EXPERIMENT – 11

DEVELOPMENT OF INSTRUCTION PROCESSING SYSTEM FROM FETCHING TO EXECUTION

Aim: To design an instruction processing system from fetching to execution using Logisim.

Tools Required: Logisim

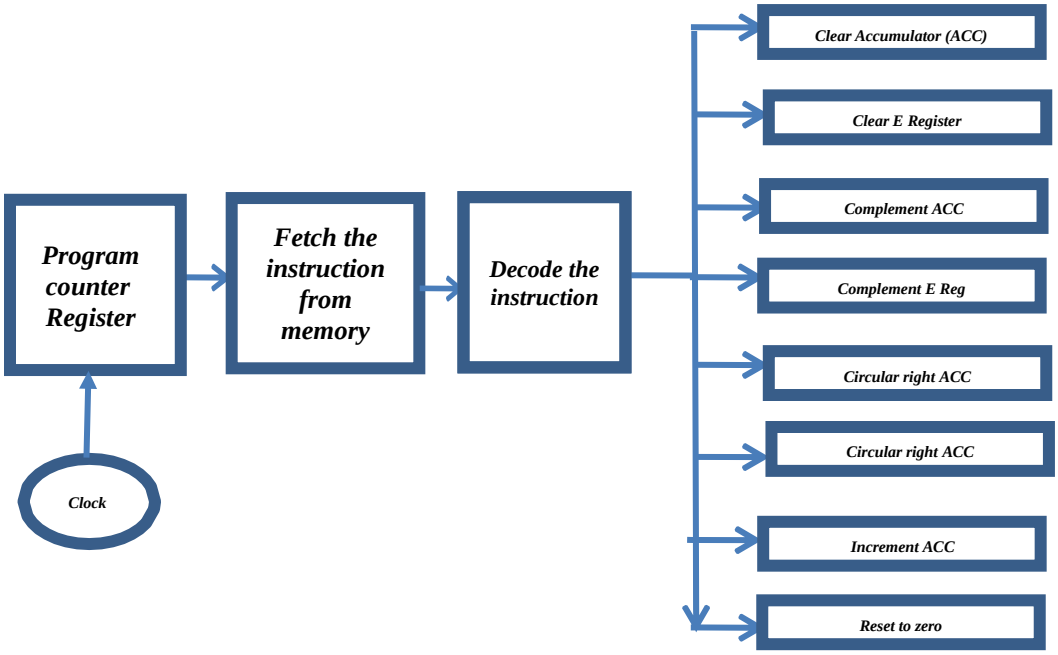
Components/devices can be used: Registers, Memory, Decoder, shifters, tri-state buffer.

Need and purpose:

The main purpose of the central processing unit is to execute the instructions. Instruction cycle is the most important process by which a computer retrieves a program instruction from its memory, decodes the instruction to determine the operation to be done and then carries out the operation. For this reason instruction cycle is also called as fetch- decode-execute cycle.

CPU has a special register named Program Counter (PC) (also referred as Instruction Pointer) which is a part of Internal Storage. The PC is used to determine which instruction is executed, and based on this execution, the PC is updated accordingly to the next instruction to be run. In the second step, the bits used for the opcode are used to determine how the instruction should be executed. This is what is meant by "decoding" the instruction. Control unit (CU) then passes the decoded information as a signal to perform operations.

Model Diagram / Table :



Pre-Lab:

1. What is the role of a register in an instruction processing system?

Answer: Registers are small, fast storage locations within the CPU that hold data temporarily during processing. In an instruction processing system, registers are crucial for holding operands, intermediate results, and addresses during various stages of instruction execution.

2. Explain the concept of instruction fetching in a CPU.

Answer: Instruction fetching is the process of retrieving the next instruction from memory for execution. It involves reading the instruction from memory and placing it into a designated register or buffer where it can be decoded and executed by the CPU.

3. Describe the purpose of a decoder in an instruction processing system.

Answer: A decoder is a combinational logic circuit that takes an input and activates one of several output lines based on the input's value. In an instruction processing system, a decoder is used to interpret the instruction opcode, determining which operation the CPU needs to perform.

4. Why are shifters essential in instruction processing?

Answer: Shifters are used to manipulate data by shifting its bits left or right. In instruction processing, shifters are often utilized for tasks such as shifting operands into position for arithmetic or logical operations, or for shifting the address bits to access different memory locations.

5. Explain the significance of memory in an instruction processing system.

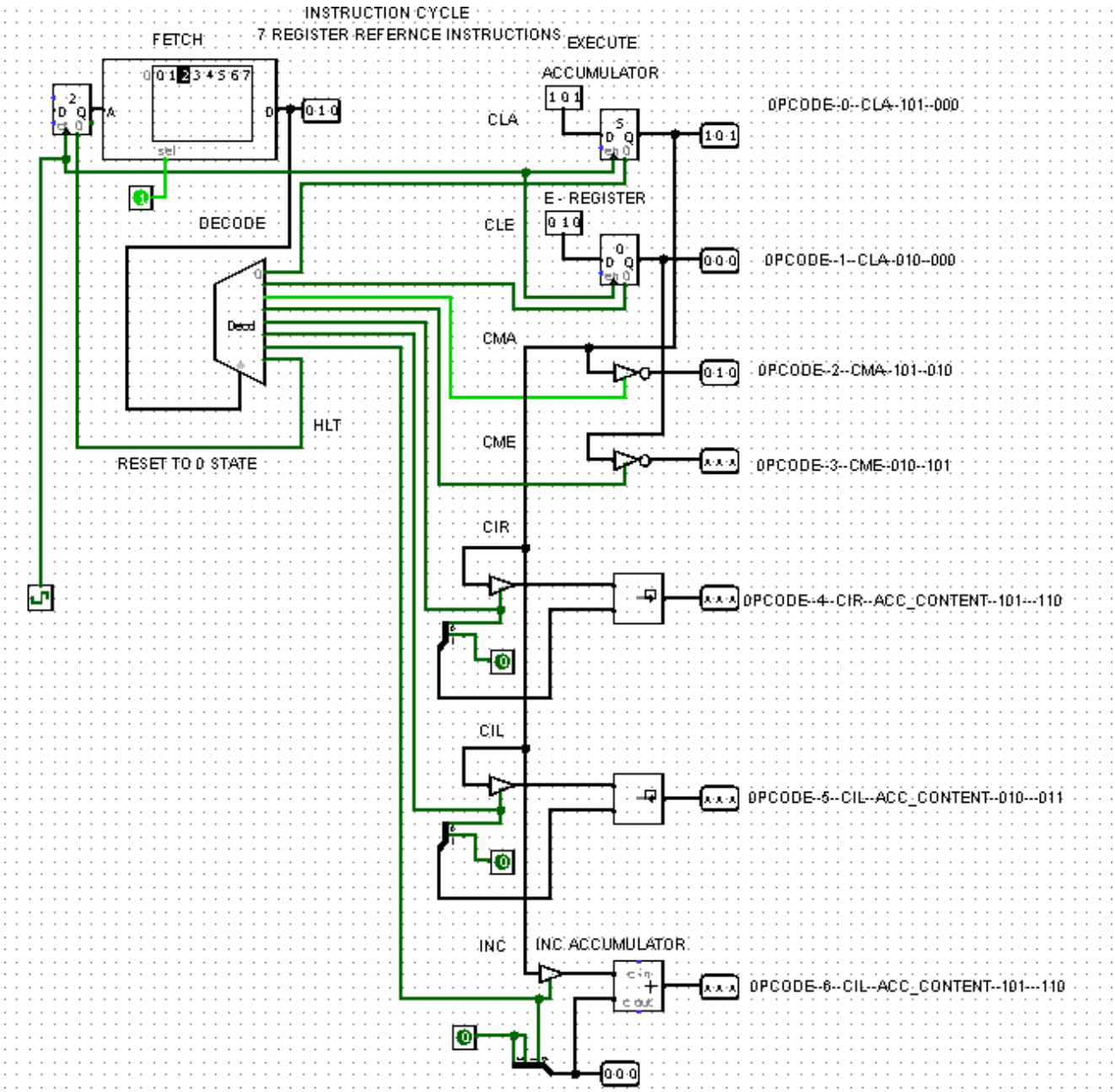
Answer: Memory stores both the instructions and data that the CPU needs to execute programs. It provides a means for the CPU to read and write information during the course of program execution. Memory is accessed by the CPU to fetch instructions, store data, and perform various operations required by the program.

6. Briefly outline the steps involved in the execution of a typical instruction in a CPU.

Answer: The steps typically involved in executing an instruction in a CPU are:

- Fetching the instruction from memory.
- Decoding the instruction to determine the operation and operands.
- Executing the operation specified by the instruction.
- Optionally, storing the result back in memory or in registers.
- Advancing to the next instruction and repeating the process.

Circuit Diagram:



Procedure:

1. Analyze the instruction execution mechanism with the given model diagram.
2. Select the required modules and operations in Logisim and implement the system.
3. Verify the operations in Logisim.

Viva Questions and answers:

1. What are the primary components of an instruction processing system, and how do they interact with each other?
2. Explain the role of registers in an instruction processing system. How do they facilitate the execution of instructions?
3. Describe the significance of memory in the context of CPU design. How does the CPU interact with memory during instruction execution?
4. What is the purpose of a decoder in an instruction processing system, and how does it contribute to the execution of instructions?
5. How do shifters aid in instruction processing? Provide examples of how shifters can be utilized in CPU operations.

Result: The experiment successfully demonstrated the construction of Instruction Processing System from Fetching to Execution using Logisim.