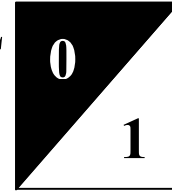




**ISTANBUL TECHNICAL  
UNIVERSITY**



**COMPUTER ENGINEERING**

**DIGITAL CIRCUITS LABORATORY  
EXPERIMENT REPORT**

**EXPERIMENT NO: 6**

**EXPERIMENT NAME: Latches and Flip-Flops**

**EXPERIMENT DATE: 31.03.2014**

**GROUP NO: A6**

**STUDENTS WHO DID THE EXPERIMENT:**

Student no	Name	Surname
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150110018	Alper	Kocabıyık
150110023	Emre Can	Agatay

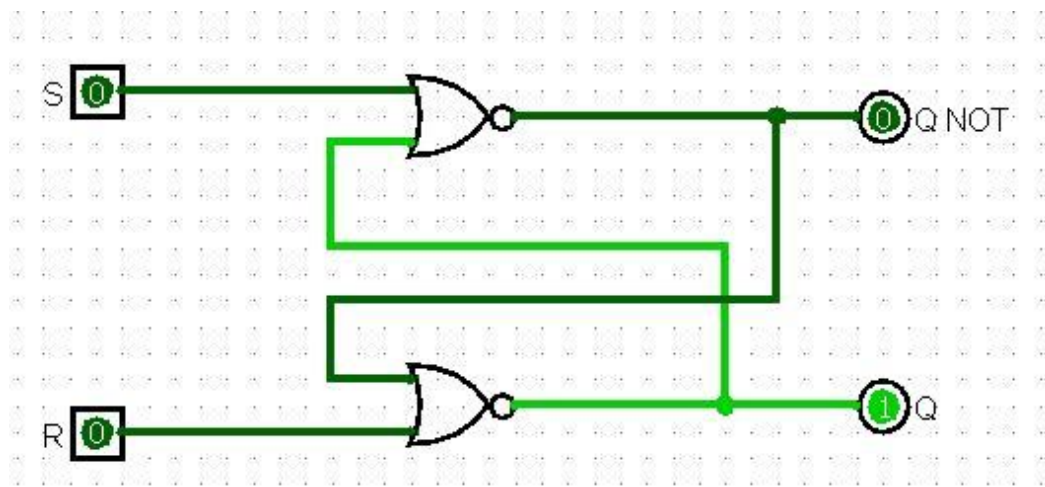
**ASSISTANT NAME WHO ASSISTED THE  
EXPERIMENT: Mahiye Uluyağmur**

## A) INTRODUCTION

The purpose of this experiment is observing latch, flip-flop and difference between latch and flip-flop which stores a data.

## B) EXPERIMENTS

### #1.1: SR Latch



S	R	Q	Q <sub>NOT</sub>
0	0	no change	no change
1	0	1	0
0	0	1	0
0	1	0	1
0	0	0	1
1	1	0	0

S=1, R=1 are the forbidden inputs.

**S:** *set*

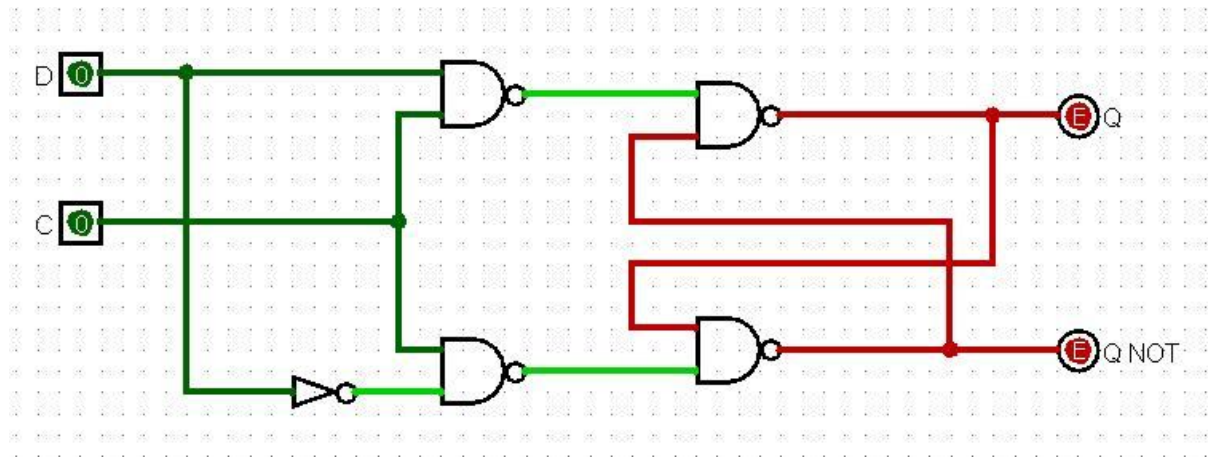
**R:** *reset*

**Q:** *output(state)*

**Q<sub>NOT</sub>:** *complement of output*

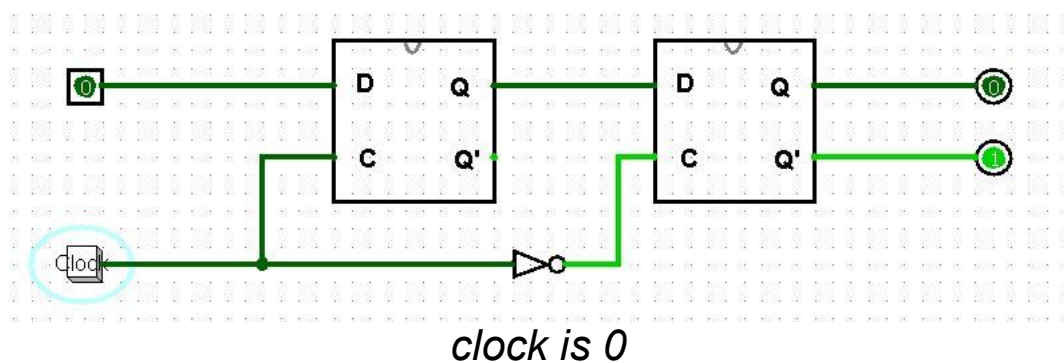
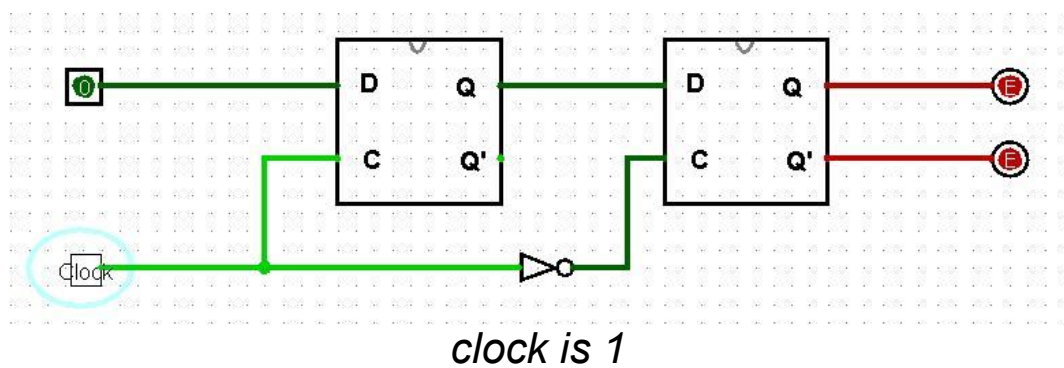
$$Q_{t+1} = S + Q_t \cdot R', \quad S \cdot R = 0$$

## #1.2: SR Latch with enable input



C	S	R	$Q_{t+1}$
0	X	X	$Q_t$
1	1	0	1
1	0	1	0
1	0	0	$Q_t$
1	1	1	forbidden

## #1.3: Falling edge triggered D flip flop



Changing is observed when the clock signal is 1 to 0.

### #1.4: 8 bit shift register

a) Frequency input

For 1/2 , 0011 0011

For 1/4 , 0000 1111

For 1/8 , 1111 1111

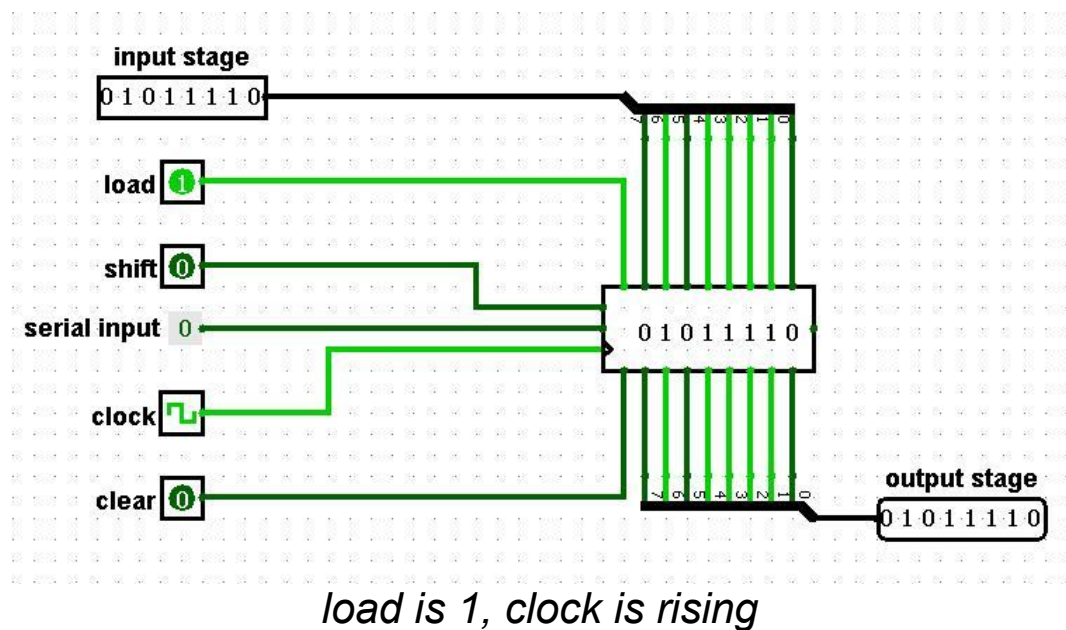
b) Impact / space ratio

For 1/3 , 0001 0001

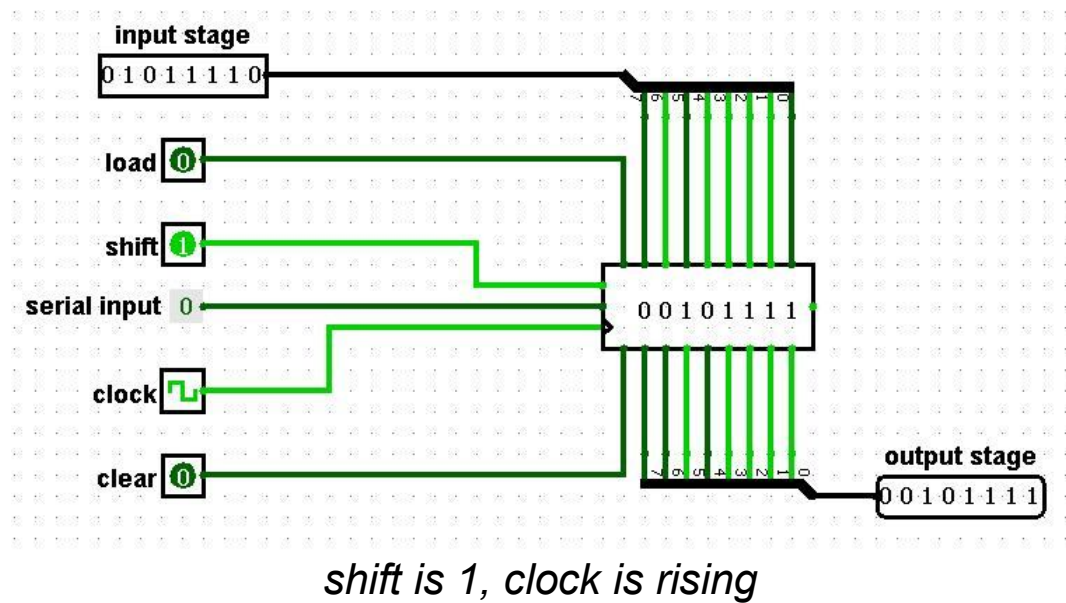
For 1/7 , 0000 0001

### Basic working principles of shift registers

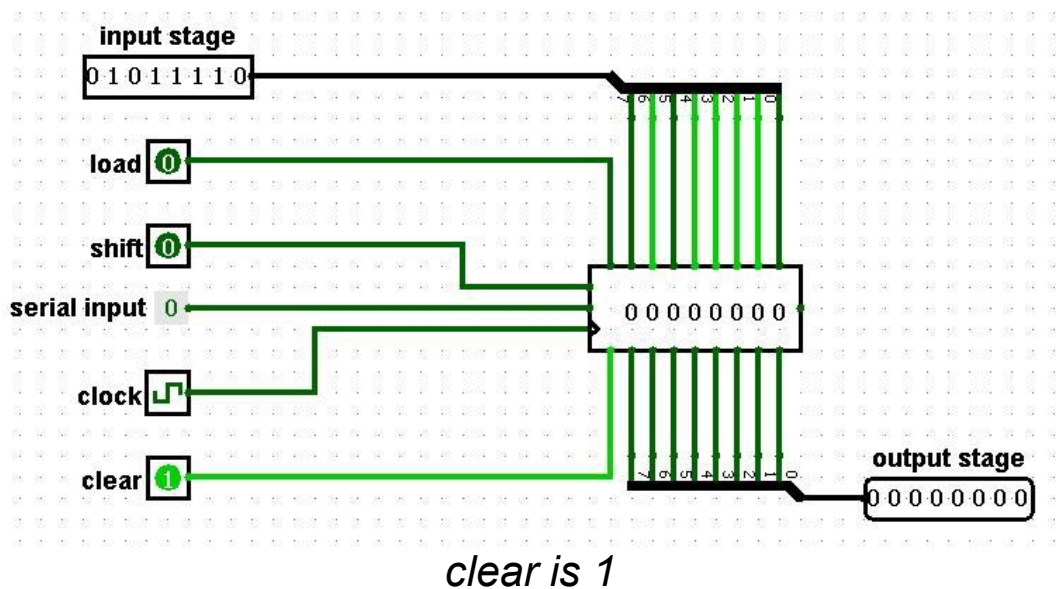
Firstly input stages loads to register.



Secondly register shifts data and it can be observed both on register and output stage.



If reset is required, clear signal should be turned into 1.



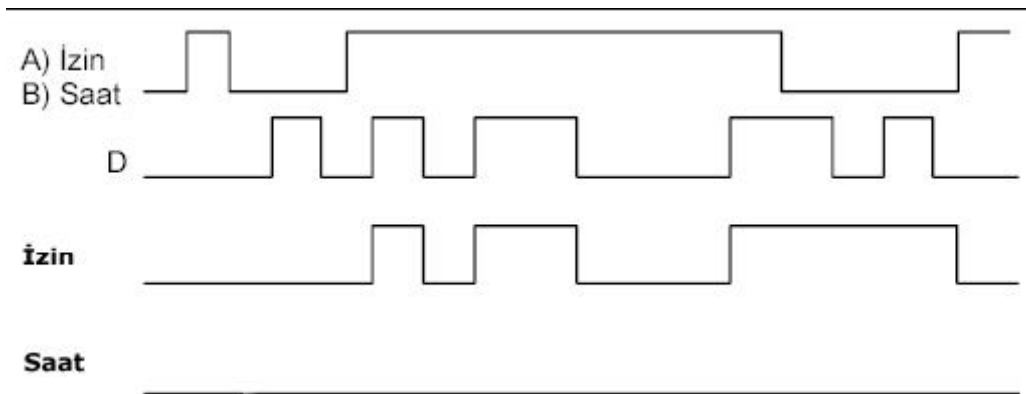
## C) QUESTIONS

### #1: Latches and Flip-Flops

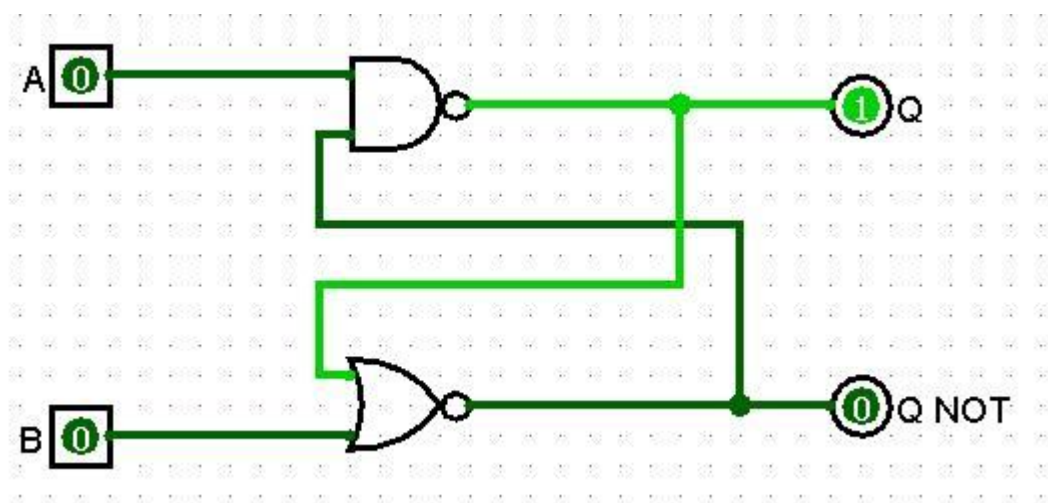
*Latches* and *flip-flops* are the basic elements for storing information. One latch or flip-flop can store one bit of information.

- Latches' outputs are constantly affected by their inputs as long as the enable signal is asserted. When they are enabled, their content changes immediately when their inputs change.
- Flip-flops have their content change only either at the rising or falling edge of the enable signal. After the clock, the flip-flop content remains constant even if the input changes.

**#2:**



**#3:**



<b>Q<sub>t</sub></b>	<b>A</b>	<b>B</b>	<b>Q<sub>t+1</sub></b>
0	0	0	forbidden
0	0	1	1
0	1	0	0
0	1	1	forbidden
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

<b>A</b>	<b>B</b>	<b>Q</b>	<b>Q<sub>NOT</sub></b>
1	0	no change	no change
0	0	1	0
0	1	1	0
1	0	1	0
1	1	1	0