



SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB231 – DIGITAL ELECTRONICS

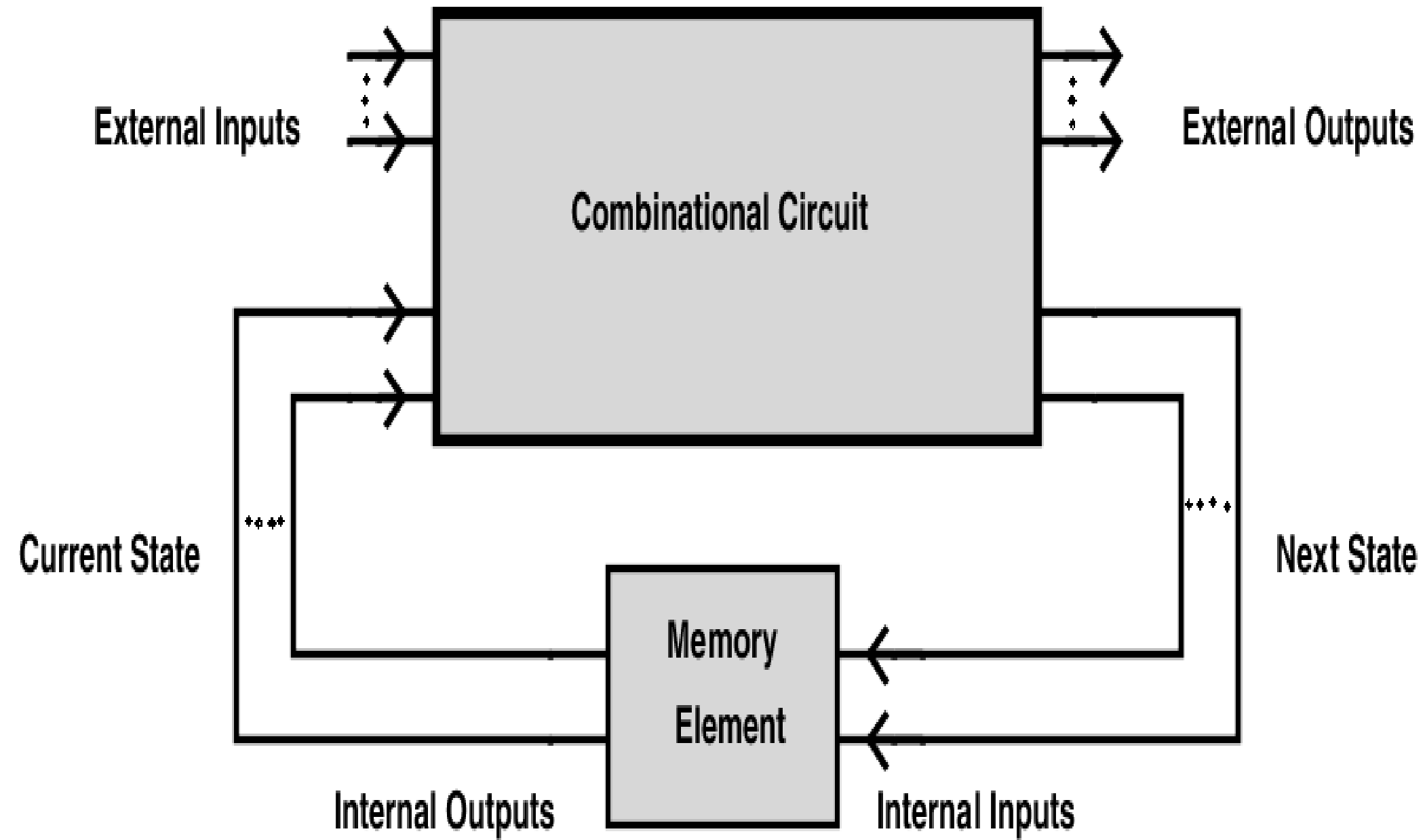
II YEAR/ III SEMESTER

UNIT 3 – SEQUENTIAL CIRCUITS

TOPIC 1 - LATCHES



SEQUENTIAL CIRCUITS





SEQUENTIAL CIRCUITS



- This sequential circuit contains a set of inputs and outputs
- The outputs of sequential circuit depends not only on the combination of present inputs but also on the previous outputs
- Previous output is nothing but the **present state**
- Therefore, sequential circuits contain combinational circuits along with memory storage elements
- Some sequential circuits may not contain combinational circuits, but only memory elements



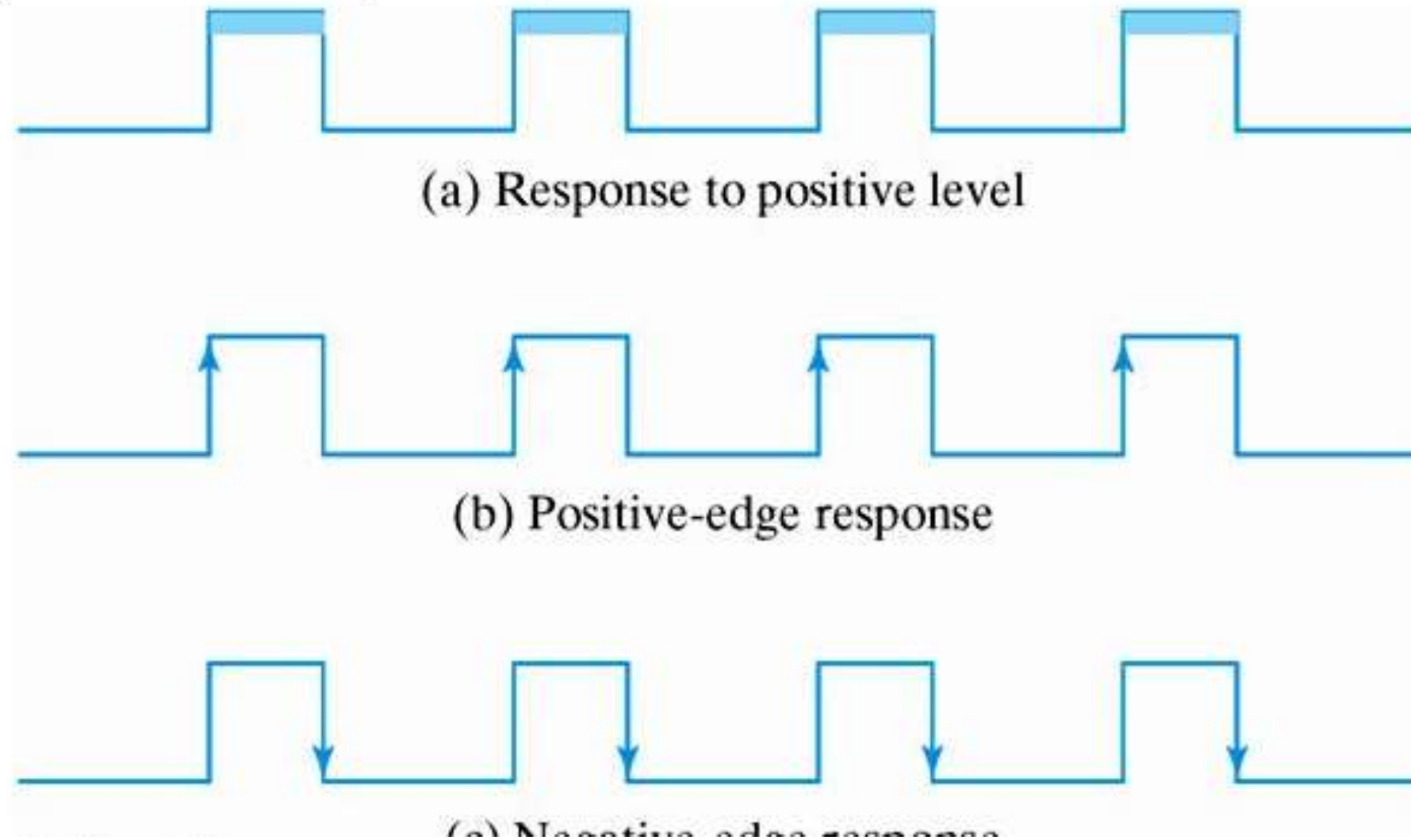
LATCH



- LATCH –building block of sequential circuits capable of storing one bit information
- It has 2 output states Q and Q Complement
- It is built from Logic gates
- Latches does not have Clock signal instead it have enable line
- Output changes only when enable input signal is applied
- Latch is level Triggered



- A trigger
 - The state of a latch or flip-flop is switched by a change of the control input
- Level triggered – latches
- Edge triggered – flip-flops



. 5.8

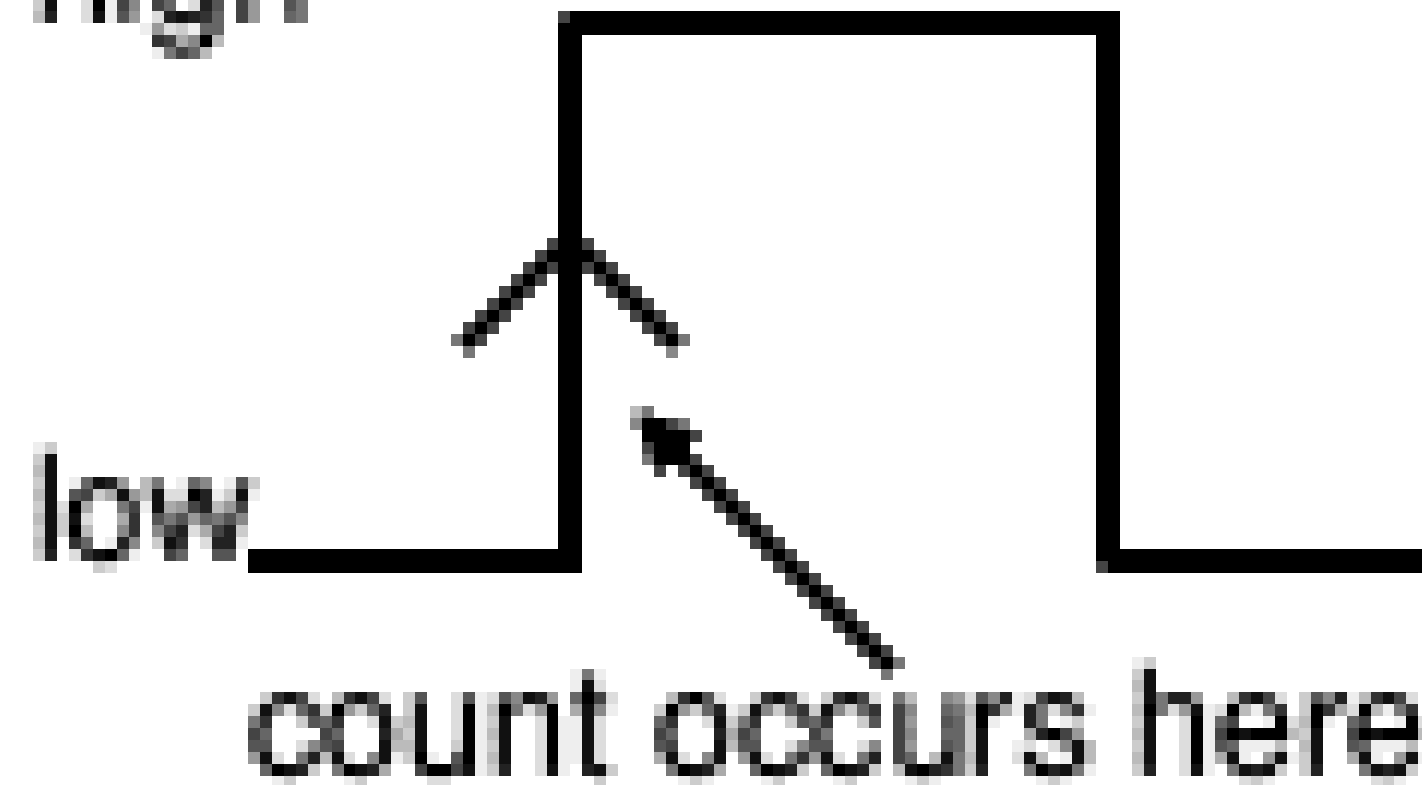


EDGE TRIGGERING

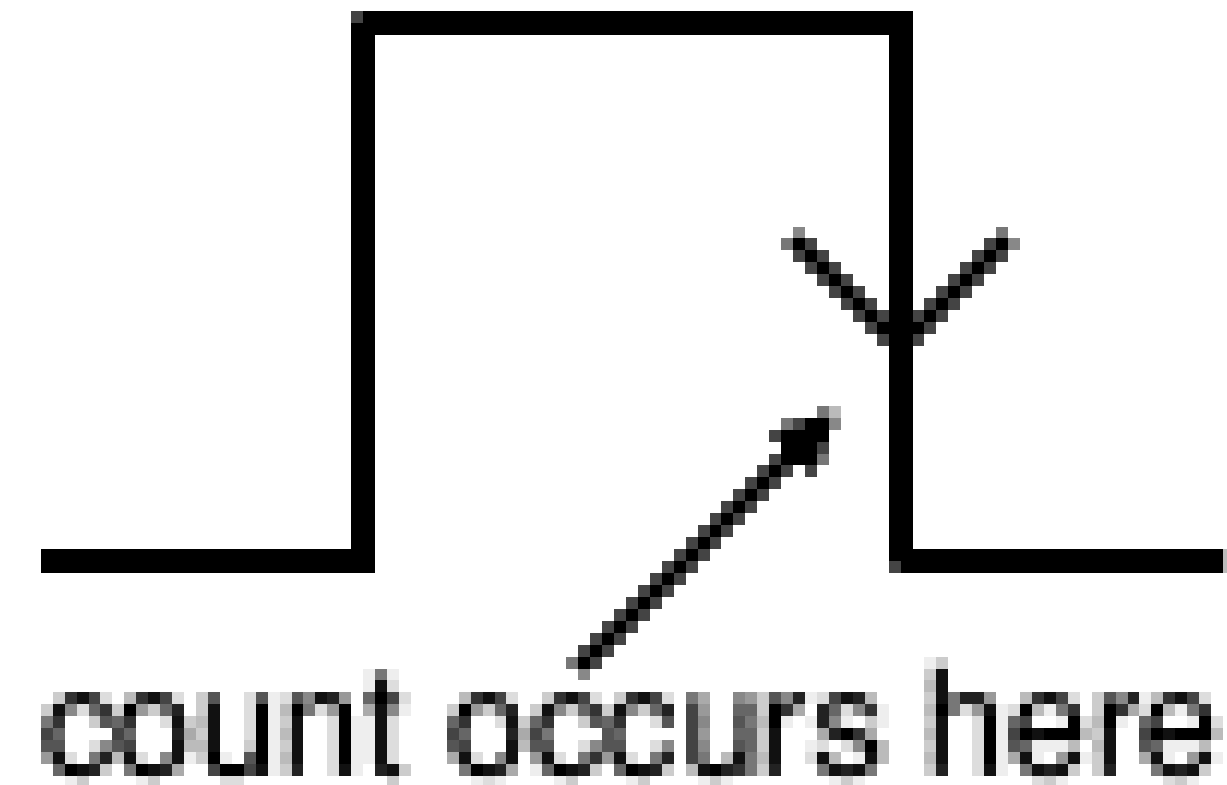


Rising-edge

high



Falling-edge





Level Triggering	Edge Triggering
<p>1. It is of two types</p> <ul style="list-style-type: none">- High level triggering- Low level triggering <p>2. The latch or flip-flop circuits which change their outputs only corresponding to active high or low levels are called as level triggered latches or flip-flops.</p>	<p>1. It is of two types :</p> <ul style="list-style-type: none">- Positive edge triggering- Negative edge triggering <p>2. Those flip-flops which change their outputs only corresponding to the positive or negative edge of the clock input are called as edge triggered flip-flops.</p>



TYPES OF LATCH



1.SR Latch

R=Reset and S=Set

2.D Latch

D means Delay

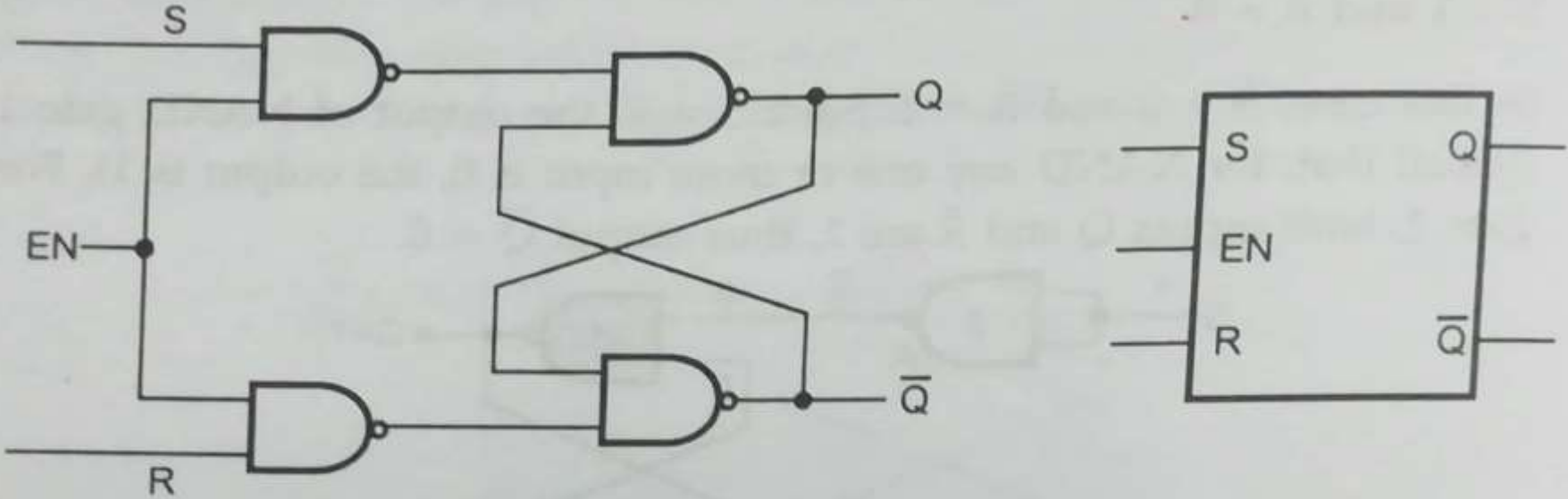
3.T Latch

T means Toggle

4.JK Latch



SR LATCH



(a) SR latch with enable input using NAND gates

(b) Logic symbol

Fig. 6.7

EN	S	R	Q_n	Q_{n+1}	State
1	0	0	0	0	No change (NC)
1	0	0	1	1	
1	0	1	0	0	Reset
1	0	1	1	0	
1	1	0	0	1	Set
1	1	0	1	1	
1	1	1	0	X	Indeterminate
1	1	1	1	X	
0	X	X	0	0	No change (NC)
0	X	X	1	1	

Table 6.2 Truth table for SR latch with enable input



SR LATCH



Characteristics Equation

S	R Q _n			
	00	01	10	11
0	0	1	0	0
1	1	1	X	X

$$Q_{n+1} = S + \bar{R} Q_n$$



SR LATCH

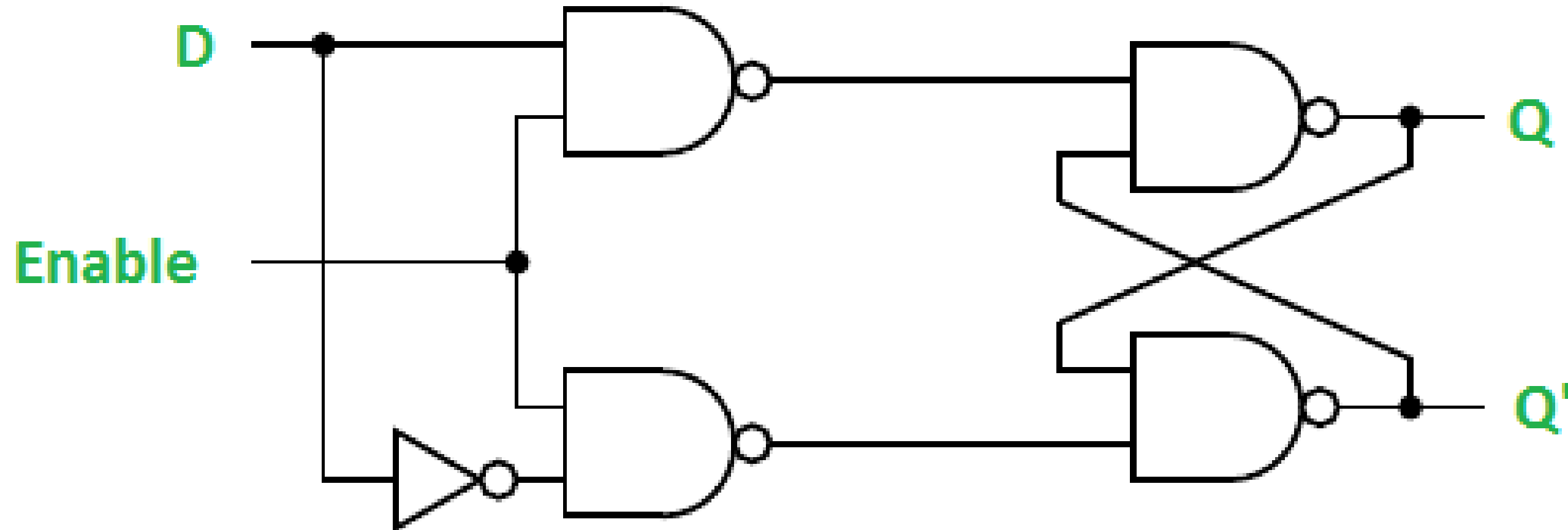


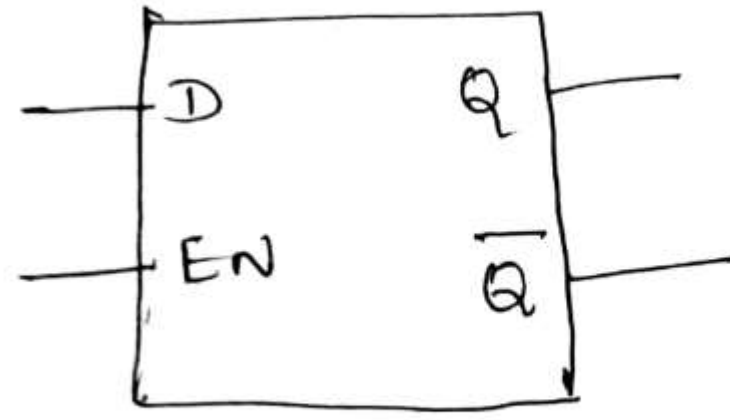
Excitation Table

Q_n	Q_{n+1}	S	R
0	0	0	X
0	1	1	0
1	0	0	1
1	1	X	0



D LATCH





Logic Symbol.

Truth Table

E	D	Q _n	Q _{n+1}
↑	0	0	0
↑	1	1	1
↑	0	1	0
↑	1	0	1
0	X	0	0
0	X	1	1



Characteristic Equation

D	$Q_n = 0$	$Q_n = 1$
0	0	0
1	1	1

$$Q_{n+1} = D$$

Excitation table

Q_n	Q_{n+1}	D
0	0	0
0	1	1
1	0	0
1	1	1



ADVANTAGES OF LATCHES



- The advantages of latches include the following.
- The designing of latches is very flexible when we compare with FFs (flip-flops)
- The latches utilize less power.
- The performance of latch in the design of the high-speed circuit is quick because these are asynchronous within the design and there is no need of CLK signal.
- The shape of the latch is very small and occupies less area
- If the operation of latch based circuit is not finished in a set time, they borrow the necessary time from other to complete the operation
- Latches give aggressive clocking when contrasted with flip-flop circuits.



APPLICATIONS OF LATCHES



- The applications of latches include the following.
- Generally, latches are used to keep the conditions of the bits to encode binary numbers
- Latches are single bit storage elements which are widely used in computing as well as data storage.
- Latches are used in the circuits like power gating & clock as a storage device.
- D latches are applicable for asynchronous systems like input or output ports.
- Data latches are used in synchronous two-phase systems for reducing the transit count.



ASSESSMENTS



- 1.What is Latch?
- 2.List the types of latches.
- 3.Difference between level trigger and edge triggering.



THANK YOU