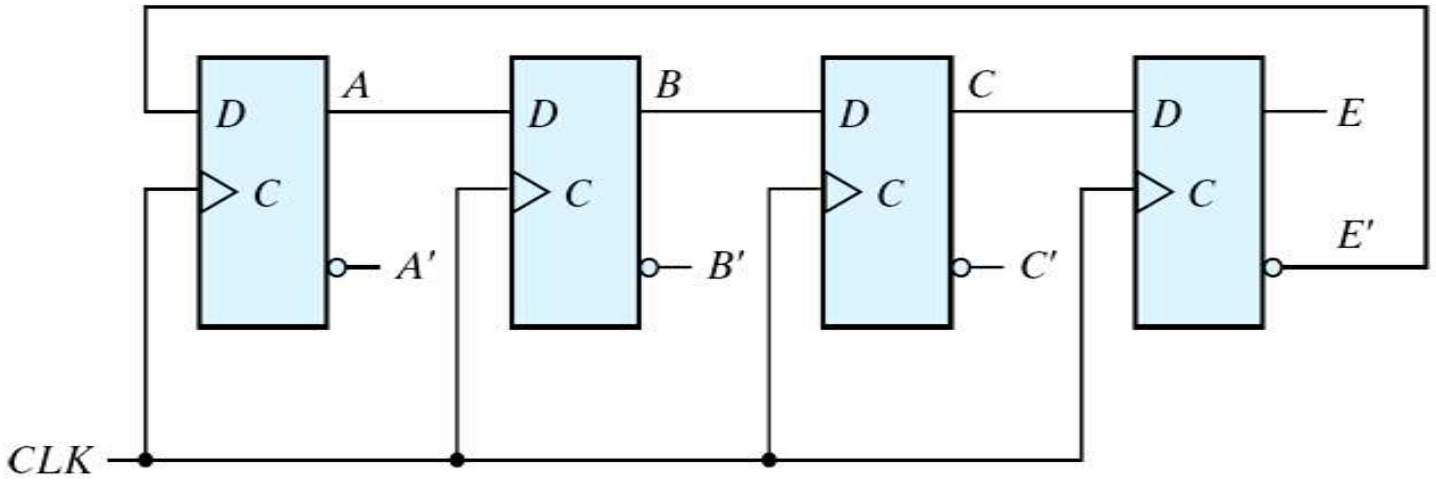


Johnson Counter

Ring counter vs. Switch-tail ring counter

- Ring counter
  - a *k*-bit ring counter circulates a single bit among the flip-flops to provide *k* distinguishable states.
- Switch-tail ring counter (Johnson Counter)
  - is a circular shift register the complement output of the last flip-flop connected to the input of the first flip-flop
  - a *k*-bit switch-tail ring counter will go through a sequence of 2*k* distinguishable states. (initial value = 0 0 … 0)

Johnson Counter



(a) Four-stage switch-tail ring counter

Sequence number	Flip-flop outputs			
	A	*B*	*C*	*E*
1	0	0	0	0
2	1	0	0	0
3	1	1	0	0
4	1	1	1	0
5	1	1	1	1
6	0	1	1	1
7	0	0	1	1
8	0	0	0	1

(b) Count sequence

Fig. Construction of a Johnson counter

SHIFT REGISTER VOCABULARY

REGISTER- group of flip flops capable of storing data.

SERIAL DATA TRANSMISSION- transfer of data from one place to another one bit at a time.

PARALLEL DATA TRANSMISSION- simultaneous transfer of all bits of a data word from one place to another.

SISO- SERIAL IN/SERIAL OUT- type of register that can be loaded with data serially and has only one serial output.

SIPO- SERIAL IN/PARALLEL OUT- type of register that can be loaded with data serially and has parallel outputs available.

PISO- PARALLEL IN/SERIAL OUT- type of register that can be loaded with parallel data and has only one serial output.

PIPO- PARALLEL IN/PARALLEL OUT- type of register that can be loaded with parallel data and has parallel outputs available.