

## Functioning of Microprogrammed Control Unit (Based on the Figure)

The diagram shows how a microprogrammed control unit works inside a CPU. Here is a clear explanation, following the path of operations step by step:

### 1. Instruction Register (Top)

- The control process begins when a machine instruction is fetched from memory and loaded into the instruction register.

### 2. Decoder

- The decoder examines the instruction and determines which microprogram (set of microinstructions) should be executed for this machine instruction.

### 3. Control Address Register

- Based on the decoder output, the starting address of the right microprogram is loaded into the control address register (CAR). This address points to the first microinstruction for this machine instruction.

### 4. Control Memory

- The control address register sends its address to the control memory.
- The control memory (which stores all microinstructions) outputs the microinstruction found at that address.

### 5. Control Buffer Register

- The fetched microinstruction is loaded into the control buffer register (CBR), where it is ready to be used.

### 6. Decoder (Lower Box)

- The microinstruction from the control buffer register is decoded to generate the required control signals.
- These control signals are sent in two directions:
  - To **units inside the CPU** (e.g., ALU, registers, internal data paths).
  - To the **system bus** (for external actions, memory or I/O operations).

### 7. Sequencing Logic

- Sequencing logic determines what the next microinstruction address will be.
- It takes input from:
  - **ALU and Flags:** Conditions/results produced during execution (e.g., zero, carry, etc.).
  - **Clock:** Timing signals.

- It uses this information, along with the current microinstruction, to decide if the next address should be:
  - The next sequential address (typical step to next microinstruction).
  - A branch address (if a condition is met, the microprogram jumps to a new address for alternate processing).

#### **8. Loop Continues**

- The new address is loaded into the control address register, and the process repeats (steps 4–7) until the entire microprogram for the instruction is complete.

### **Flow Summary**

- **Instruction fetched → Decoded → Starting microinstruction address loaded**
- **Microinstruction fetched from control memory into buffer**
- **Microinstruction decoded to generate control signals**
- **ALU and flags may affect flow and cause branching if needed**
- **Sequencing logic loads next address and repeats the cycle**

#### **In short:**

The microprogrammed control unit reads microinstructions step by step from control memory, generating the necessary control signals and deciding what to do next until the complete machine instruction is executed.

