Q. What is Microprocessor? Explain the system bus in brief.

Ans. Microprocessor :

-A Microprocessor is an important part of a computer architecture without which you will not be able to perform anything on your computer.

-It is a programmable device that takes in input performs some arithmetic and logical operations over it and produces the desired output.

-In simple words, a Microprocessor is a digital device on a chip that can fetch instructions from memory, decode and execute them and give results.

-It performs some basic operations like addition, subtraction, multiplication, division, and some logical operations using its Arithmetic and Logical Unit (ALU).

Basics of Microprocessor :

A Microprocessor takes a bunch of instructions in machine language and executes them, telling the processor what it has to do. Microprocessor performs three basic things while executing the instruction:

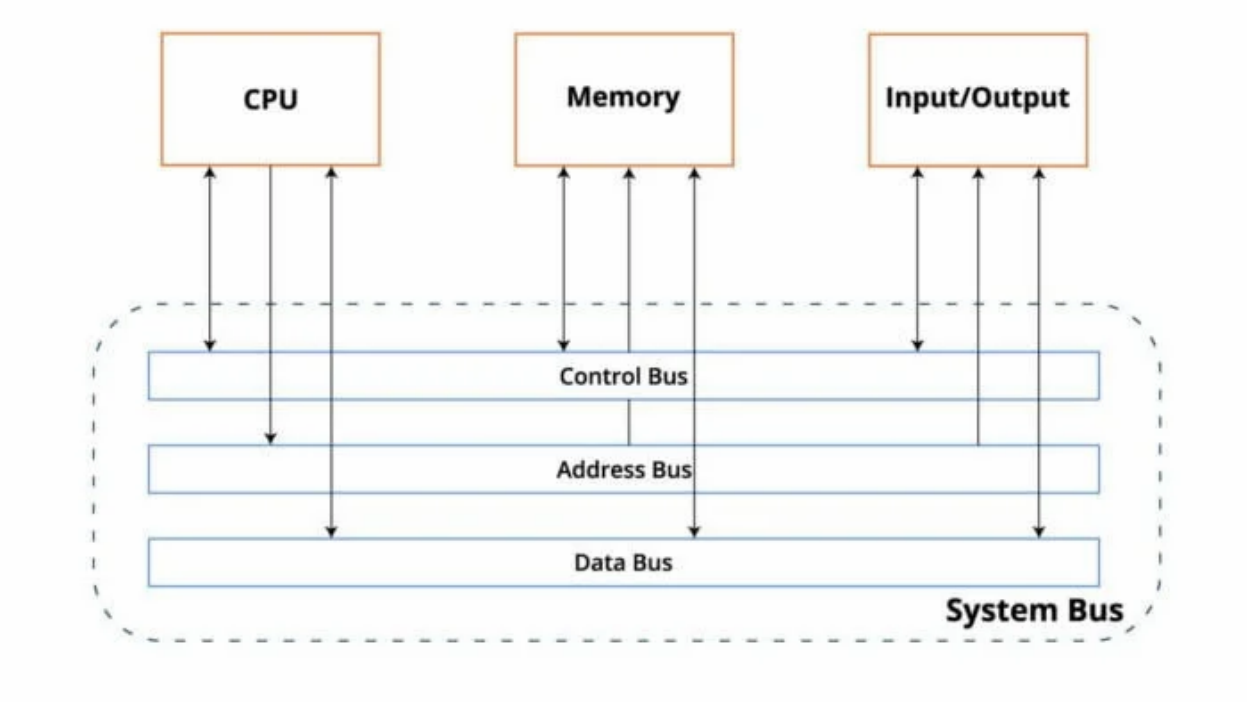
1. It performs some basic operations like addition, subtraction, multiplication, division, and some logical operations using its Arithmetic and Logical Unit (ALU). New Microprocessors also perform operations on floating-point numbers also.

2. Data in microprocessors can move from one location to another.

3. It has a Program Counter (PC) register that stores the address of the next instruction based on the value of the PC, Microprocessor jumps from one location to another and takes decisions.

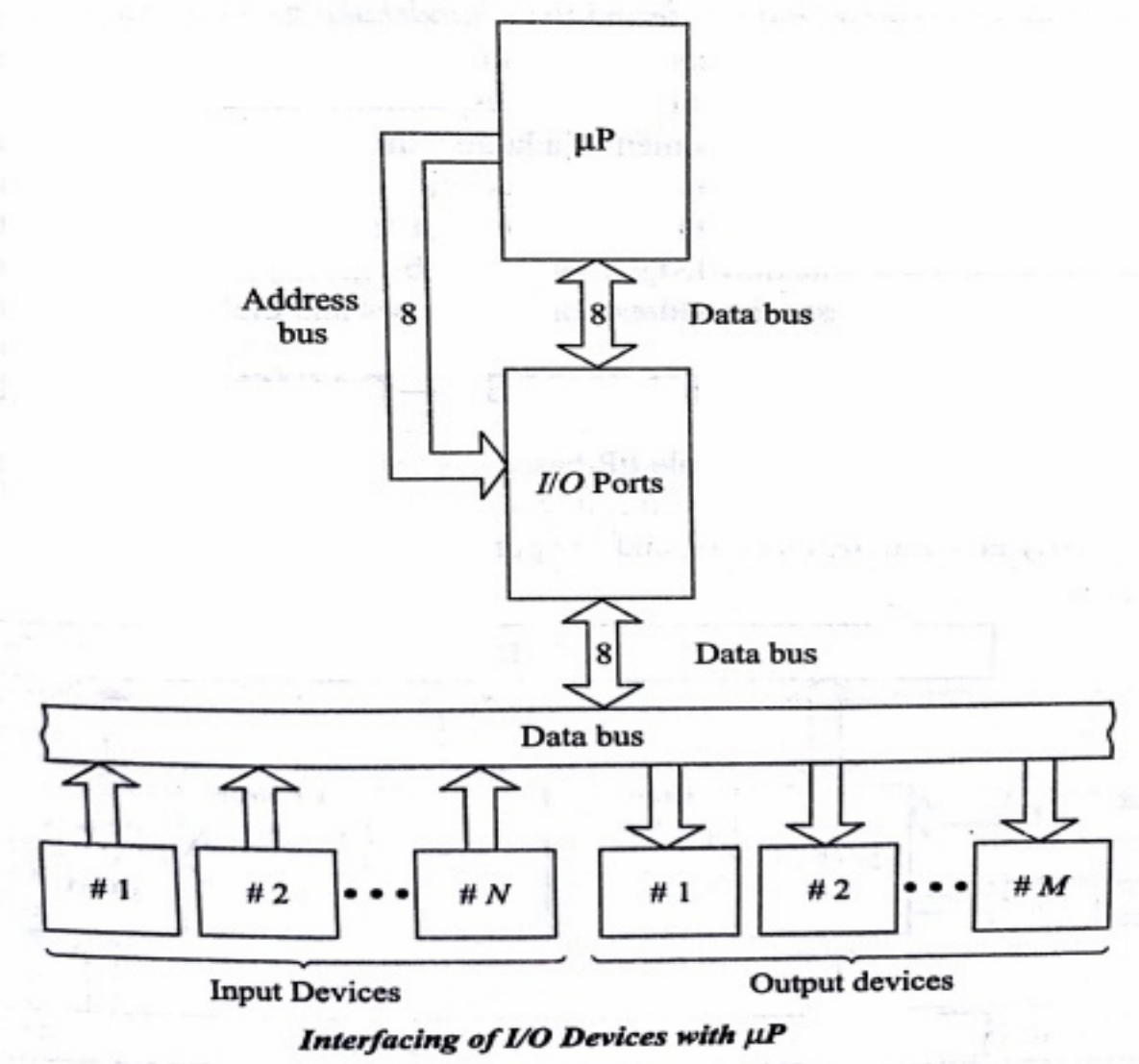
System Bus (Data, Address and Control Bus)

This network of wires or electronic pathways is called the ‘Bus’. A system bus is a single computer bus that connects the major components of a computer system. It combines the functions of a data bus to carry information, an address bus to determine where it should be sent, and a control bus to determine its operation. The technique was developed to reduce costs and improve modularity.



Address Bus

It is a group of wires or lines that are used to transfer the addresses of Memory or I/O devices. It is unidirectional. The width of the address bus corresponds to the maximum addressing capacity of the bus or the largest address within memory that the bus can work with. The addresses are transferred in binary format, with each line of the address bus carrying a single binary digit. Therefore the maximum address capacity is equal to two to the power of the number of lines present (2^lines).

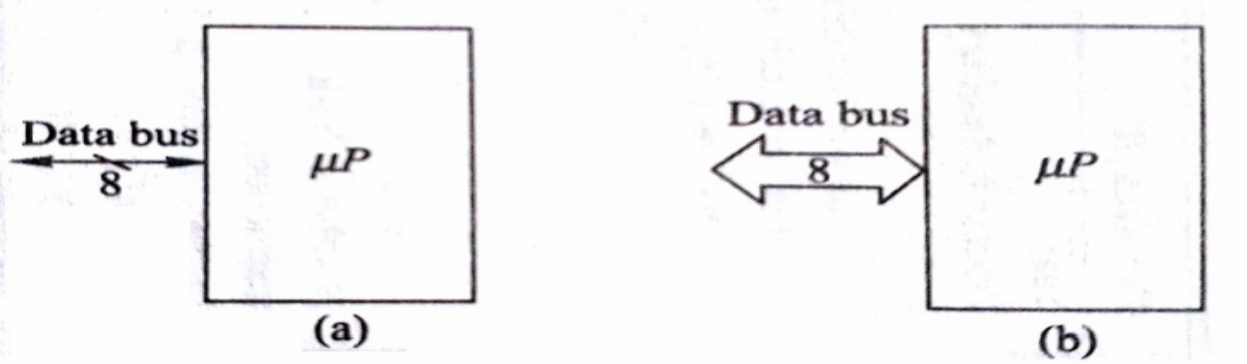


Interfacing of I/O Devices with µP

Data Bus

It is used to transfer data within Microprocessor and Memory/Input or Output devices. It is bidirectional as Microprocessor requires to send or receive data. Each wire is used for the transfer of signals corresponding to a single bit of binary data. As such, a greater width allows greater amounts of data to be transferred at the same time.

- Data lines that provide a path for moving data among system modules
- May consist of 32, 64, 128, or more separate lines
- The number of lines determines how many bits of data can be transferred at a time.



Representation of Bidirectional Bus

Control Bus

The microprocessor uses a control bus to process data, i.e. what to do with the selected memory location. Some control signals are Read, Write and Opcode fetch, etc. Various operations are performed by a microprocessor with the help of a control bus. This is a dedicated bus because all timing signals are generated according to the control signal.

The control bus is a bidirectional bus that is used to carry control signals between the microprocessor and other components such as memory and I/O devices.

It is used to transmit commands to the memory or I/O devices for performing specific operations.

It is a group of conducting wires, which is used to generate timing and control signals to control all the associated peripherals, microprocessor uses control bus to process data, that is what to do with selected memory location

Q. Explain the Memory organization of the microprocessor.

Ans- **What is Memory?**

- A memory is just like a human brain. It is used to store data and instructions.
- Computer memory is the storage space in the computer.
- The memory unit stores the binary information in the form of bits.
- Generally, memory/storage is classified into 2 categories:
- Volatile Memory: This loses its data, when power is switched off.(RAM)
- Non-Volatile Memory: This is a permanent storage and does not lose any data when power is switched off.(ROM)

RAM (Random Access Memory)

- RAM (Random Access Memory) is the internal memory of the CPU for storing data, program, and program result.
- It is a read/write memory which stores data until the machine is working. As soon as the machine is switched off, data is erased.
- RAM is of two types −
- Static RAM (SRAM)
- Dynamic RAM (DRAM)

ROM stands for Read Only Memory :

- The memory from which we can only read but cannot write on it.
- This type of memory is non-volatile.
- The information is stored permanently in such memories during manufacture.
- A ROM stores such instructions that are required to start a computer.
- This operation is referred to as bootstrap.
- ROM chips are not only used in the computer but also in other electronic items like washing machine and microwave oven.

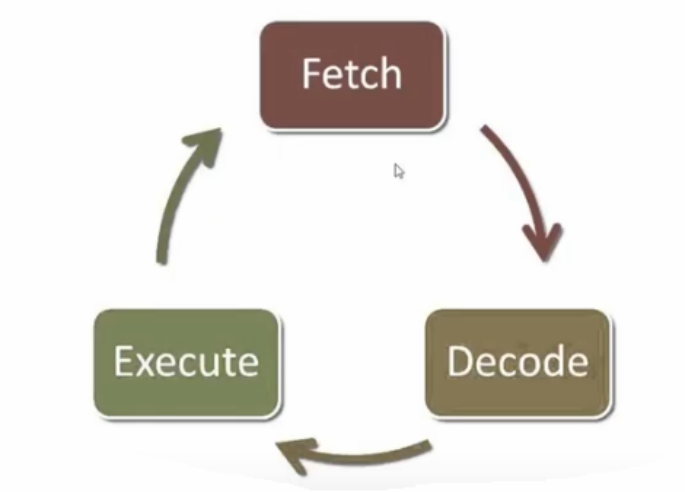
Types of ROM:

1. PROM – Programmed ROM
2. EPROM – Erasable floating gate programmed
3. EEPROM or E2PROM – electrically erasable floating gate programmed

RAM	ROM
1. Temporary Storage.	1. Permanent storage.
2. Store data in MBs.	2. Store data in GBs.
3. Volatile.	3. Non-volatile.
4.Used in normal operations.	4. Used for startup process of computer.
5. Writing data is faster.	5. Writing data is slower.

Difference between RAM and ROM

- **Explain various operations of the microprocessor.**



- **FETCH:** At the beginning of each instruction cycle the processor fetches an instruction from memory.

  EXECUTE: Execute the Instruction.

13.7 MICROPROCESSOR OPERATION

From the above discussion, it is amply clear that basically a microprocessor performs the following two operations:

1. FETCH an instruction from memory, and
2. EXECUTE the instruction.

The various steps involved in performing these operations are as follows:

FETCH

1. The μP places the address of the first byte of instruction on the address bus, along with a control signal, to read from the addressed memory location.
2. The μP gets this byte on the data bus. This byte is referred to as the *operation code* (*Op code*) and the operation of getting this byte from the memory as the *Op-code fetch*.
3. The Op code is decoded and the necessary control signals are generated.
4. If the instruction is a multi-byte instruction, the second and the subsequent bytes are read from the memory one by one by following steps similar to 1 and 2.

The operation of getting instruction bytes from the memory is known as *instruction fetch*.

EXECUTE

After the μP gets the complete instruction (all the bytes of the instruction), it performs the operation specified by the instruction. This is referred to as *execution*.

Thus, a microprocessor can be defined as a digital device on a chip which can fetch instructions from a memory, decode and execute them, i.e. perform certain arithmetic and logical operations, accept data from input devices, and send results to output devices.

It should be clearly understood that a μP alone cannot do anything. It can be used meaningfully only when it is interfaced with memory and *I/O* devices.

Q.Which are various functional units of microprocessors? Explain ALU in brief.

Ans :

ALU: An arithmetic-logic unit is the part of a central processing unit that carries out arithmetic and logic operations on the operands in computer instruction words. In some processors, the ALU is divided into two units: an arithmetic unit (AU) and a logic unit (LU).

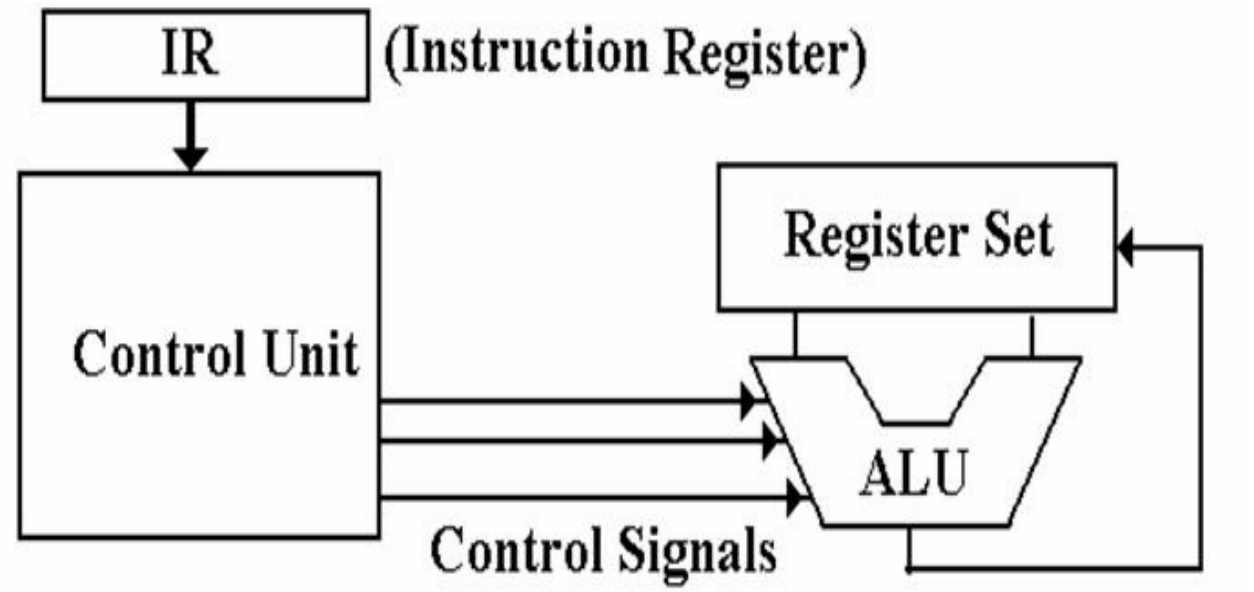
- In addition to the arithmetic & logic circuits, the ALU includes the accumulator, which is part of every arithmetic & logic operation.

- Also, the ALU includes a temporary register used for holding data temporarily during the execution of the operation. This temporary register is not accessible by the programmer.

Control Unit:

This unit controls the operations of all parts of the computer but does not carry out any actual data processing operations.

Block Diagram of Control Unit



The control unit (CU) is a component of a computer's central processing unit (CPU) that directs the operation of the processor.

- It tells the computer's memory, arithmetic and logic unit and input and output devices how to respond to the instructions that have been sent to the processor.
- The Control Unit makes decisions and sends the appropriate signal down its lines to other parts of the compute

Functions of this Control unit are –

- **It is responsible for controlling the transfer of data and instructions among other units of a computer.**
- **It obtains the instructions from the memory, interprets them, and directs the operation of the computer.**
- **It communicates with Input/output devices for transfer of data or results from storage.**
- **It does not process or store data**

The ALU (Arithmetic Logic Unit) IC 74181 is a versatile integrated circuit primarily designed to perform arithmetic and logic operations. It can perform various arithmetic operations such as addition, subtraction, multiplication, and division along with logic operations like AND, OR, XOR, etc.

Here's a basic overview of how you can perform arithmetic operations using the ALU IC 74181:

1. **Addition:**
   - To perform addition, you would input two numbers (A and B) to the ALU, set the control lines accordingly to indicate addition, and then read the output pins to obtain the result.
2. **Subtraction:**
   - Subtraction can be performed using the ALU by utilizing 2's complement arithmetic. You'd input the numbers A and B, set the control lines for subtraction, and interpret the output considering the 2's complement representation.
3. **Multiplication:**
   - Multiplication using the ALU IC 74181 often involves multiple cycles of addition and shifting to achieve the multiplication result. It requires setting the control lines to perform iterative addition and shifting operations.
4. **Division:**
   - Division is a more complex operation that can be achieved through a series of subtraction and shifting operations in a loop. The control lines need to be set accordingly to perform these operations iteratively.

Each operation requires proper configuration of control lines and interpreting the output correctly based on the operation being performed.

The ALU IC 74181 provides a range of operations through the manipulation of control lines and interpreting the output pins. However, the specific steps and control line configurations might vary based on the exact implementation and the circuit design. It's essential to refer to the datasheet and documentation for the IC for a more detailed understanding and specific configurations for each operation.

1.9 ALU USING ... ARITHMETIC OPERATIONS USING ALU

GQ. Write short note on ALU.

- ALU is a combinational logic circuit used for performing arithmetic an logical operations.
- It is mainly used in microprocessor and microcontrollers.
- Fig. 1.9.1 shows the block diagram of ALU 74181.
- The functions of input/output and control lines are as follows :

A and B : Binary data inputs.

$\overline{C}_n$: Active low carry input

$\overline{C}_{n+4}$: Active low carry output.

F_{3-0} : Binary data output.

P carry propagate output

G carry generate output.

A = B equality output.

S_{3-0} : Select input lines M

Mode control : M = 0 arithmetic operation.

M = 1 logical operation

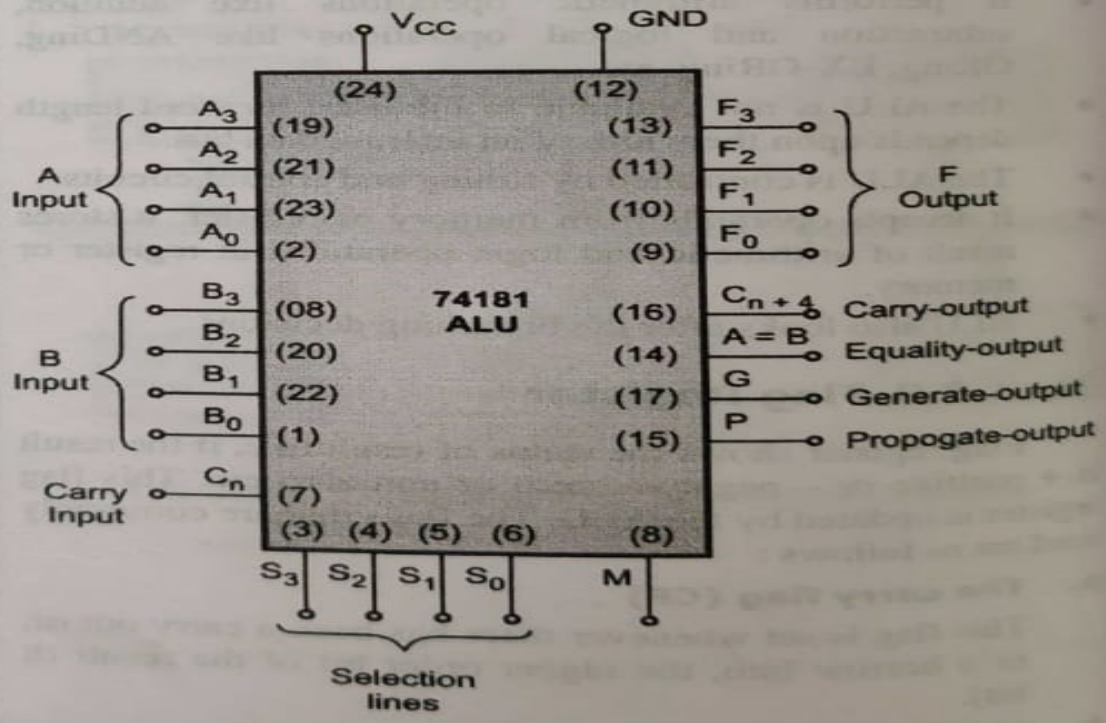


Fig. 1.9.1 : Block diagram of ALU

- The G and P output are used while cascading ALU with 74182 look ahead carry generators for speeding of the arithmetic operations.