Digital Design
First Semester 2020-21
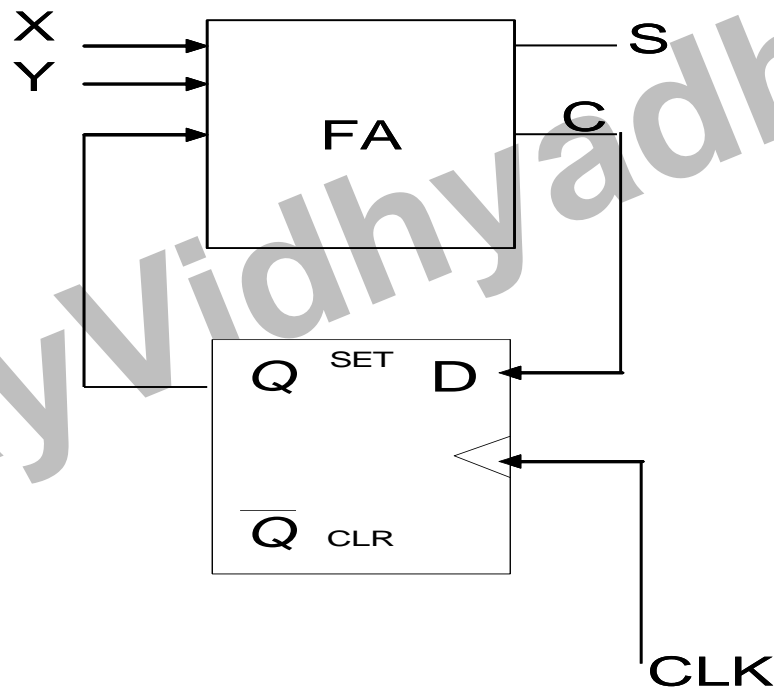# Tutorial : 10

State Table Reduction

1. A sequential circuit has one flip-flop Q, two inputs x and y, and one output S. It consists of a full-adder circuit connected to a D flip-flop, as shown. Derive the state table and state diagram of the sequential circuit.
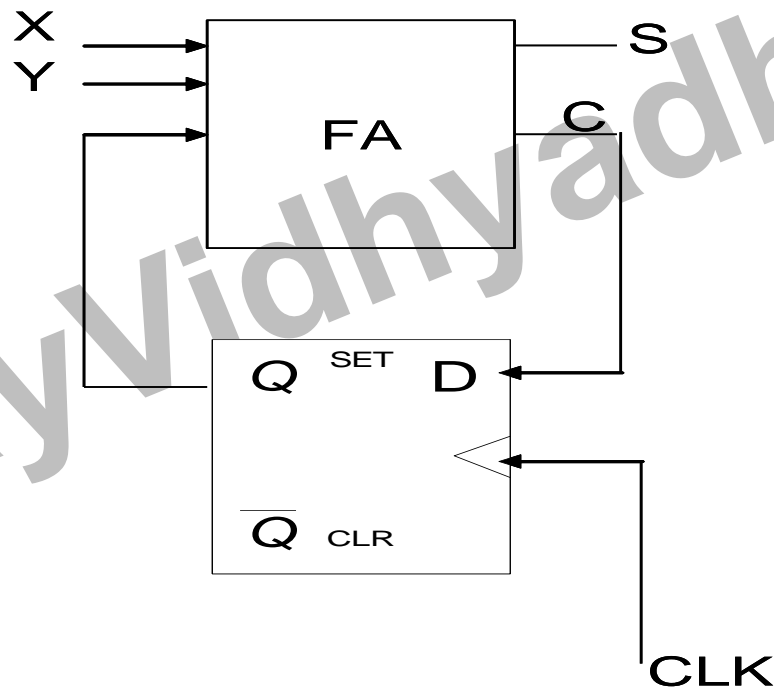
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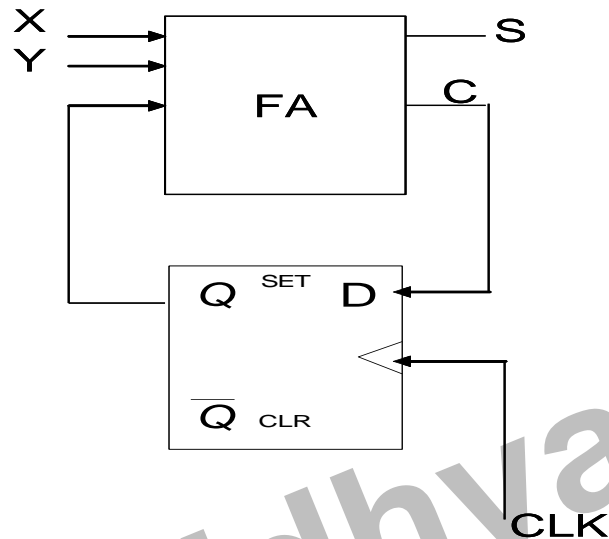
1.

FA equations: $S = X \oplus Y \oplus Q$ $C = XY + XQ + YQ$

Input equation: $D_Q = C$
$= XY + XQ + YQ$ (from the FA equations or from the K-map)

Characteristic equation:

$Q(t+1) = D = XY + XQ + YQ$

State equation:

$Q(t+1) = C$

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1.

PRESENT STATE	INPUTS		NEXT STATE	OUTPUT
Q	X	Y	Q	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

State Diagram:
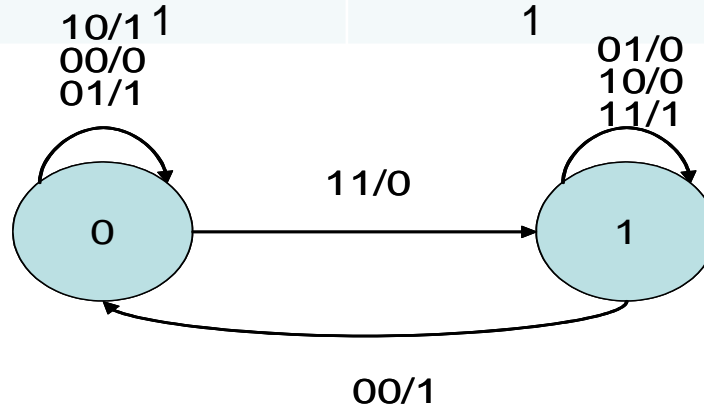
10/1
00/0
01/1

01/0
10/0
11/1

11/0

0   1

00/1

2. Reduce the number of states in the following table and tabulate the reduced state table.

PRESENT STATE	NEXT STATE		OUTPUT	
	X=0	X=1	X=0	X=1
a	f	b	0	0
b	d	c	0	0
c	f	e	0	0
d	g	a	1	0
e	d	c	0	0
f	f	b	1	1
g	g	h	0	1
h	g	a	1	0

2. Reduce the number of states in the following table and tabulate the reduced state table.

States b,e are the same ,we will replace state e with state b .
States d,h are the same ,we will replace state h with state d .

PRESENT STATE	NEXT STATE		OUTPUT	
	X=0	X=1	X=0	X=1
a	f	b	0	0
b	d	c	0	0
c	f	b	0	0
d	g	a	1	0
f	f	b	1	1
g	g	d	0	1

2. Reduce the number of states in the following table and tabulate the reduced state table.

States a,c are the same ,we will replace state c with state a .

PRESENT STATE	NEXT STATE		OUTPUT	
	X=0	X=1	X=0	X=1
a	f	b	0	0
b	d	a	0	0
d	g	a	1	0
f	f	b	1	1
g	g	d	0	1

3. Optimize using Implication Table .

State Table to be Reduced.

Present State	Next State		Output	
	x=0	x=1	x=0	x=1
a	d	a	0	0
b	e	a	0	0
c	g	f	0	1
d	a	d	1	0
e	a	d	1	0
f	c	b	0	0
g	a	e	1	0

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3. Optimize using Implication Table .

State Table to be Reduced.

Present State	Next State		Output	
	x=0	x=1	x=0	x=1
a	d	a	0	0
b	e	a	0	0
c	g	f	0	1
d	a	d	1	0
e	a	d	1	0
f	c	b	0	0
g	a	e	1	0

b	(d,e) √				
c	X	X			
d	X	X	X		
e	X	X	X	√	
f	(c,d) (a,b)	(c,e) (a,b)	X	X	X
g	X	X	X	(d,e) √	(d,e) √	X
	a	**b**	**c**	**d**	**e**	**f**

3. Optimize using Implication Table .

Reduced State Table.

Present State	Next State		Output	
	x=0	x=1	x=0	x=1
a	d	a	0	0
c	d	f	0	1
d	a	d	1	0
f	c	a	0	0

	a	b	c	d	e	f
b	(d,e) √					
c	X	X				
d	X	X	X			
e	X	X	X	√		
f	(c,d) X (a,b)	(c,e) X (a,b)	X	X	X	
g	X	X	X	(d,e) √	(d,e) √	X