

RPSC - A.En.

← Assistant Engineering →

ELECTRICAL

Rajasthan Public Service Commission (RPSC)

Volume - 7

Microprocessor



MICROPROCESSOR AND MICROCONTROLLER

THEORY

1. INTRODUCTION OF MICROPROCESSOR

Microprocessor is one of the most important components of a digital computer. It can be viewed as a programmable logic device that can be used to control processes or to turn on/off devices. Simultaneously, it can be viewed as a data processing unit or a computing unit of a computer.

1.1 DEFINITION

Microprocessor is the controlling unit or CPU of a micro-computer, fabricated on a very small chip capable of performing ALU operations and communicating with the external devices connected to it.

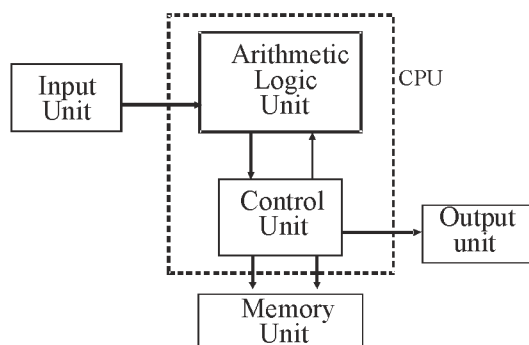
or

A microprocessor is a programmable integrated device that has computing and decision making capability similar to that of the Central Processing Unit (CPU) of a computer.

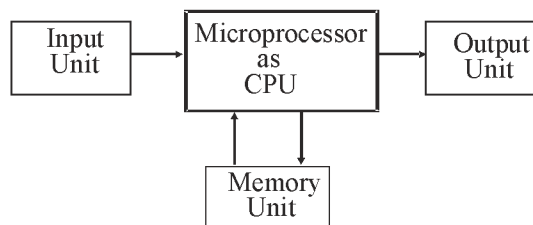
2. MICROPROCESSOR AS A CPU (MPU)

Generally, a basic computer has the four components/units :

- (1) Input Unit
- (2) Output Unit
- (3) Memory Unit
- (4) Central Processing Unit



Basic Block Diagram of Computer

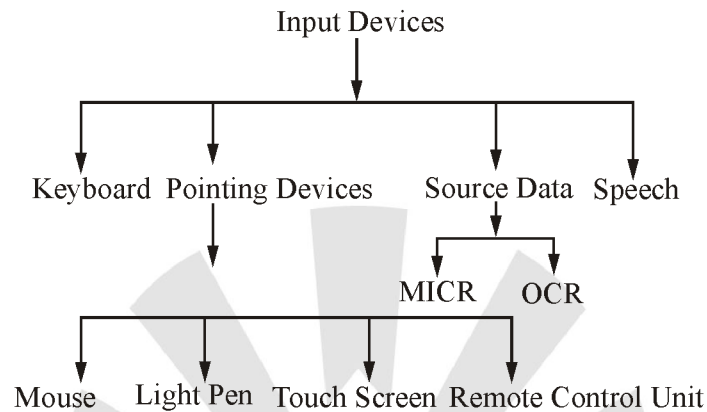


Block Diagram of microprocessor as a CPU or a Micro Computer

2.1 INPUT UNIT :

The input unit consists of the devices which accept the data and instructions from the user and communicates it to the CPU.

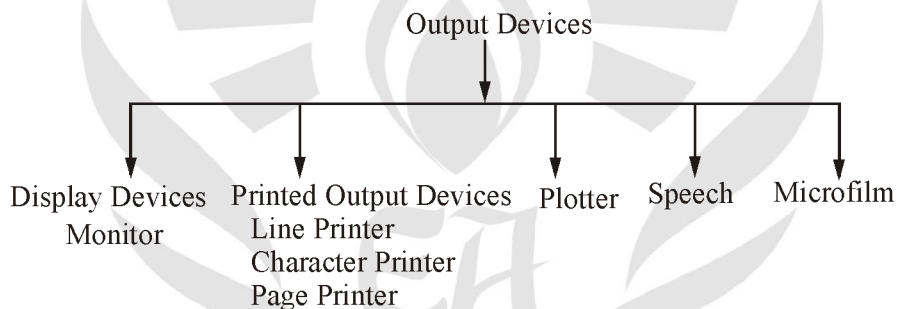
Various input devices are : Keyboard, mouse, Joystick, trackball etc.



2.2 OUTPUT UNIT :

It provides the result of the various operations performed by the CPU to the user.

Various output devices are : Printer, Monitor, Loudspeaker etc.



2.3 CENTRAL PROCESSING UNIT (CPU) :

It fetches the instruction and data from the peripheral devices and performs all the arithmetic operations, takes logical decision and controls the operations of all other units.

CPU is considered to be the heart and nerve centre of the computer.

Sub blocks of the central processing unit are :

- (a) Arithmetic & Logic Unit (ALU)
- (b) Timing & Control Unit (CU)
- (c) Registers

2.4 ARITHMETIC AND LOGIC UNIT (ALU) :

This unit performs all the logical and arithmetic operations.

Various arithmetic operations are : additions, subtraction, increment and decrement etc.

Various Logical operations are : AND, OR, NOT, XOR, etc.

2.5 TIMING AND CONTROL UNIT (CU) :

This unit controls the entire operations being performed by the system. It controls the operation of ALU, input/output devices and memory unit. This unit interprets the instructions and generates various timing and control signals.

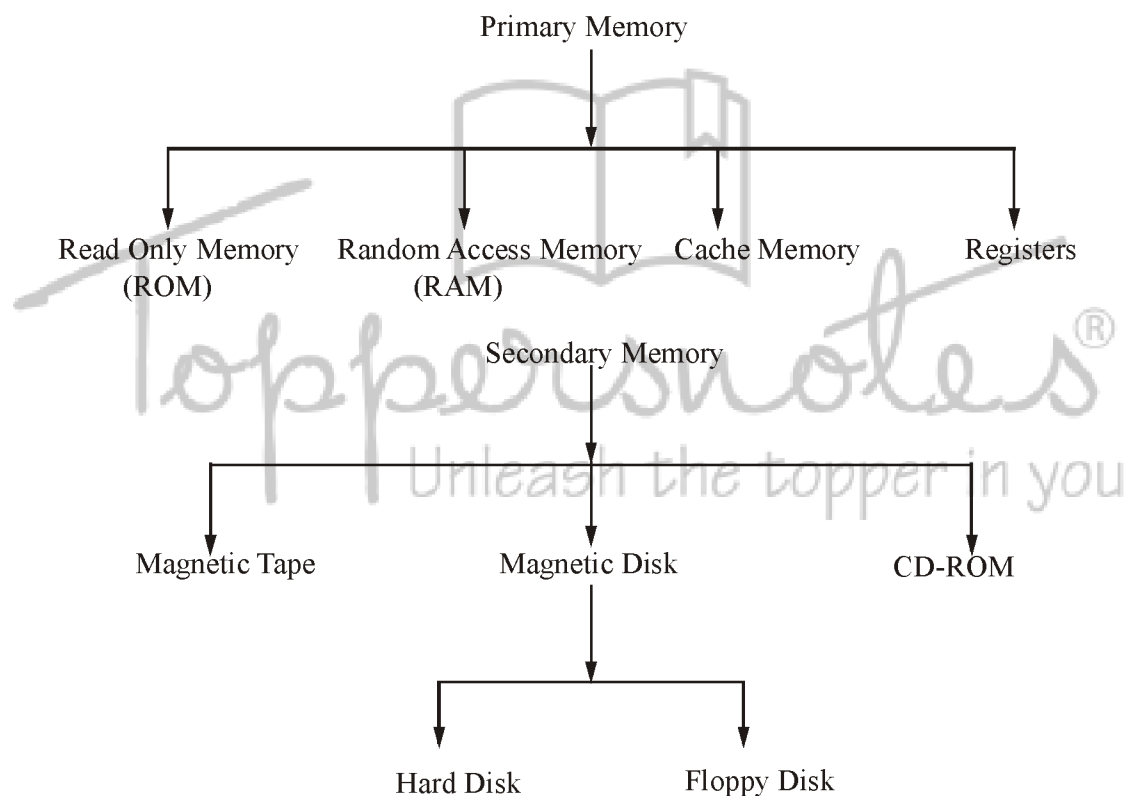
2.6 REGISTERS :

A register is a very small amount of very fast memory that is built into the CPU in order to store the current data and instructions which are being executed by the CPU.

2.7 MEMORY UNIT :

- (1) It stores the program statement and the data i.e., the information supplied from the input unit and also stores the final output.
- (2) Through a bi-directional bus, it is connected to the CPU,
- (3) CPU processes the information as taken from the memory and performs the operations in the ALU section.

Results are either transferred to the output unit or stored in the memory for later use by CPU



3. MICRO-COMPUTER

- (1) The microprocessor, embedded in a larger system, can be a stand alone unit controlling processes, or at can function as the CPU of a computer called microcomputer.
- (2) The block diagram of the microcomputer is similar to the computer except that the central processing unit of the micro computer is contained in a single IC called microprocessor.

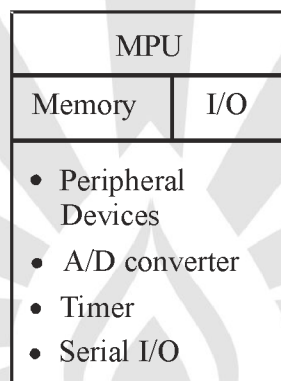
(3) A microprocessor is a LSI (Large Scale Integration) IC that does almost all the functions of CPU.

The basic function of microprocessor is :

- (1) To fetch the instructions stored in the main memory
- (2) Identify the operations and the devices involved in it.
- (3) Generate control signals to determine when a given action is to take place.
- (4) A desktop computer, laptop, notebook, palmtop, etc., contain one microprocessor to act as a CPU and hence they come under the category of micro computer.

4. MICROCONTROLLER

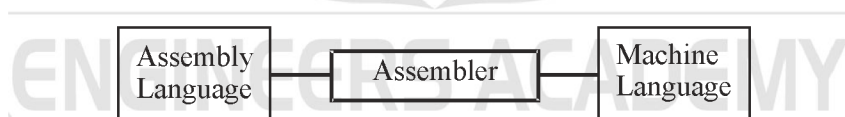
A highly integrated chip that contains all the components such as CPU, RAM. Some form of ROM, input-output ports, A/D converter and timers is called Microcontroller or microcontroller unit (MCU).



5. MICROPROCESSOR CHARACTERISTICS

5.1 INSTRUCTION SET :

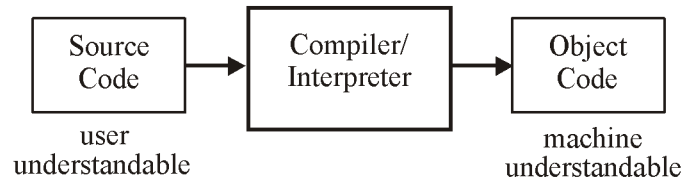
- (1) A Microprocessor communicates and operates in the binary format 0 and 1 called bits.
- (2) Each microprocessor has a fixed set of instructions in the form of binary pattern called a machine language (platform dependent or machine specific language or low level language)
- (3) It is difficult for humans to communicate in the language of 0s and 1s, hence, binary instructions are given abbreviated names, called mnemonics, which form assembly language (platform dependent or machine specific language or low level language)



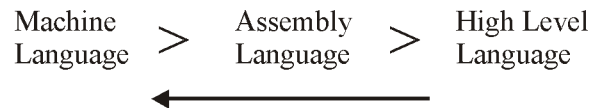
- (4) Assembler is a software. If translation task is performed manually, it is known as hand assembly.

Note: (1) *Compiler reads whole program at once from source code and produces object code that is executed by processor.*

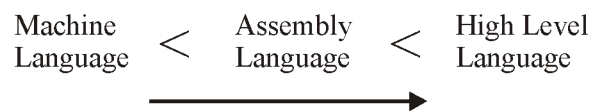
- (2) *Interpreter. Reads instruction at a time from source code and produces its object code that is executed by processor before reading next instruction from source code.*



- **Faster Execution :**

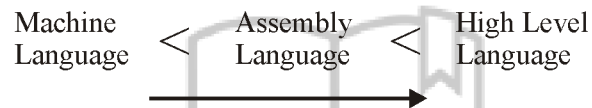


- **Memory :**



(Require Large memory to store)

- **Debugging :**



(Debugging or trouble shooting
is faster i.e., to find error)

5.2 BAND WIDTH :

- (1) Gordon Moore, cofounder of Intel corporation, predicted that the number of transistors per integrated circuit would double every 18 months i.e., Moore's law.
- (2) Currently, processors are designed with 15 million transistors, that can address one Terabyte (1×10^{12}) of memory and can operate at 400 MHz to 1.5 GHz frequency.

5.3 CLOCK SPEED :

- (1) The clock speed determines how many operations per second the processor can perform.
- (2) Every computer contains an internal clock that regulates the rate at which instructions are executed and synchronizes the various computer components.
- (3) Expressed in megahertz (MHz) or gigahertz (GHz), faster the clock, more instructions CPU execute per second.
- (4) Microprocessor of personal computer have clock speeds of anywhere from 300 MHz to over 3.8 GHz.

5.4 WORD LENGTH :

- (1) It depends upon the width of internal data bus, registers, ALU etc.
- (2) Word length is defined as the number of bits the microprocessor recognizes and processes at a time.

6. CISC AND RISC

CISC :- CISC stands for complex instruction set architecture. The CISC approach attempts to minimize the number of instructions per program, instead of number of cycle per instruction.

RISC :- RISC stands for reduced instruction set architecture. The RISC approach attempts to reduce the cycle per instructions per program.

6.1 COMPARISON BETWEEN RISC AND CISC :

Parameter	RISC	CISC
Design	Simple	Complex
Design time	Short	Long
Speed	High	Low
Price	Cheap	Costly
	Single length instruction	Variable length instruction
	Simple operation	Complex operation
	Number of instruction is more	Number of instruction is less
	Tablet, Smartphone etc use RISC	Computer uses CISC

7. WORKING OF MICROPROCESSOR :

- (1) The instructions are stored sequentially in the memory.
- (2) The microprocessor fetches the first instruction from its memory sheet, decodes it and executes that instruction.
- (3) The sequence of fetch, decode and execute is continued until the microprocessor comes across an instruction to stop.
- (4) During the entire process, the microprocessor uses the system bus to fetch the binary instruction and data from the memory.
- (5) Uses register from the register section to store data temporarily and performs the computing function in the ALU section.
- (6) Using same bus lines, it sends out the result in binary format to the seven segment LED display.

8. MICROPROCESSOR APPLICATIONS

The applications of microprocessors are given below:

- (1) Toys Robots, remote-controlled cars, and hand games.
- (2) Simple Applications Microwave oven, telephone diallers, smart thermostats, shortwave scanners, and TV remote controls.
- (3) Complex Intelligent Product Controllers VCR control and programming, security systems, and lighting system controllers

- (4) Computer Peripherals Video Display, higher-speed printers, modems, plotters, and communication controllers.
- (5) Industrial Controllers Robotics, processing control, sequence control, and machine tool control.
- (6) Instruments Logic analyses, communication analyzers, disk drive testers, digital oscilloscopes, and smart voltmeters.
- (7) Communications Data, voice, mobile, electronic switching, and routing.
- (8) Automatic Test Equipment Automatic test equipment at all levels from development, fabrication, component testing assemble, PCB, module and system testing.
- (9) Electrical Power System Data acquisition, logging, protection, metering, control and processing, automatic control of generators voltage and fuel control of furnaces in a power plant.
- (10) Industrial Process Control Instrumentation, monitoring and control, data acquisition, logging and processing.
- (11) Household Appliances Cooking ovens, and washing machines.
- (12) Medical Electronics Quick patient check up, diagnosis, blood analysis, ECG, etc.
- (13) Database Management Word processing, database management and storing information.

