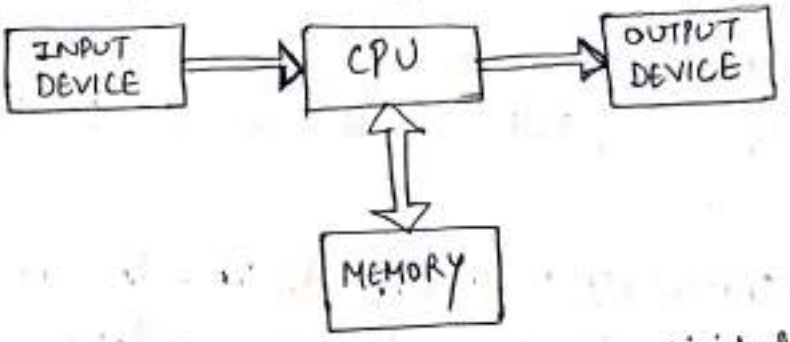
MODULE :- Introduction to microprocessor, 8085 microprocessor architecture - Bus structure, Register organization. (1)

INTRODUCTION TO MICROPROCESSORS

Introduction :- The most powerful tool that a man has created is a computer. A digital computer is programmable.



(Block diagram of a digital computer)

The main parts of the computer are CPU, input device and output device. The CPU performs the task of executing instructions as per the user's requirement. The input device is used to send data and programs to the computer, whereas output device is used to send data from the computer to display unit, printer etc. The CPU is built on single IC called microprocessor. A microprocessor is a CPU to which we have to add ROM, RAM and ports to make a microcomputer.

EVOLUTION OF MICROPROCESSOR :

The first microprocessor was introduced in the year 1971 by Intel. It was a 4 bit PMOS microprocessor named as Intel 4004. After that an enhanced version of Intel 4004 was developed.

In 1972 Intel introduced the first 8 bit microprocessor Intel 8008. It also used the PMOS technology. These processor were slow and not compatible with the TTL logic. So, Intel introduced a faster NMOS microprocessor Intel 8080. But the main drawback of Intel 8080 was that it

required three power supplies. Hence, in 1975 Intel developed an improved version of microprocessor 8080 called Intel 8085.

The first X86 processor was developed in 1979 by Intel and was called the 8086 microprocessor. It is a 16 bit microprocessor with 16 bit data bus and 20 bit address bus. It allows 1MB of addressing space.

MICROPROCESSOR CHARACTERISTICS:

The power of the microcomputer is determined by the characteristic of the microprocessor

1. PROCESSING CAPABILITY :- It depends upon the number of instructions and flexibilty of the instruction.

2. WORD LENGTH :- It depends upon the width of internal data bus, register, ALU etc. The word length of microprocessor is given as n bit where n may be 8, 16, 32, 64 etc. An 8 bit microprocessor can process 8 bits at a time, similarly a 16 bit microprocessor can process 16 bits at a time. A processor with longer word length is more powerful.

3. CLOCK FREQUENCY :- The processing speed of microprocessor depends upon clock frequency. The program execution speed is also determined by this parameter. The maximum clock frequency depends upon technology adopted in microprocessor fabrication.

4. WIDTH OF THE DATA BUS :- This parameter decides the word length of the microcomputer. This is the width of the external data bus.

5. WIDTH OF THE ADDRESS BUS :- This parameter decides the memory addressing capability of the microprocessor. The maximum size of the memory unit is decided by this parameter.

6. I/O addressing capability :- The maximum number of the I/O ports accessed by the microprocessor depends upon the width of the I/O address provided in the I/O instruction. (2)

7. DATA TYPES :- The microprocessor handles various types of data formats like binary, BCD, ASCII, integer, real numbers, signed numbers and unsigned numbers etc.

8. INTERRUPT CAPABILITY :- Interrupts are used to handle unpredictable and random events in the microcomputer. It is used to interrupt the microprocessor. It is also used to speed up the I/O programs. It improves the throughput of the system.

Depending on the size and capabilities the computers are classified into various types

COMPUTERS

MAINFRAMES

- The largest & the most powerful are called a mainframes
- Their size is very large and can operated at a very high speed.
- Mainframes can work with large data words which are typically 64 bits or greater. They have a very large size of memory.
- Applications of mainframes are military defence control, business data processing.

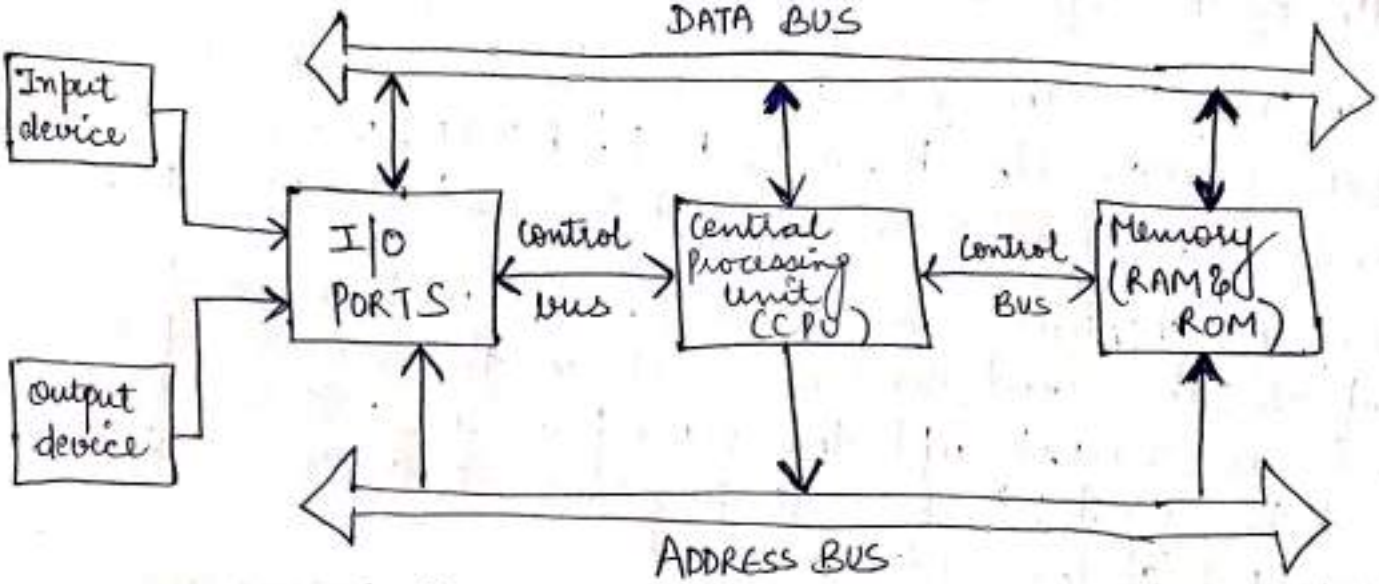
MINICOMPUTERS

- Minicomputers are small mainframes. All the features of a mainframe are scaled down to obtain a minicomputer.
- Minicomputer operate more slowly and they work with smaller data words.
- The memory size of minicomputers is also small.
- Applications of a minicomputer are business data processing, industrial control

MICROCOMPUTERS

- Microcomputers are much smaller computers.
- They operate still more slowly and they work with still smaller data words.
- They can address a few thousands to a few million memory locations.
- They have all the features of minicomputers & mainframes.

ORGANIZATION OF A MICROCOMPUTER :



(BLOCK DIAGRAM OF A MICROCOMPUTER)

Main parts of a microcomputer are :-

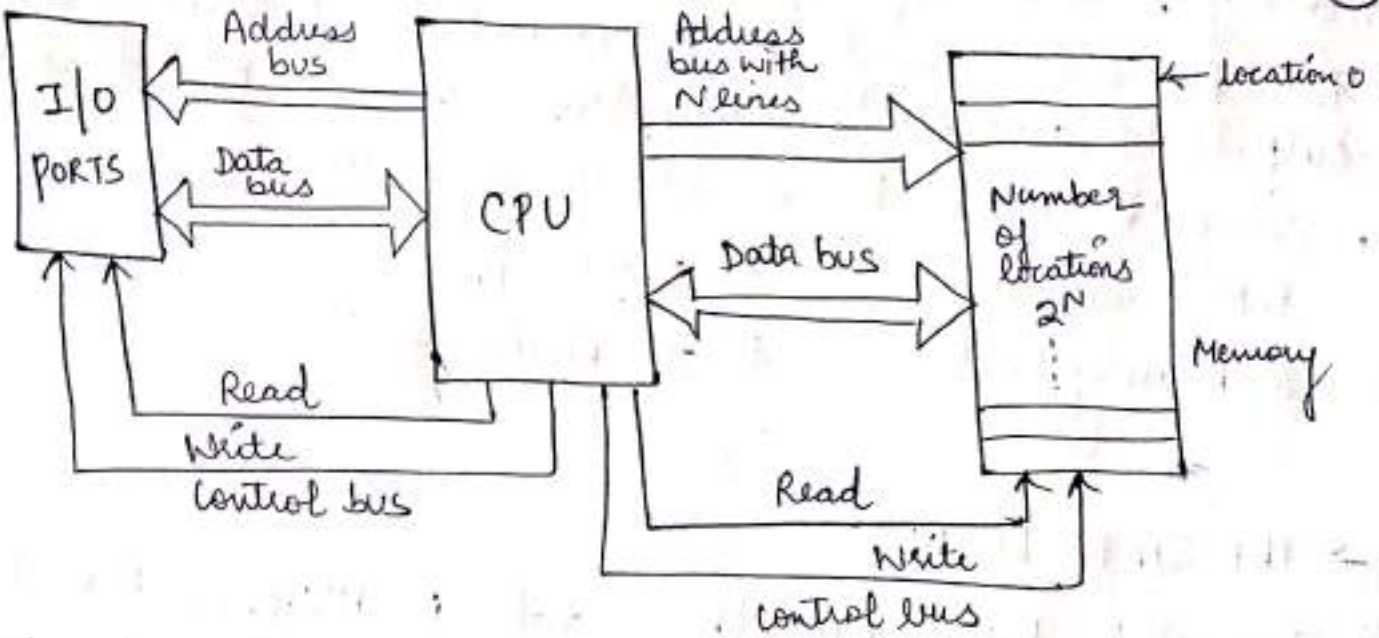
(1) Central Processing Unit
(2) Memory (ROM & RAM)
(3) Input and output circuitry
(4) Three buses namely address bus, data bus and control bus.

BUSES :- A bus, as it pertains to a microprocessor is a bundle of wires that are grouped together to serve single purpose. The major parts of microcomputer are connected to each other by three sets of parallel lines called buses. Some pass data, some pass address and other act as control lines.

The three buses are address bus, data bus and control bus.

ADDRESS BUS

- A set of parallel connected lines is called a bus.
- The bus over which the CPU sends out the address of the memory location is called as address bus.



- The address bus carries the address of the memory location to be written to or read from.
- The address bus may consists of 16, 20, 24 or 32 parallel signal lines. If there are N address lines, then it can directly address 2^N memory locations.
- For Example if the number of address lines N=16 then it can address $2^{16} = 65,536$ memory locations.

DATA BUS

- The data bus consists of 8, 16 or 32 parallel lines.
- The data bus is a bi-directional bus. That means the data can get transferred from CPU to memory and viceversa.
- The data bus also connects the I/O ports and CPU. So the CPU can write data to or read it from the memory or I/O ports.
- The number of data lines used in the data bus is equal to the size of data word being written or read.

CONTROL BUS

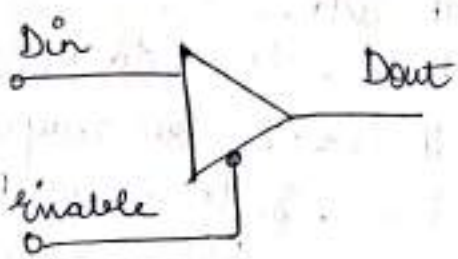
- The control bus consists of 4 to 10 parallel signal lines. The control bus is used for sending control signals to the

memory and Input/output devices.

- The CPU sends signals on the control bus to enable the outputs of addressed memory devices or I/O port devices.
- Some of the control bus signals are as follows:
  1. Memory read
  2. Memory write
  3. I/O read.
  4. I/O Write.

→ TRI-STATE LOGIC.

Tri-state device have three states i.e HIGH, LOW and Hi-Z (high impedence). When the device is in tri-state (Hi-Z) condition, the connection before that device and after that device is "electrically disconnected".



INPUTS		OUTPUTS	
Din	Enable	Dout	
X	1	Hi-Z	→ High Impedence condition & electrically disconnected
1	0	1	→ HIGH
0	0	0	→ LOW

→ BUFFER

- Buffer is a logic circuit used to increase the strength or driving capabilities of lines. The buffer increase the power i.e current on line.
- When a buffer is selected it gives respective output but when a buffer is not selected it makes the lines in high impedance state.
- Each buffered line is capable of sourcing 15mA current & sinking 24mA current.

- There are two buffer ICs generally used in microprocessor systems:
  (i) 74LS244 (ii) 74LS245

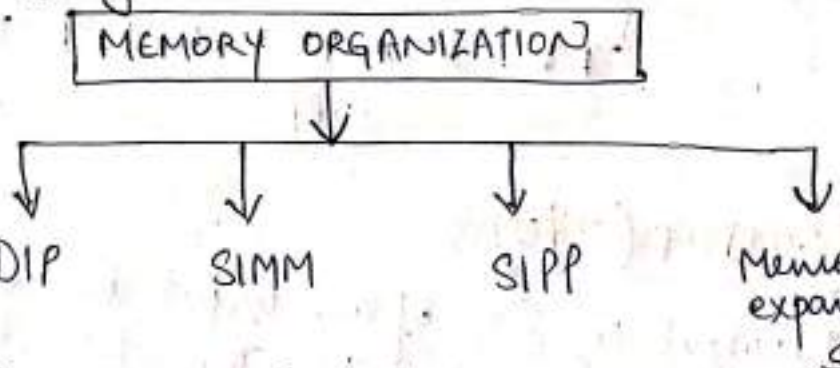
→ LATCH (a circuit which retains whatever output state results from a momentary input signal until reset by another signal)

- The IC 74LS373 is an 8 bit latch having D type flipflops. It provides buffer controller inputs.

Features of 74373 :-
1. It provides choice of 8 latches or 8 D type flipflops
2. It has tristate bus driving outputs
3. It has full parallel access for loading.
4. It has buffered control inputs.

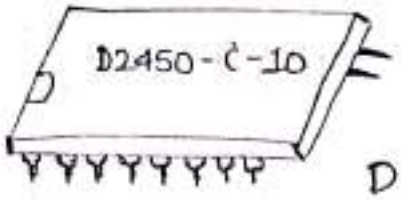
MEMORY :

The memory of a microcomputer consists of RAM as well as ROM. The memory may also contain the floppy disks, magnetic hard disks or optical disks. The use of memory is multifold. First purpose of using a memory is storage of sequence of instructions in the form of binary codes. Another purpose is to store the binary coded data with which the computer is going to work.



DIP (Dual Inline Package): It is most common packaging in all memory chips. It resembles a flat rectangular box with metal pins on both sides in order to insert the chip in the socket on mother board.

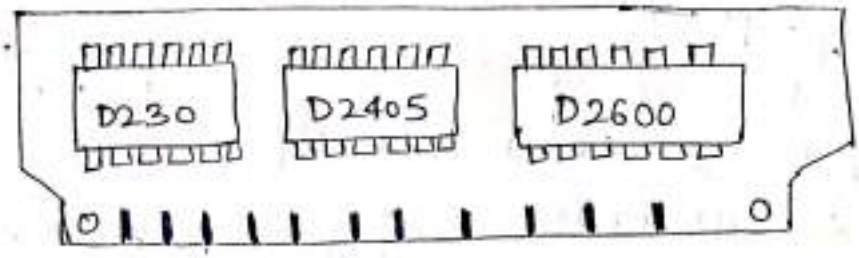
It is available in 8 and 168-pin packages.



DIP

SIMM (SINGLE INLINE MEMORY MODULE):

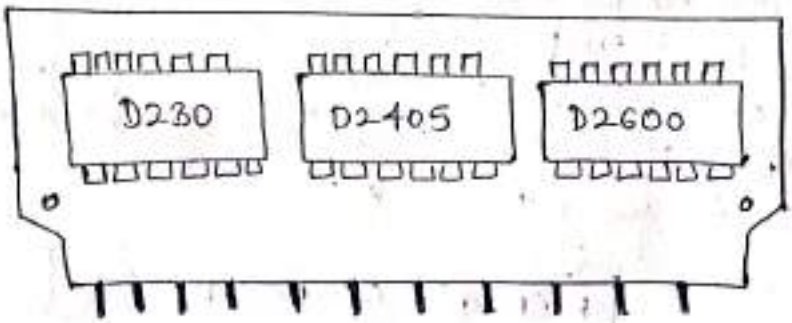
It contains a number of RAM chips soldered on a small expansion. They are available in SRAM, DRAM, etc. All the chips in a SIMM module must contain same technology.



SIMM

SIPP (SINGLE INLINE PIN PACKAGE):

It is same like SIMM. The only difference is that SIPP contains pins at bottom to fix them into the mother board socket.



SIPP

INPUT/OUTPUT (I/O):

The input/output consists of an input device and output device and input/output ports. The I/O section enables the computer to take the data from the user and/or send the data to outside world. Devices such as keyboards, video display terminals, printers are called as peripherals and they are connected to the I/O section.

PORTS:- The actual physical devices which are used for interfacing the computer buses with the external systems are called as ports. The ports are of two types namely input ports and output ports.
The input port will allow the connection of data from the keyboard or some other source to the computer.
An output port is used for connecting the data from the computer to the outside world.

CENTRAL PROCESSING UNIT (CPU):

The jobe of a CPU is to control the operations of the computer. In the microcomputer, CPU is nothing but the microprocessor.

simplified operation of CPU

Step① FETCHING: It fetches instructions from memory. They are in the binary coded form.

⇩

Step② DECODING: It then decodes these instructions into a series of simple actions.

⇩

Step③ ACTIONS: It carries out these actions in a sequence of steps.

APPLICATIONS OF MICROPROCESSOR

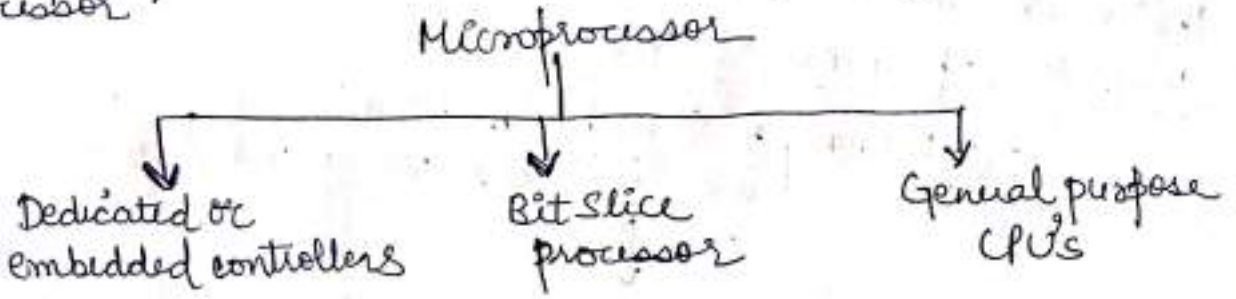
- They are used in industrial control applications, calculators, instrumentation, commerical appliances etc.
- It is used in laboratory for training the students.
- It is used as CPU of a computer. It is also used to control input, output and other devices of a computer.
- They are used for word processing, database management, storing information, scientific and engineering calculations.
- They are used in smart terminals, office automation, data acquisition systems.

- Controller for appliances, video games and automobiles.
- They are used in computers for railway ticket reservations, air ticket reservations, books, smart camera, energy meters.
- They are used to measure and control the temperature of a furnace, speed of electric motor.

TYPES OF MICROPROCESSOR:

The microprocessors are commonly classified based on the numbers of bits that their ALU (Arithmetic Logic Unit) can work with at a time.

So a microprocessor with 8 bit ALU is called as an 8 bit microprocessor.



1. DEDICATED OR EMBEDDED CONTROLLERS:

- There are specially designed microprocessors used to control the smart machines such as washing machines, microwave ovens.
- Examples of embedded controllers are Intel 8051 & Motorola MC 6801.
- These devices are popularly known as microcontrollers.
- They contain CPU, ROM, RAM, parallel I/O ports, programmable counters and serial port all in one chip.

2. BIT SLICE PROCESSOR:

- The general purpose microprocessor such as 6800 are not suitable for certain applications. They may not have an adequate speed or their instruction set is not suitable for the required application.
- For such applications manufacturers produce devices which can be used to build a custom CPU.

- The example of such devices is the 2900 family of advanced micro devices. This family contain multiplexers, sequencers, 4 bit ALU sequled for custom-building CPU.
- These ports can be connected in parallel to work with any size of words such as 8 bit, 16 bit, 32 bit words etc.
- This is viewed as adding as many slices as needed for particular application.

3. GENERAL PURPOSE CPU :-

- The use of general purpose CPUs gui the microcomputers almost all the computing power comparable to a minicomputer.
- The example of general purpose CPUs is Intel 8085. It is an 8 bit processor. The next general purpose CPU is Intel 8086 which is a 16 bit protessor.