# Lab 6:

## Arfah rizwan (54983)

### Question 1:Write a detailed explanation of how the Fetch-Decode-Execute cycle works.

### ****Fetch****

* The **Program Counter (PC)** holds the memory address of the next instruction to be executed.
* The **Address Register (AR)** receives this address from the PC.
* The instruction is fetched from memory and stored in the **Instruction Register (IR)**.
* The PC is incremented to point to the next instruction in memory.

### ****2. Decode****

* The CPU decodes the instruction in the IR to determine what operation needs to be performed.
* The **Control Unit (CU)** interprets the instruction and prepares the necessary components (registers, ALU, etc.) for execution.
* If the instruction involves fetching data, the required memory addresses are identified.

### ****3. Execute****

* The CPU executes the decoded instruction. This could involve:
  + Performing arithmetic or logical operations in the **Arithmetic Logic Unit (ALU)**.
  + Moving data between registers and memory.
  + Controlling input/output devices.

### Question 2:Use a simple instruction as an example and describe each step.

**In this we take a example Instruction (ADD A, B)**:

* **Fetch**: Get "ADD A, B" from memory.
* **Decode**: Understand that it means "add value in B to A".
* **Execute**: Perform the addition and store the result in A.

Question 3: Explain the role of PC, AR, IR, AC, and DR in your own words.

**Roles of Registers**:

* **PC (Program Counter)**: Keeps track of the next instruction.
* **AR (Address Register)**: Holds memory addresses.
* **IR (Instruction Register)**: Stores the current instruction.
* **AC (Accumulator)**: Stores intermediate arithmetic results.
* **DR (Data Register)**: Holds data being transferred.

## Question 4: What is the function of the Arithmetic Logic Unit (ALU) in CPU operations? How does ALU interact with registers and memory?

### Alu functions :

The ALU (Arithmetic Logic Unit) performs calculations (addition, subtraction, logic operations).

## ALU interact :

· The **Control Unit (CU)** sends the instruction to the ALU.

· The ALU **fetches operands** (data) from **registers** like the **Accumulator (AC), Data Register (DR), or general-purpose registers**.

· The ALU **performs the operation** based on the instruction (e.g., ADD, SUB, AND).

· The result is **stored back** into a register (e.g., AC) or written to memory if needed.

· The CPU continues executing the next instruction in the **Fetch-Decode-Execute** cycle.

## Question 5:Create a new base machine and change the bit width of a register (e.g., make AC 8-bit instead of 16-bit).





