- The state table tells us about the relation between the p...

11.5.1 State Diagram :

- The information available in the state table is represented graphically using the state diagram.
- The state diagram is drawn by using the state table as a reference. Such a state diagram is shown in Fig. 11.5.1.

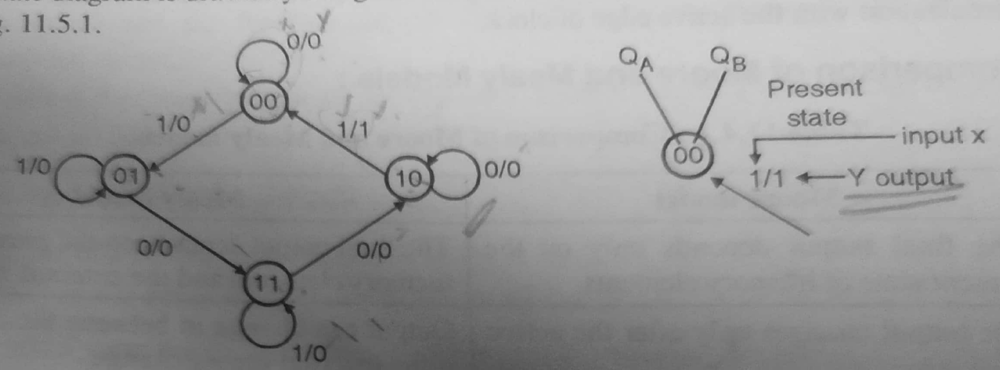


Fig. 11.5.1 : State diagram

- The circle represents the present state. The arrows between the circles define the state transition say from 00 to 01 or 01 to 11.

- A directed line connecting the same circle indicates that the next state is same as the present state.
- The lines joining the circles are labeled with a pair of binary numbers with a " / " in between. For example the line joining 00 and 01 is labeled as 1/0.
- Note that 00 to 01 transition takes place when x = 1 and Y = 0 (see row-1 of the state table). Hence 1 in 1/0 corresponds to x and 0 corresponds to y.

...'t care condition in the state diagram :

- Sometimes the same next state is reached for more than one present states.
- This is called as don't care condition in the state diagram, as shown in Fig. 11.5.2.

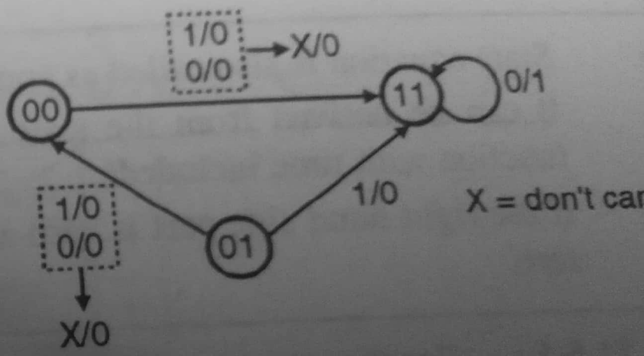
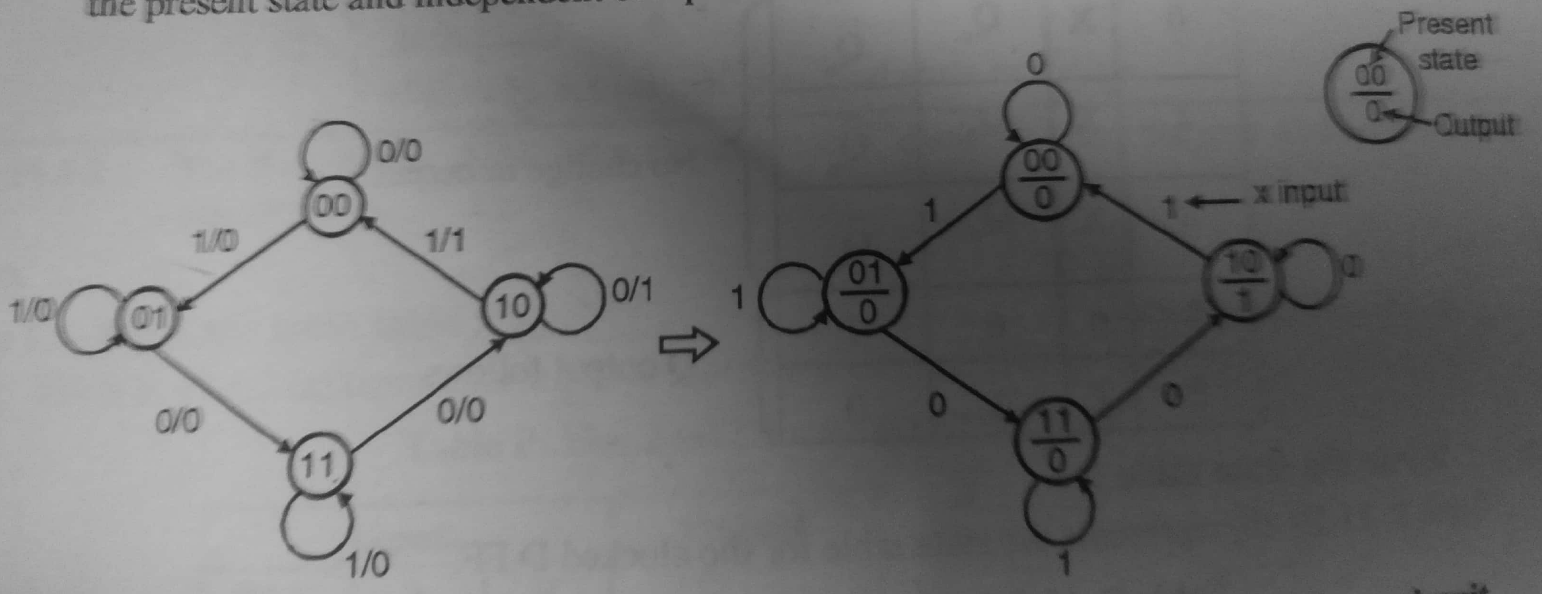


Fig. 11.5.2 : Don't care condition i... state diagram

Scanned with CamScanner

State diagram of a Moore Circuit :

- The state diagram of a Moore circuit is slightly modified than the basic state diagram as shown in Fig. 11.5.3(b).
- The labelling of the directed line now contains only one binary number corresponding to x input which causes the state transition.
- The output state is now indicated inside the circle. This is because the output Y depends only on the present state and independent of input x.



(a) Original state diagram (b) Modified state diagram for a Moore circuit

Fig. 11.5.3

11.5.2 State Equation :

- State equation is an algebraic equation. The left side of this equation represents the next state of the flip flops.
- And the right hand side of this equation specifies the present state conditions which make the next state equal to 1.

Ex. 11.5.1 : For the clocked D FF write the state table, draw the state diagram and write the state equation.

Soln. :

Step 1 : Write the truth table :

Table P. 11.5.1 (a) represents the truth table for a clocked D flip flop.

Table P. 11.5.1 (a) : Truth table of a clocked D FF

Inputs		Outputs		
CLK	D	Q_{n+1}	$\bar{Q}_{n+1}$	
0	X	Q_n	$\bar{Q}_n$	No change in output
1	X	Q_n	$\bar{Q}_n$	
↓	X	Q_n	$\bar{Q}_n$	
↑	0	0	1	Q output follows
↑	1	1	0	

Step 2 : Write the state table :

Table P. 11.5.1 (b) represents the state table for the clocked D FF.

Table P. 11.5.1 (b) : State table of a clocked D FF

Present state Q_n	Next state Q_{n+1}	
	D = 0	D = 1
0	0	1
1	0	1

Step 3 : State diagram :

State diagram of clocked D FF is shown in Fig. P. 11.5.1.

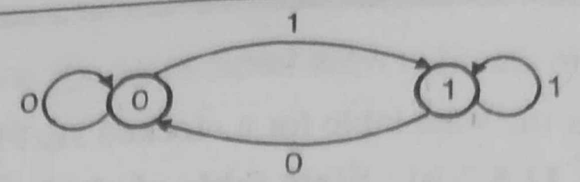


Fig. P. 11.5.1 : State diagram of a clocked D FF

Step 4 : Write excitation table :

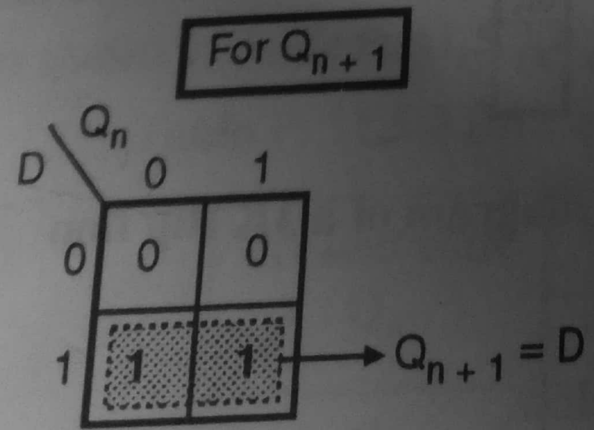
The excitation table for D FF is given below.

Table P. 11.5.1 (c) Excitation table for D FF

Present state Q_n	Next state Q_{n+1}	D
0	0	0
0	1	1
1	0	0
1	1	1

Step 5 : Write the state equation :

The K-map for output Q_{n+1} is shown in Fig. P. 11.5.1 (a).



∴ **State equation**

$Q_{n+1} = D$ ..... **Ans**

Fig. P. 11.5.1 (a) : K-map and state equation

...tate diagram and write the state

Ex. 11.5.2 : For the clocked JK FF write the state table, draw the state diagram and write the state equation.

Soln. :

Step 1 : Write the truth table :

Table P. 11.5.2 (a) represents the truth table for a clocked JK flip flop.

Table P. 11.5.2 (a) : Truth table of JK FF

Inputs			Output	
CLK	J	K	Q_{n+1}	
0	X	X	Q_n (NC)	No change in output
1	X	X	Q_n (NC)	
↓	X	X	Q_n (NC)	
↑	0	0	Q_n (NC)	
↑	0	1	0	
↑	1	0	1	
↑	1	1	$\bar{Q}_n$	

Step 2 : Write the state table :

Table P. 11.5.2(b) represents the state table for a clocked JK FF.

Table P. 11.5.2(b) : State table of clocked JK FF

Present state Q_n	Next state Q_{n+1}			
	JK = 00	JK = 01	JK = 10	JK = 11
0	0	0	1	1
1	1	0	1	0

Step 3 : Draw the state diagram :

State diagram is as shown in Fig. P. 11.5.2(a).

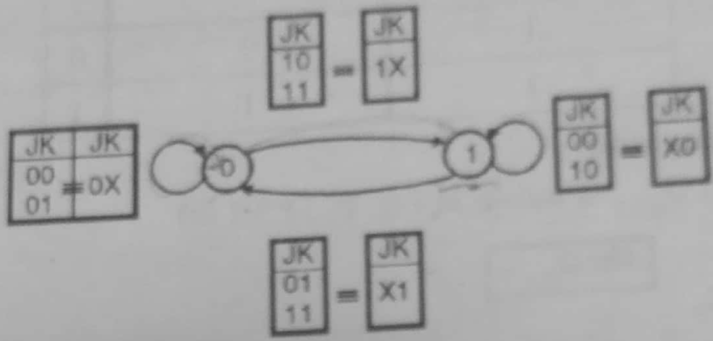


Fig. P. 11.5.2 (a) : State diagram of a JK flip flop

Step 4 : Write the excitation table :

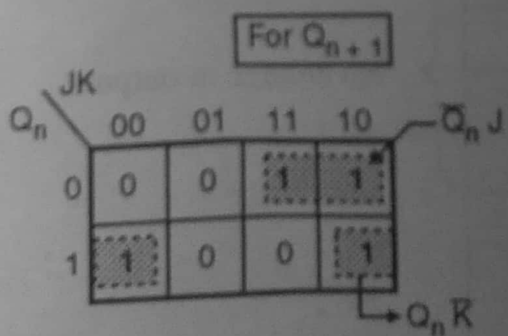
The excitation table of JK FF is as shown below.

Table P. 11.5.2(c) : Excitation table for JK FF

Present state Q_n	Next state Q_{n+1}	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

Step 5 : Write the state equation :

The K-map for output Q_{n+1} is shown in Fig. P. 11.5.2(b).



∴ **State equation**

$$Q_{n+1} = \bar{Q}_n J + Q_n \bar{K}$$

Fig. P. 11.5.2 (b) : K-map state equation

Ex. 11.5.3 : For a toggle FF write the state table, draw the state diagram and write the state equation.

Soln. :

Step 1 : Write the truth table :

Table P. 11.5.3(a) gives the truth table for a T FF.

Table P. 11.5.3 (a) : Truth table for a T FF

CLK	T	Q_{n+1}
0	X	Q_n
1	X	Q_n
↑	X	Q_n
↓	0	Q_n
↓	1	$\bar{Q}_n$

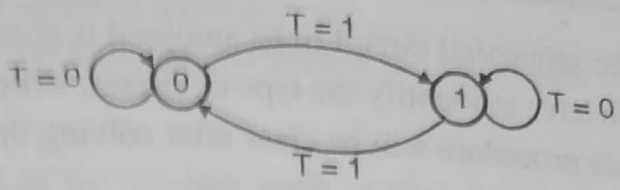


Fig. P. 11.5.3 (a) : State diagram of a T FF

Step 2 : Write the state table :

The state table is shown in Table P. 11.5.3(b).

Table P. 11.5.3 (b) : State table for a T FF

Present state Q_n	Next state Q_{n+1}	
	T = 0	**T = 1**
0	0	1
1	1	0

tep 3 : Draw the state diagram :

The state diagram is shown in Fig. P. 11.5.3(a).

ep 4 : Write the excitation table :

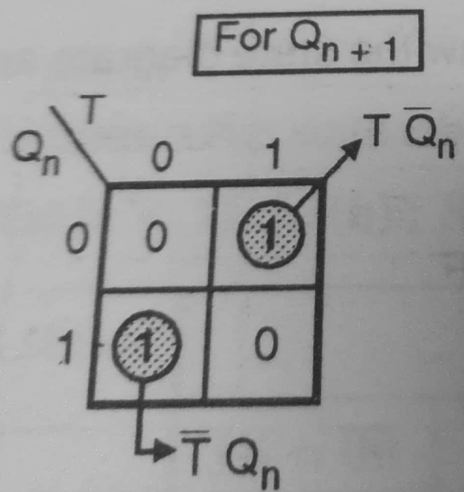
Table P. 11.5.3(c) represents the excitation table of T FF.

Table P. 11.5.3(c) : Excitation table for T FF

Present state Q_n	Next state Q_{n+1}	T
0	0	0
0	1	1
1	0	1
1	1	0

p 5 : Write the state equation :

The K-map for Q_{n+1} output is shown in Fig. P. 11.5.3(b). The state equation can be obtained n this K-map.



∴ **State equation**

$$Q_{n+1} = T\bar{Q}_n + \bar{T}Q_n$$
$$= T \oplus Q_n$$

Fig. P. 11.5.3(b)