COMPUTER ORGANIZATION AND ARCHITECTURE (COA)

What is COA?

Computer Organization and Architecture (COA) is a core subject in computer science and engineering that explains how a computer system is designed and how it works internally.

1. Computer Architecture

Computer Architecture refers to the conceptual design and functional behavior of a computer system — what the computer does.

It includes:

- Instruction Set Architecture (ISA)
- Data types
- Addressing modes
- Register set
- Memory addressing
- Input/ Output mechanisms

2. Computer Organization

Computer Organization refers to **how the architecture is implemented** — how the hardware components are connected and operate together

It includes:

- Control unit design
- ALU (Arithmetic Logic Unit)
- Registers
- Memory hierarchy
- Buses
- Micro architecture

Importance of COA

- Helps understand how programs run on hardware
- Improves efficient coding and system design
- Essential for learning processors, embedded systems, and operating systems

MEMORY:-

Memory is the part of a computer that stores data, instructions, and results so the CPU can use them when needed-

Memory is used to store:

- Program instructions (software)
- Input data
- Intermediate results
- Final output results

TYPES OF MEMORY:-

1. Primary Memory (Main Memory)-

- Directly accessed by the CPU
- Faster than secondary memory

Examples:

- **RAM (Random Access Memory)** – Temporary, volatile
- **ROM (Read Only Memory)** – Permanent, non-volatile

2. Secondary Memory (Auxiliary Memory)-

- Used for long-term storage
- Slower but larger capacity

Examples:

- Hard Disk, SSD, Pen Drive, CD/DVD

MEMORY HIERARCHY:-

Memory Hierarchy is the arrangement of different types of memory in a computer system based on speed, cost, and capacity**.**

Purpose of Memory Hierarchy

- To provide **fast access** to data
- To reduce **cost**
- To balance **speed and storage capacity**

Levels of Memory Hierarchy (Top to Bottom)

Registers

- Fastest
- Inside CPU
- Very small size

Cache Memory

- Very fast Stores
- frequently used
- Between CPU and main memory

Main Memory (RAM)

- Moderate speed
- Volatile
- Stores running programs

Secondary Memory

- Slowest
- Non-volatile
- Large storage capacity
- Example: Hard Disk, SSD

FLIP-FLOP-

A flip-flop is a bistable device that can store one binary digit (0 or 1) and changes its state in response to a clock signal.

Types of Flip-Flops

- SR Flip-Flop
- JK Flip-Flop
- D Flip-Flop
- T Flip-Flop