

Department of BES-II

Digital Design and Computer Architecture

23ECI1202

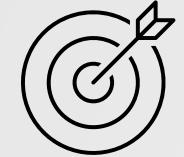
Topic:

Modeling of memory and registers

Session No: 14

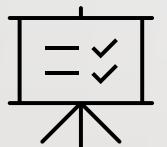
AIM OF THE SESSION

To familiarize students with the basic concept of Modeling of Memory and Registers



INSTRUCTIONAL OBJECTIVES

This Session is designed to:



1. Demonstrate the Architecture of Memory Systems
2. Describe the Functionality of Memory Units
3. List Out Different Types of Memory
4. Describe the Impact of Memory and Register Design on System Performance

LEARNING OUTCOMES



At the end of this session, you should be able to:

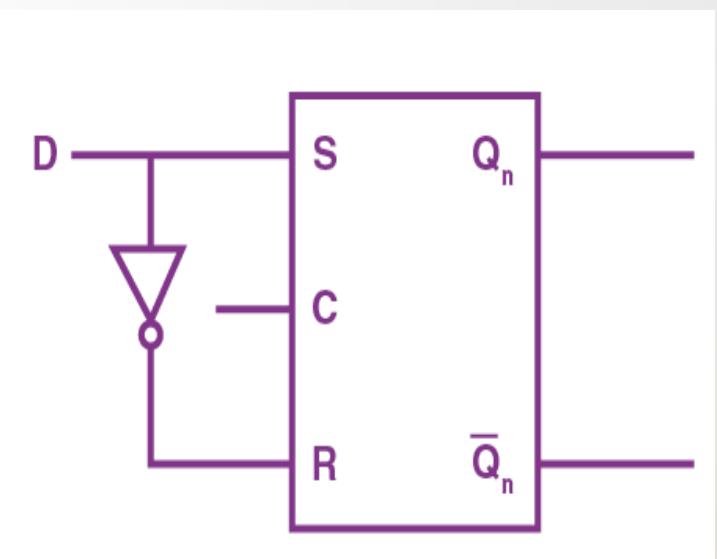
1. Define Memory in Digital Systems
2. Describe Memory Architecture
3. Summarize Key Concepts in Memory and Register Modeling

SESSION INTRODUCTION

- Memory and registers serve as storage elements in digital systems.
- Modelling them allows engineers to abstract their behaviour at a higher level, focusing on how data is stored, retrieved, and manipulated without delving into the intricate details of the physical implementation.

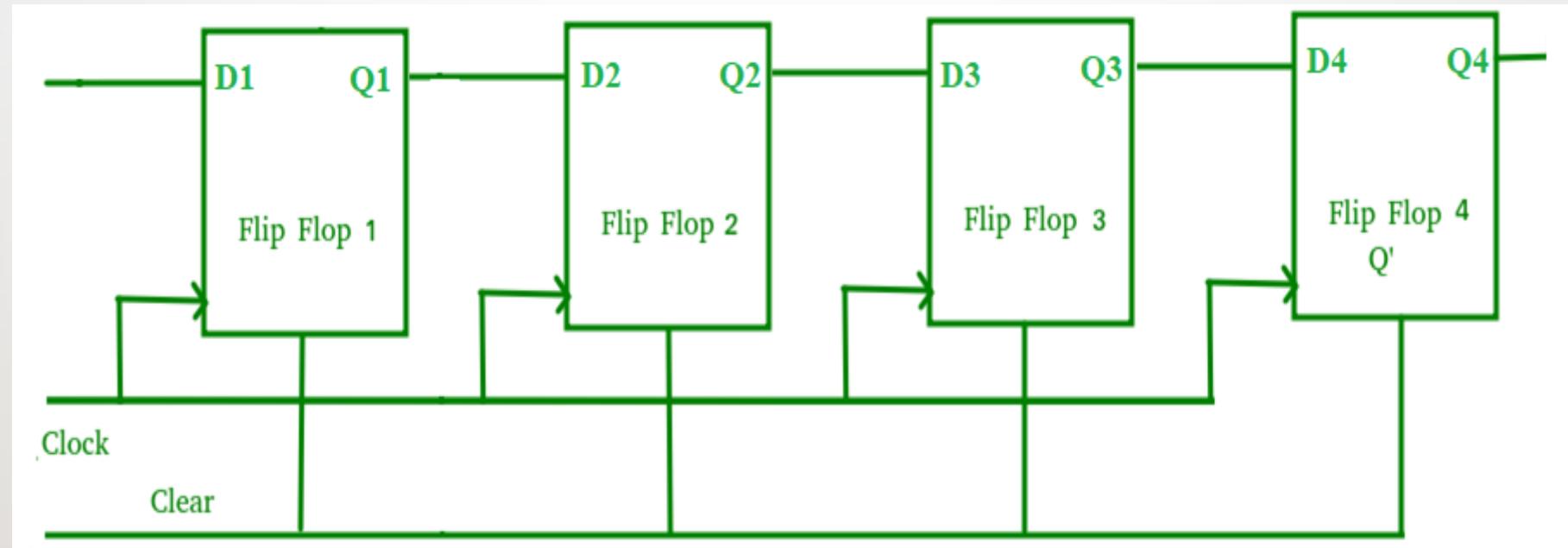
Registers

- To increase the storage capacity compared to flip-flop (1-bit storage), we use group of flip-flops called as registers.
- If we want to store an n-bit word, we have to use an n-bit register containing n number of flip flops.
- Registers are used to hold data that is actively being operated on by the CPU. They store operands for arithmetic and logic operations and hold intermediate results.



1-bit storage – D Flip-flop

Registers



Ex: Data in 8-bit register:

0	1	0	1	1	0	1	0
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Major Purpose of Registers

- **Data Registers:** Hold data for arithmetic and logic operations.
- **Address Registers:** Store memory addresses.
- **Status Registers:** Contain flags indicating the status of the CPU (e.g., zero flag, carry flag).
- **Instruction Register (IR):** Holds the current instruction being executed.

Modelling of Memory

Register Array:

- Registers are arrayed together to create larger memory structures.
- For example, a 4x8 register array would consist of 4 registers, each capable of storing 8 bits. This array can store 32 bits in total.
- The array can be expanded to any size as needed, depending on the storage requirements.

Addressing and Access:

- In a register array, each register is typically given an address.
- Accessing a specific register involves specifying its address.
- This can be done through additional circuitry like multiplexers and de-multiplexers.
- Read and write operations are controlled through control lines.

SUMMARY

- Memory in digital systems is constructed using flip-flops, which are circuits capable of storing a single bit of information. Registers, which are made up of multiple flip-flops, are used to store larger units of data (like a group of 8, 16, or 32 bits).
- Registers are arrayed together to create larger memory structures. Each register in an array can store multiple bits, and the entire array can hold a significant amount of data. These arrays are organized and accessed using addressing mechanisms.

SELF-ASSESSMENT QUESTIONS

1. What is the primary component used to construct a register in digital systems?

- A. Transistor
- B. Capacitor
- C. Flip-Flop
- D. Diode

2. How many bits of information can a single D flip-flop store?

- A. 2
- B. 4
- C. 1
- D. 8

SELF-ASSESSMENT QUESTIONS

3. What is the purpose of a common clock signal in a register made of flip-flops?

- A. To synchronize the reading of data
- B. To synchronize the storing of data
- C. To provide power to the flip-flops
- D. To amplify the signal strength

4. In a memory array constructed with registers, how is a specific register typically accessed?

- A. Through direct current
- B. Using a unique address
- C. By manual switches
- D. Randomly without any order

TERMINAL QUESTIONS

Short answer questions:

- I. Illustrate the modelling diagram of a 3-bit register using flip-flops.

REFERENCES FOR FURTHER LEARNING OF THE SESSION

Reference Books:

1. Computer System Architecture by M. Morris Mano
2. Fundamentals of Digital Logic with Verilog HDL by Stephen Brown and ZvonkoVranesic

Sites and Web links:

1. <https://www.javatpoint.com/registers-in-digital-electronics>
2. https://www.tutorialspoint.com/computer_logical_organization/digital_registers.html

THANK YOU



Team – Digital Design & Computer Architecture