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# **Introduction to Computer Hardware and Software**

## **Part I : Introduction to Computer Hardware and Software**

### **1.1 : Computer Generations, Computer Types, Bits, Bytes and Words**

**Q.1 Define computer.**

**OR Distinguish between data and information.**

**Ans. :** • The term computer is derived from the word compute, it means to calculate.

- **Definition :** Computer is an electronic device which accepts data, process the data and gives the desired output.
- It performs pre-defined or programmed computations at a high speed and with great accuracy.
- **Data :** Data is the fact or raw material for the information processing.
- **Information :** The processed data is called information.
- Computer accepts data and process it to convert it into usable information. The process may involves recording, analyzing, sorting, searching, calculating, distributing and storing data. Thus computer is known as data processing system.

**Q.2 Define digital computer. List the basic operations performed by computer.**

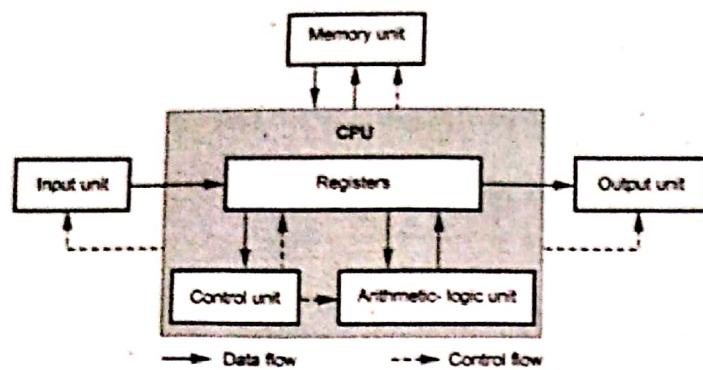
**Ans. :** • Digital computer is a computer which represents information by numerical (binary) digits. They represent data as having only two distinct values.

- In this type of computers, any type of information is broken into tiny units and these pieces of information is represented by numbers.
- Personal computer is an example of digital computer.
- The five basic operations performed by computer are:
  - **Input :** It is the process of capturing or acquiring the information, or it is the process of accepting data or information.
  - **Process :** It is a transformation process. It converts input data into useful information.
  - **Output :** It is the process by which the useful information is made available to the user by displaying it or by printing a hard copy of it.
  - **Storing :** It is the process of storing or retaining the data or information or instructions, so that the user can retain and retrieve it whenever required.
  - **Controlling :** It is the process of directing the manner and sequence in which all the operations are to be performed.

**Q.3 Draw the functional block diagram of a digital computer and discuss its components in brief.**

**Ans. :** • Fig Q.3.1 shows the block diagram of a digital computer.

- It consists of input unit, control unit, Arithmetic-Logic Unit (ALU), registers, memory unit and output unit.
- 1. **Input unit :** It accepts instructions and data from the user and applies them as input to the computer.
- 2. **Central Processing Unit (CPU) :** It processes and controls instructions and data inside the computer.
- 3. **Output unit :** After completing processing, this unit communicates results to the user.



**Fig. Q.3.1 Block diagram of a computer with flow of data and instructions**

4. **Memory unit :** The memory unit stores the data read from input device and provides it for processing when required. It also stores the intermediate and final results of processing.

#### **Q.4 Discuss the digital computer generation in brief.**

**Ans. : The first generation - Vacuum tubes (1943-1946)**

The first electronic computer, ENIAC (Electronic Numerical Integrator and Computer).

- It was made up of more than 18000 vacuum tubes and 1500 relays.
- It was able to perform nearly 5000 additions or subtractions per second.
- It was a decimal rather than a binary machine.
- Its data memory consists of 20 accumulators, each capable of storing a ten digit decimal number.

#### **The Second Generation - Transistors (1947)**

- **Uses transistors** - Transistors are smaller, cheaper and they dissipate less heat, i.e. low power consumption.
- Greater speed, larger memory capacity and smaller size than first generation.
- Ferrite core memories are developed and used for main memory and magnetic discs are used for secondary memory.
- Due to addition of a set of index registers and arithmetic circuits, CPU can handle both floating-point and fixed-point operations.

#### **The Third Generation - Integrated Circuits**

- Uses integrated circuits.
- Integrated circuit technology enabled lower-cost, faster processors and development of memory chips.
- Integrated circuit technology allowed to increase memory size and number of I/O ports.
- Magnetic core memories were replaced by integrated circuit memories.
- Various techniques were introduced to improve the performance of the computer. These are :
  - Microprogramming
  - Parallel processing - a) Multiprocessing and b) Pipelining
  - Sharing resources

#### **Q.5 Explain various types of computers in detail.**

**Ans. :** According to size, cost computational power and application computers are classified as :

- Microcomputers
- Minicomputers
- Desktop computers
- Personal computers
- Portable notebook computers
- Workstations
- Mainframes or enterprise systems
- Servers
- Super computers.

#### **Microcomputers :**

- As the name implies micro-computers are smaller computers.
- They contain only one Central Processing Unit.
- One distinguishing feature of a microcomputer is that the CPU is usually a single integrated circuit called a microprocessor.
- Microcomputer is the integration of microprocessor and supporting peripherals (memory and I/O devices).
- The word length depends on the microprocessor used and is in the range of 8 bits to 32 bits.

- These type of computers are used for small industrial control, process control and where storage and speed requirements are moderate.

#### **Minicomputers :**

- Minicomputers are the scaled up version of the microcomputers with the moderate speed and storage capacity.
- These are designed to process smaller data words, typically 32-bit words.
- This type of computers are used for scientific calculations, research, data processing application and many other.

#### **Desktop Computers :**

- The desktop computer are the computers which are usually found on a home or office desk.
- They consist of processing unit, storage unit, visual display and audio as output units, and keyboard and mouse as input units.
- Usually storage unit of such computer consists of hard disks, CD-ROMs, and diskettes.

#### **Personal Computers :**

- The personal computers are the most common form of desktop computers.
- They found wide use in homes, schools and business offices.

#### **Portable Notebook Computers :**

- Portable notebook computers are the compact version of personal computers.
- The laptop computers are the good example of portable notebook computer.

#### **Workstations :**

- Workstations have higher computation power than personal computers.
- They have high resolution graphics terminals and improved input/output capabilities.
- Workstations are used in engineering applications and in interactive graphics applications.

#### **Mainframes or Enterprise Systems :**

- Mainframe computers are implemented using two or more Central Processing Units (CPU).

- These are designed to work at very high speeds with large data word lengths, typically 64 bits or greater.
- The data storage capacity of these computers is very high.
- This type of computers are used for complex scientific calculations, large data processing applications, Military defense control and for complex graphics applications (e.g. : For creating walkthroughs with the help of animation software).

#### **Servers :**

- These computers have large storage unit and faster communication links.
- The large storage unit allows to store sizable database and fast communication links allow faster communication of data blocks with computers connected in the network.
- These computers serve major role in Internet communication.

#### **Supercomputers :**

- These computers are basically multiprocessor computers used for the large-scale numerical calculations required in applications such as weather forecasting, robotic engineering, aircraft design and simulation.

#### **Q.6 What do you mean by bit, bytes and words.**

**Ans. :** The following figure shows the format of binary number. Four binary digits form a nibble, eight binary digits form a byte, sixteen binary digits form a word and thirty-two binary digits form a double-word.

**Nibble :** 4-bits can represent  $2^4 = 16$  distinct values

**Byte :** 8-bits can represent  $2^8 = 256$  distinct values

**Word :** 16-bits can represent  $2^{16} = 65536$  distinct values

**Double word :** 32-bits can represent  $2^{32} = 4294967296$  distinct values

$b_{31} b_{30} b_{29} b_{28}$	$b_{27} b_{26} b_{25} b_{24}$	$b_{23} b_{22} b_{21} b_{20}$	$b_{19} b_{18} b_{17} b_{16}$	$b_{15} b_{14} b_{13} b_{12}$	$b_{11} b_{10} b_9 b_8$	$b_7 b_6 b_5 b_4$	$b_3 b_2 b_1 b_0$	Bit
Nibble 7	Nibble 6	Nibble 5	Nibble 4	Nibble 3	Nibble 2	Nibble 1	Nibble 0	
Byte 3		Byte 2			Byte 1		Byte 0	
Word 1				Word 0				
Double word								

### 1.2 : CPU, Primary Memory, Secondary Memory

**Q.7 Explain the components of the CPU with block diagram.**

- Ans. :**
- The CPU is the brain of the computer system. It works as an administrator of a system.
  - All the operations within the system are supervised and controlled by CPU. It interprets and co-ordinates the instructions.
  - The data and instructions are temporarily stored in its memory unit. After performing operation, the result of operation can be stored in this memory unit.
  - The results of operation are sent towards output unit for the user.
  - Thus, CPU controls all internal and external devices, performs arithmetic and logical operations, controls the memory usage and control the sequence of operations.

- For performing all these operations, the CPU has three subunits :

- Arithmetic and Logic Unit (ALU)
- Control Unit
- Memory (CPU registers) Unit
- The Fig. Q.7.1 shows the subsystem in the CPU and CPU interaction with other units.

**Q.8 What is ALU ? Explain its function.**

**OR Distinguish between CPU and ALU.**

**Ans. :**

- As mentioned earlier, ALU is a subunit of CPU.

- It performs arithmetic operations like addition, subtraction and logic operations like OR, AND, invert, exclusive-OR on binary words. The data stored in memory unit is transferred to ALU. The ALU performs the operation, that is, the data is processed and the result is stored in internal memory unit of CPU. The result of final operation is transferred from memory unit to an output unit.

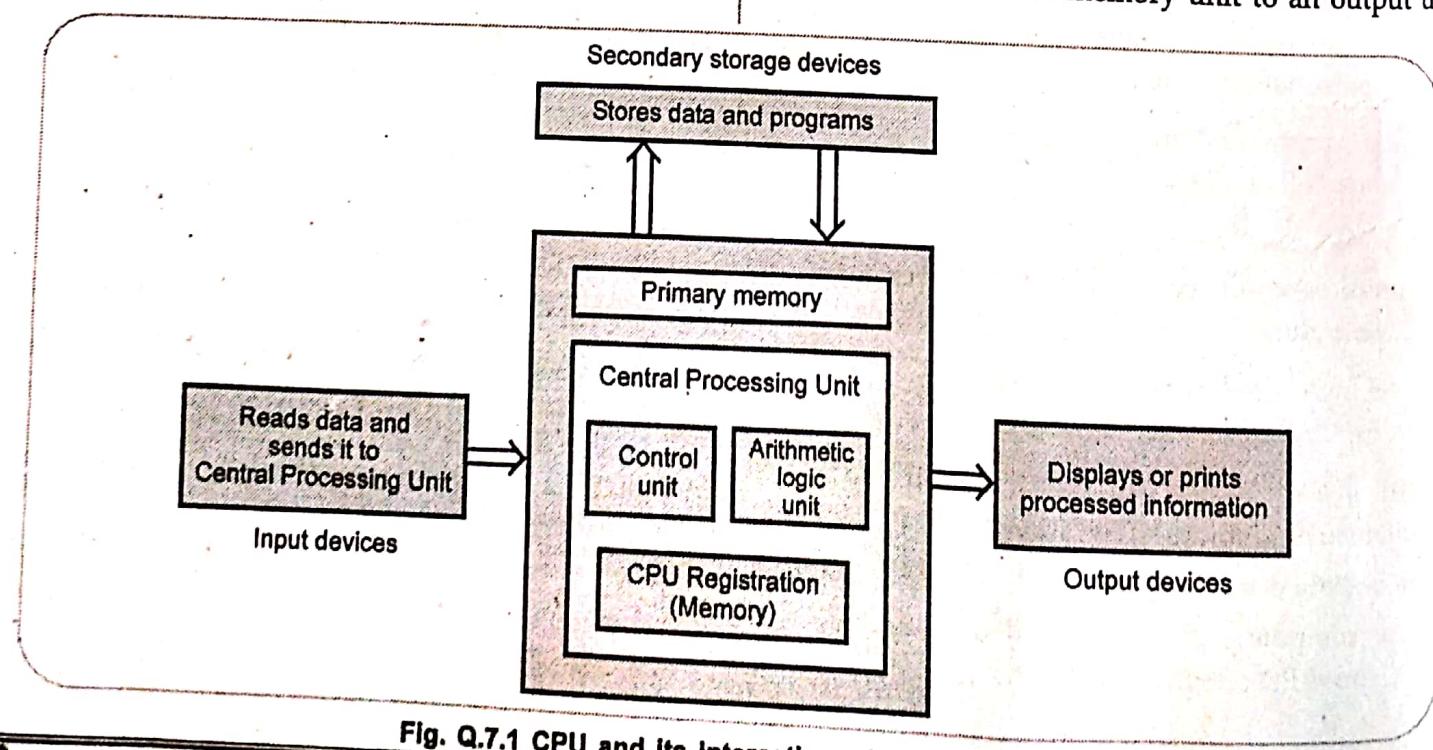


Fig. Q.7.1 CPU and its Interaction with other units

- Arithmetic and logic operations performed by ALU sets flags to represent certain conditions such as equal to condition, zero condition, greater than condition and so on. These conditions are checked by program instructions to change the sequence of program execution.

**Q.9 Explain the role of control unit of CPU in computer system.**

Ans. : The control unit controls all the operations which internally take place within the CPU and also the operations of CPU related to input/output devices. The control unit directs the overall functioning of a computer system.

It interprets program instructions and generates control signals to ensure correct execution of the program. The control signals generated by the control unit direct the overall functioning of the other units of the computer.

All operations in the digital computer are controlled by clock signals. The clock signal provides the basic timing signal for computer operations. The oscillator circuit (internal / external) generates the clock signal. The control unit along with the oscillator circuit is known as timing and control unit.

**Q.10 Explain the function of input unit.**

Ans. : • The function of input unit is to accept data from user and convert it into the form that the computer can understand.

- The input unit consists of input devices such as keyboard, mouse, joystick, light pen, trackball, spaceball, digitizers, scanners and so on. The most commonly used input devices are keyboard and mouse. The keyboard is used for entering text and numeric information. The mouse is used to position the screen cursor and thereby enter the information by selecting option.

**Q.11 What is the function of output unit ?**

Ans. : • Output unit is a communication media between the computer and human. After finishing the processing by the CPU, the output unit sends results to the user using output devices. These devices take the machine coded output results from the CPU and convert them into a form which the human can understand.

- The output unit consists of output devices to display or print the processing results.

**Q.12 What is the function of memory unit ?**

**OR What is the purpose of memory in a computer ?**

**OR What is primary and secondary storage memory ?**

Ans. : • The memory unit is used to store programs and data. Usually, two types of memory devices are used to form a memory unit : primary storage memory device and secondary storage memory device.

- The primary memory, commonly called main memory is a fast memory used for the storage of programs and active data (the data currently in process). It is semiconductor memory.
- The secondary storage devices are extensively used for storing data or instructions. The storage units supply the stored information to the other units of computer as and when required. The commonly used storage devices are floppy disks, hard disks, tape drives etc.

**Q.13 Which are the various units used to measure computer memory ?**

**OR How the size of memory specified ?**

Ans. : • Memory unit stores binary information in groups of bits. The basic unit of memory is bit.

- The computer can understand binary information, that is in the form of 0s and 1s. Computers generally deal with data which is group of bits.
- Group of eight bits is called 'byte'. Modern computers deal with group of bytes (Usually 2 or 4).
- The maximum number of bits (or group of bytes) that can deal with, is called 'word'.
- A memory unit stores words. A word in memory is an entity of bits that moves in and out of storage as a unit.
- Table Q.13.1 shows the various units used to measure computer memory.

Unit	No. of Bytes	Abbreviation
Byte	$2^0 = 1$	B
Kilobyte	$2^{10} = 1024$	KB
Megabyte	$2^{20} = 1, 048, 576$	MB
Gigabyte	$2^{30} = 1, 073, 741, 824$	GB
Terabyte	$2^{40} = 1, 099, 511, 627, 776$	TB

Table Q.13.1 Units of measure for computer memory

**Q.14 What are volatile and non volatile memories ? Explain.**

**Ans. :** • If memory can hold data even if power is turned off, it is called **nonvolatile memory**; otherwise it is called **volatile memory**.

#### Distinguish between volatile and non-volatile memories

Sr. No.	Volatile memory	Non-volatile memory
1.	Volatile memory requires constant power to maintain the stored information.	Non-volatile memory can hold the stored information even when there is no power supply to the memory or storage device.
2.	Volatile memory is typically used only for primary storage.	Non-volatile memory is typically used for the task of secondary storage or long-term persistent storage.
3.	Type of volatile memories are : i) Random Access Memory (RAM) ii) Static RAM (SRAM) iii) Dynamic RAM (DRAM) iv) Fast Page Mode DRAM (FPM DRAM) v) Extended Data Output RAM (EDO RAM) vi) Synchronous DRAM (SDRAM) vii) Double Data Rate (DDR) SDRAM	Examples of non-volatile memory include read-only memory, flash memory, most types of magnetic computer storage devices (e.g. hard disks, floppy disk drives and magnetic tape), optical disc drives, and early computer storage methods such as paper tape and punch cards.

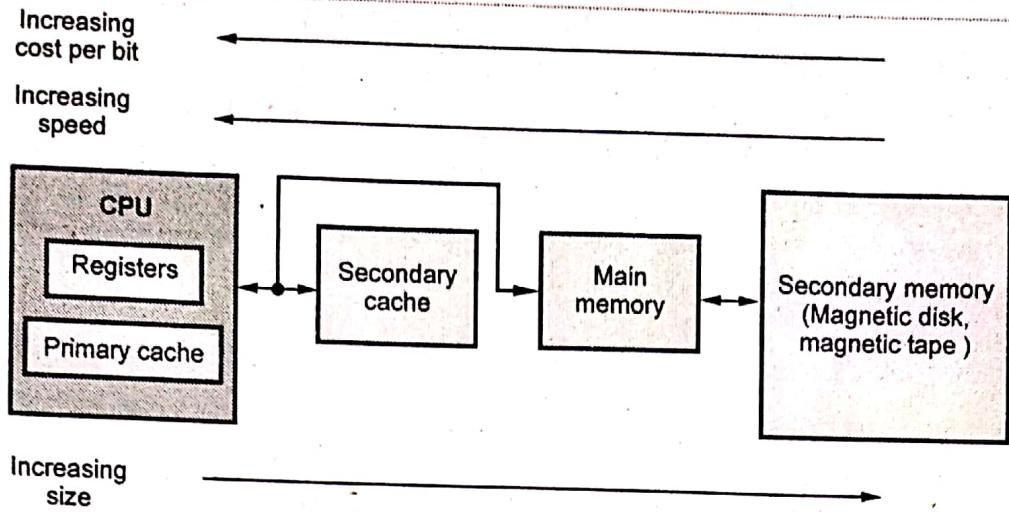
**Q.15 Differentiate between primary memory and secondary memory.**

**Ans. :**

Parameter	Primary Storage Memory	Secondary Storage Memory
Types	It includes static RAM and dynamic RAM	It includes Floppy disk, Hard disk, CDROM, Magnetic tape, Magnetic bubble memory etc.
Storage capacity	It has less storage capacity ranging from 1 kbytes to 512 kbytes.	It has a high storage capacity and it is practically unlimited because when one disk or tape is full, the next one can be used.
Access	Microprocessor can access and process data/program directly from these memories.	Microprocessor cannot directly access or process data/program stored in these memories. Data/program need to be copied into primary storage memory for microprocessor access.
Speed	It can be accessed with a greater speed.	Its access speed is slow.
Cost	Its cost is high for per unit storage capacity.	Its cost is low for per unit storage capacity.
Physical size	Physical size is large for per unit storage capacity.	Physical size is small for per unit storage capacity.

**Q.16 Draw the memory hierarchy structure of a computer system. Explain each memory unit in brief.**

**Ans. :** • Ideally, computer memory should be fast, large and inexpensive. Unfortunately, it is impossible to meet all the three of these requirements simultaneously. Increased speed and size are achieved at increased cost. Very fast memory system can be achieved if SRAM (Static RAM) chips are used. These chips are expensive and for the cost reason it is impracticable to build a large main memory using SRAM chips. The only alternative is to use DRAM chips for large main memories.



**Fig. Q.16.1 Memory hierarchy**

- Thus entire memory unit comprises of CPU registers, on-chip cache memory, external cache memory, primary memory and secondary memory. This is illustrated in Fig. Q.16.1.
- In the memory system, small section of SRAM (Fast memory) is added along with main memory, referred to as **cache memory**.
- The program which is to be executed is loaded in the main memory, but the part of program (code) and data that work at a particular time is usually accessed from the cache memory. This is accomplished by loading the active part of code and data from main memory to cache memory.
- The cache memory just discussed is called **secondary cache**. Recent processors have the built-in cache memory called **primary cache**.
- The Fig. Q.16.1 shows how memory hierarchy can be employed in a computer system.
- As shown in the Fig. Q.16.1 at the bottom of the hierarchy magnetic tapes and magnetic disks are used as a **secondary memory**. This memory is also known as **auxiliary memory**. It provides large storage space.
- The main memory (Dynamic RAM) occupies a central position by being able to communicate directly with the CPU.

#### **Q.17 Compare static RAMs and dynamic RAMs.**

**Ans. :**

Sr. No.	Static RAM	Dynamic RAM
1.	Static RAM contains less memory cells per unit area.	Dynamic RAM contains more memory cells as compared to static RAM per unit area.
2.	It has less access time hence faster memories.	Its access time is greater than static RAMs.
3.	Static RAM consists of number of flip-flops. Each flip-flop stores one bit.	Dynamic RAM stores the data as a charge on the capacitor. It consists of MOSFET and the capacitor for each cell.
4.	Refreshing circuitry is not required.	Refreshing circuitry is required to maintain the charge on the capacitors after every few milliseconds. Extra hardware is required to control refreshing. This makes system design complicated.
5.	Cost is more.	Cost is less.

#### **Q.18 Explain various types of ROM.**

**Ans. :** There are four types of ROM : Mask ROM, PROM, EPROM and EEPROM.

- Mask Programmable Read-only memories (ROMs) are the least expensive type of solid state memory. They are primarily used for storing video game software and fixed data for electronic equipment,

such as fonts for laser printers, dictionary data in word processors and sound data in electronic musical instruments.

- ROM stands for Read Only Memory. A typical application of a ROM might be an industrial machine that repeats the same sequence over and over to manufacture auto parts. Another example might be the boot up software for a regular PC, which performs the same task each time the power is turned on.
- PROM stands for Programmable ROM. PROMs are often used for testing phases.
- EPROM stands from electrically programmable ROM. We can erasure the contents of an EPROM by submitting it to ultraviolet light for five to ten minutes. EPROMs are often used in development phase of the product.
- EEPROM stands for Electrically Erasable Programmable ROM. EEPROM is a special type of PROM that can be erased by exposing it to an electrical charge. EEPROMs are used for industrial and military applications.

#### Q.19 Differentiate RAM and ROM

**Ans. :**

Parameter	RAM	ROM
Stands for	Random Access Memory	Read-only memory
Definition	Random Access Memory or RAM is a form of data storage that can be accessed randomly at any time, in any order and from any physical location, allowing quick access and manipulation.	Read-only memory or ROM is also data storage that can be accessed randomly at any time, in any order and from any physical location; however, its contents can't be altered or reprogrammed.
Use	RAM allows the computer to read data quickly to run applications. It allows reading and writing.	ROM stores the program required to initially boot the computer. It only allows reading.

Volatility	RAM is volatile i.e. its contents are lost when the device is powered off.	It is non-volatile i.e. its contents are retained even when the device is powered off.
Types	The two main types of RAM are static RAM and dynamic RAM.	The types of ROM include PROM, EPROM and EEPROM.

#### 1.3 : Ports and Connections

##### Q.20 State types of ports.

**Ans. :** Input port, Output port, serial port and parallel port.

##### Q.21 What is Input port ?

**Ans. :** Input port is used to read data from input device such as keyboard. The simplest form of input port is a buffer. The input device is connected to the CPU through buffer, as shown in the Fig. Q.21.1. This buffer is a tri-state buffer and its output is available only when enable signal is active. When CPU wants to read data from the input device (keyboard), the control signals from the CPU activates the buffer by asserting enable input of the buffer. Once the buffer is enabled, data from the input device is available on the data bus. CPU reads this data by initiating read command.

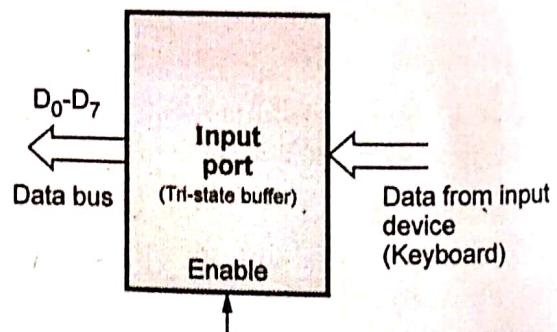


Fig. Q.21.1

##### Q.22 What is output port ?

**Ans. :** The output port is used to send data to the output device such as display port is a latch. The output device is connected to the CPU through latch, as shown in the Fig. Q.22.1. When CPU wants to

send data to the output device it puts the data on the data bus and activates the clock signal of the latch, latching the data from the data bus at the output of latch. It is then available at the output of latch for the output device.

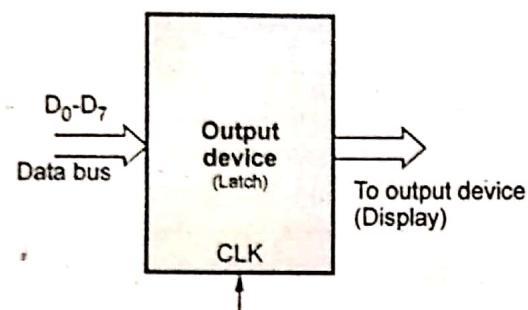


Fig. Q.22.2

#### 1.4 : Input and Output Devices

**Q.23 What is the importance of input and output devices ? Describe any two input/output devices.**

**Ans. :** We can interact with the personal computer using input-output (I/O) devices. Using input devices, computer can accept data and instructions from the user or another computer system (For example, computer on the Internet). Using output devices, computer can send the processed data to the user or to another computer system.

##### Input Devices

The function of an input device is to apply data to the computer for processing.

- **Keyboard :** It is the most commonly used input device which accepts text and numbers.
- **Mouse :** It is again the commonly used input device to position the screen cursor.



(a) Keyboard



(b) Mouse

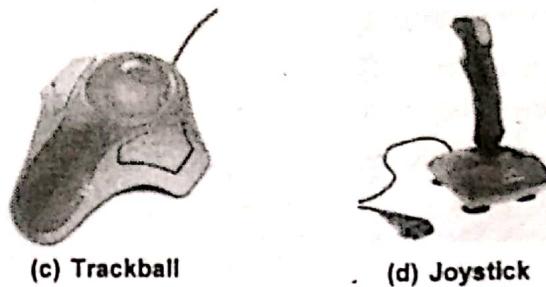


Fig. Q.23.1

- **Trackball :** It allows to produce screen cursor movement. It is two-dimensional positioning device.
- **Spaceball :** It is usually used in three-dimensional positioning and selecting operations in virtual-reality systems.
- **Joystick :** It has a small, vertical lever (called the stick) mounted on the base and used to steer the screen cursor around. Both x and y co-ordinate positions can be simultaneously altered by the motion of a single lever in a joystick. (Refer Fig. Q.23.1 (d)).
- **Scanner :** The scanner is a device, which is used to store drawings, graphs, photos or text available in printed form for computer processing.
- **Digital Camera :** The still images can be recorded with it. These images can be viewed and edited any time on the computer.
- **Light Pen :** It is a pencil shaped device used to select positions by detecting the light coming from points on the CRT screen. It consists of photoelectric cell housed in a pencil like case.
- **Microphone :** It enables to input data which is in the form of voice or music.
- **Digitizers :** It is used for applications such as tracing. It consists of flat surface which can detect the position of a movable stylus.

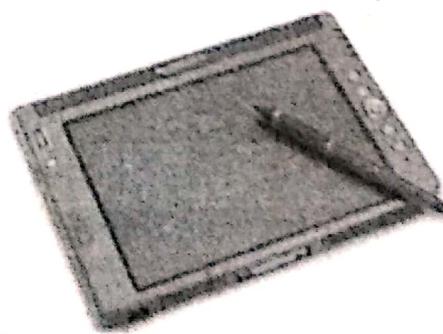
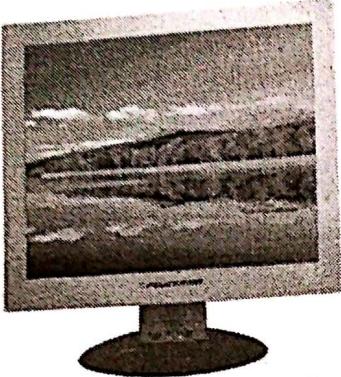


Fig. Q.23.2 Digitizer

**C Programming for Problem Solving****Output Devices**

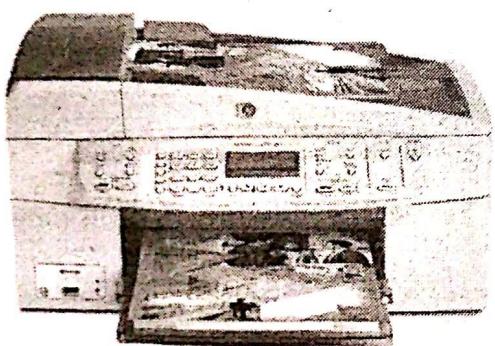
The function of an output device is to present processed data to the user.

- **Monitor** : The computer sends processed data (i.e. output) to the monitor when the user needs to observe the output.



**Fig. Q.23.3 (a) Monitor**

- **Printer/Plotter** : When the user needs hard-copy (i.e. paper-copy) of an output, the computer sends output to the printer/Plotter.

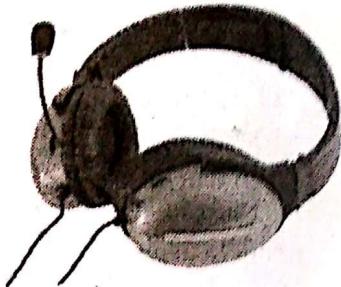


**Fig. Q.23.3 (b) Printer**

- **Head-phones or Speakers** : When the user needs a sound-output, the computer sends output to the head-phones or speakers.

Some devices act as both, input and output devices.

- **Touch Screen** : This is a monitor having touch sensing mechanism. It displays text or icons you can touch. When you touch the screen, special sensors detect the touch and the computer calculates the screen co-ordinates of point of contact. According to the location of the touch, the computer displays the information or determines the next action which to be performed.



**Fig. Q.23.3 (c) Head-phone**

- **Communication Devices** : These devices are used to connect two or more computers to each other, that is, for networking. For example, modems enable the computers to communicate through telephone lines.
- Another example is network interface cards, which allow to connect a group of computers to share data and devices.

### 1.5 : Computers in Network, Network Hardware

#### Q.24 What is network ?

**Ans.** : Network is a set of devices connected by media links. The links connecting the devices are often called communication channels. The type of network is determined by size, its ownership, physical architecture and the distance it covers.

#### Q.25 What is computer network ?

**Ans.** : Computer networking consists of two or more computers that are linked in order to share resources, exchange files, or allow electronic communications. The computers on a network may be linked through cables, telephone lines, radio waves, satellites, or infrared light beams.

#### Q.26 List the types of Computer Networks.

**Ans.** : Computer networks can be categorized depending on their physical size. Major categories of computer networks are as follows :

1. Local Area Networks (LAN)
2. Metropolitan Area Networks (MAN)
3. Wide Area Networks (WAN)

#### Q.27 What is LAN ?

**Ans.** : A Local Area Network (LAN) is a network that is confined to a relatively small area. It is

generally limited to a geographic area such as a college, lab or building. It is typically a privately owned data communication system in which the user shares resources. LAN is used for communication in a small community in which resources, such as printers, software and servers are shared. Fig Q.27.1 shows LAN.

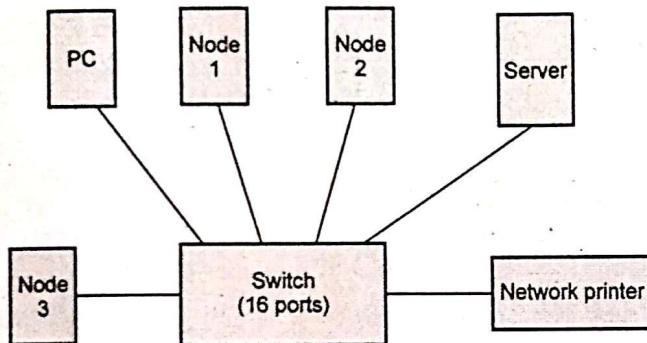


Fig. Q.27.1 LAN

#### Q.28 What is WAN ? Write a detail note on WAN.

**Ans. :** • WAN provides long distance transmission of data and voice. Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites. The largest WAN in existence is the Internet. Fig. Q.28.1 shows WAN.

- WAN consists of host and collection of machines. User program is installed on the host machine and nodes. All the hosts are connected by each other through communication subnet. Subnet carries messages from host to host.

- Subnet consists of transmission lines and switching elements. The transmission line is used for data transfer between two machines. Switching elements are used for connecting two transmission lines. Switching elements are specialized computers. It selects the proper outgoing line for incoming data and forwards the data on that line.

- The switching elements are basically computers and they are called packet switching nodes, intermediate systems and data switching exchanges. These switching elements are also called routers. Host are owned by users and subnet is owned by the telephone company or an Internet service provider.

- Each node in a WAN is a router that accepts an input packet, examines the destination address, and forwards the packet on to a particular telecommunications line. A router must select the one transmission line that will best provide a path to the destination and in an optimal manner.

- In the WAN, when the packet is sent from one router to another via one or more intermediate routers, the packet is received at each intermediate router in its entirety. This packet is stored in that router until the required output line is free. The subnet which uses this principle is called point to point, store and forward, or packet switched subnet. Almost all the WANs use store and forward subnets. If the packets are small and of same size, they are also called cells.

- WAN uses hierarchical addressing because they facilitate routing. Addressing is required to identify which network input is to be connected to which network output.

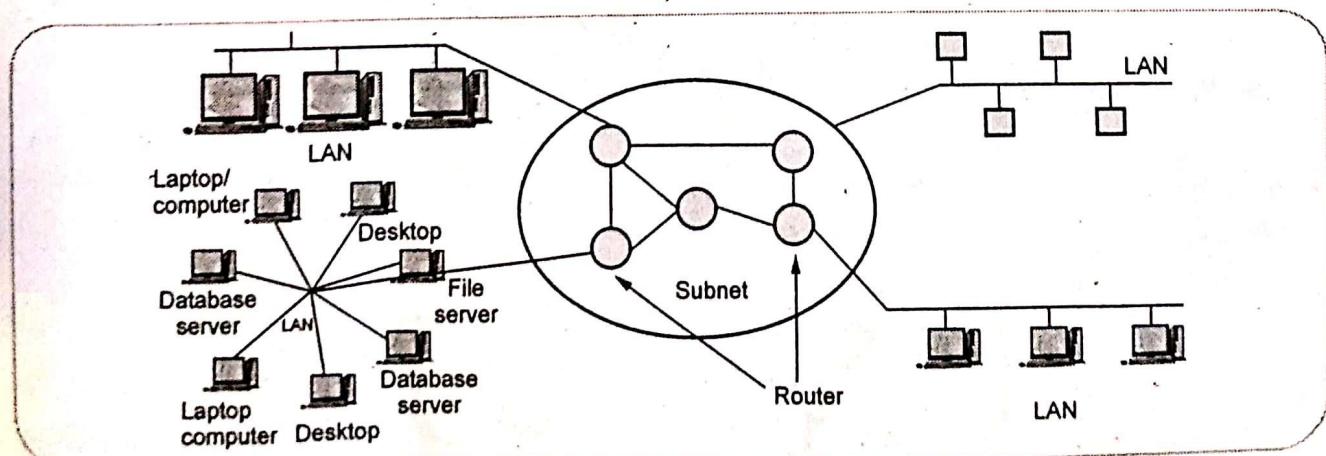


Fig. Q.28.1 WAN

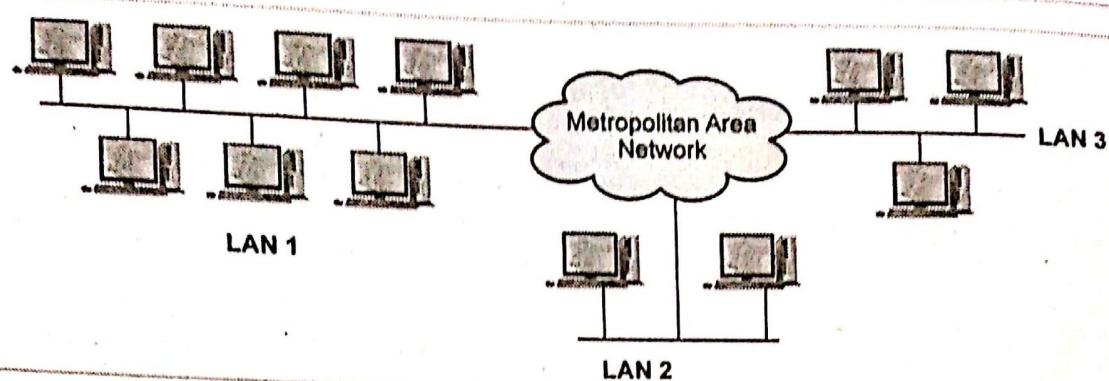


Fig. Q.29.1 MAN

### Q.29 What is MAN ?

**Ans.** : MAN Stands for Metropolitan Area Network. Its size falls intermediate between LANs and WANs.

- A MAN typically covers an area of between 5 and 50 km diameter. Many MANs cover an area the size of a city, although in some cases MANs may be as small as a group of buildings.
- A MAN often acts as a high speed network to allow sharing of regional resources (similar to a large LAN). It is also frequently used to provide a shared connection to other networks using a link to a WAN. MAN provides the transfer rates from 34 to 150 Mbps.
- Fig. Q.29.1 shows MAN. Backbone of MAN is high-capacity and high-speed fiber optics. MAN works in between Local Area Network and Wide Area Network. MAN provides uplink for LANs to WANs or Internet.
- MAN as a special category is that a standard has been adopted for them and this standard is now being implemented. It is called IEEE 802.6. In MAN, bit error rate and delay higher than LAN.

### Q.30 State the difference between LAN, WAN and MAN.

**Ans. :**

LAN	WAN	MAN
A network that connects a relatively small number of machines in a relatively close geographical area	A network that connects two or more local-area networks over a potentially large geographic distance	The communication infrastructures that have been developed in and around large cities

Covers small area, i.e. within the building	Covers large geographical area	Covers larger than LAN and smaller than WAN
Low bit error rate and delay	High bit error rate and delay.	Bit error rate and delay higher than LAN
Support higher data transfer rate	Support lower data transfer rate	Support moderate data transfer rate
LAN uses inexpensive equipment	WAN uses most expensive equipment	MAN uses moderately expensive equipment

### Q.31 Discuss OSI model of networking ?

**Ans.** : Fig. Q.31.1 shows OSI (Open Systems Interconnection) Reference model. There are 7 layers in the model. Each layer deals with a particular aspect of network communication.

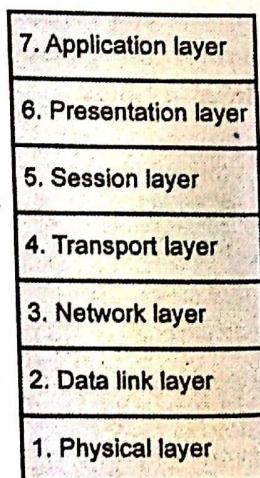


Fig. Q.31.1 OSI layers

- The OSI model describes how information or data makes its way from application programme

through a network medium to another application programmer located on another network.

- The OSI model divides the functions into a series of layers. All layers work together in the correct order to move data around. Data is passed from one layer to next layer. Each layer adds its own information (header) when data is sent, and removes it when data is received.
1. **Physical layer** : It is concerned with the transmission and reception of the unstructured raw bit stream over a physical medium.
  2. **Data link layer** : DLL is responsible for the transfer of data over the channel. It groups zeros and ones into frames. A frame is a series of bits that forms a unit of data. The data link layer provides error-free transfer of data frames from one node to another over the physical layer.
  3. **Network layer** : This is responsible for addressing messages and data so they are sent to the correct destination, and for translating logical addresses and names into physical addresses. This layer is also responsible for finding a path through the network to the destination computer.
  4. The **transport layer** ensures that messages are delivered error-free, in sequence, and with no losses or duplications.
  5. The **session layer** adds mechanisms to establish, maintain, synchronize and manage communication between network entities.
  6. The **presentation layer** is responsible for data compression, data expansion, data encryption and data decryption.
  7. **Application layer** : It contains all services or protocols needed by application software or operating system to communicate on the network.

#### **Q.32 List various networking devices ?**

**Ans. :** Networking devices are : Router, repeater, bridge, gateway, etc.

#### **Q.33 Write a note on repeater ?**

**Ans. :** • Repeaters operate at the physical layer. It forward bits from one LAN segment to another. The

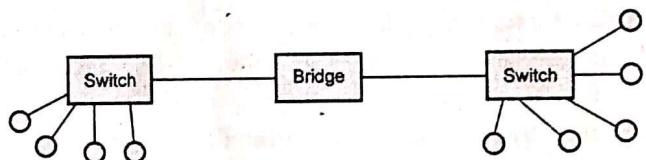
basic purpose of a repeater is to extend the distance of LAN.

- A repeater is a network device that is used to regenerate or replicate signals that are weakened or distorted by transmission over long distances and through areas with high levels of electromagnetic interference (EMI).
- Repeaters do not have physical addresses on the network.
- Repeaters do not translate anything. A repeater does not actually connect two LANs; it connects two segments of the same LAN.

#### **Q.34 Write a note on bridge.**

**Ans. :** • Bridges operate at the Data Link layer. It has a single input and single output port. A bridge extends the maximum distance of network by connecting separate network segment. A bridge simply passes on all the signals it receives.

- Fig. Q.34.1 shows bridge.



**Fig. Q.34.1 Bridge**

- The interface between the bridge and each LAN segment is known as a port. Each LAN attached to a port is called a network segment.
- Bridge performs data link functions such as error detection, frame formatting and frame routing.
- Bridges may be either local or remote. Local bridges connect multiple LAN segments within the same local area.
- Remote bridges connect multiple LAN segments in different areas.

#### **Q.35 Write a note on router.**

**Ans. :** • Routers operate at the network layer of the OSI Model.

- Its purpose is to find the best shortest path from one network environment to another and forward packets between them.

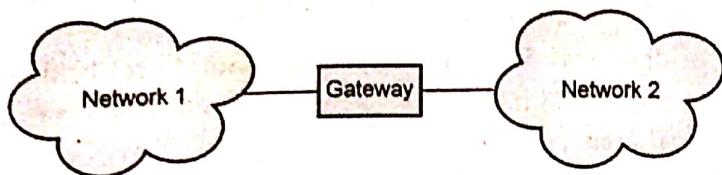
**Fig. Q.35.1 Router**

- A router forwards packet by examining protocol address at network layer, look up the address in the routing table, then forward the packet to the next hop. Router uses one or more routing algorithms to calculate the best path through an internetwork.
- Fig. Q.35.1 shows router. A router has interfaces on multiple networks.
- Router monitors network traffic and report statistics to a management information base.

**Q.36 Write a note on Gateway.**

**Ans. :** • Gateway is combination of networking hardware and software that connects two dissimilar kinds of networks. A gateway is protocol converter. It operates in all seven layers of the OSI model.

- A gateway can accept a packet formatted for one protocol (e.g. TCP/IP) and convert it to a packet formatted for another protocol (e.g. Apple Talk) before forwarding it.
- The gateway must adjust the data rate, size and data format. Gateway is generally software installed within a router.



**Fig. Q.36.1 Gateway**

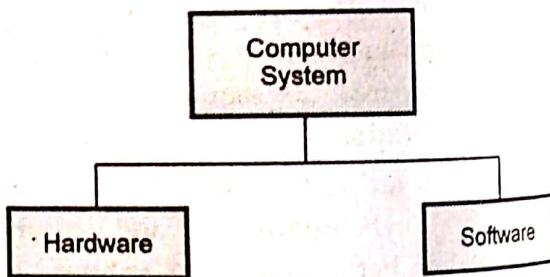
- To process the data, the gateway decapsulates incoming data through the networks complete protocol stack. The outgoing data is encapsulates in the complete protocol stack of the other network to allow transmission.

- A gateway is required to convert data packets from one protocol format to another before forwarding as it connects two dissimilar networks.
- Popular types of gateways include :
  - 1) E-mail gateways
  - 2) IBM host gateways
  - 3) Internet gateways
  - 4) LAN gateways

**1.6 : Software Basics and Software Types**

**Q.37 State the two major components of computer.**

**Ans. :** A computer system consists of two major components, hardware and software.



**Fig. Q.37.1 A computer system**

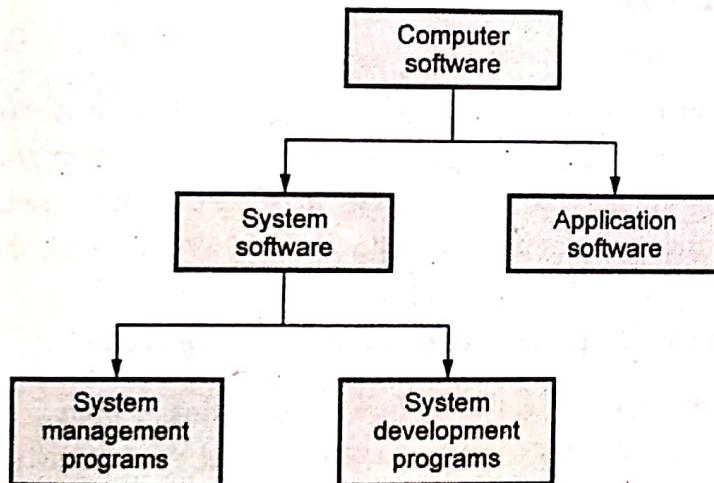
- **Hardware** : The physical parts that make up a computer which are interconnected electrical devices and which you can see and touch are called 'hardware'. The examples are, CPU, input devices like keyboard, mouse, output devices like printer, monitor.
- **Software** : A computer cannot think or perform operation on its own. The sequential instructions are to be given to perform any operation. The computer performs the operation according to the instructions issued by the user. The set of sequential instructions and data which perform the operations is called **program**. This program or collection of such programs is called **software**.

- The software controls and operates the hardware to get the desired output. Every action and function of hardware is driven by software.

#### **Q.38 Give classification of software categories.**

**Ans. :** • Computer software can be divided into two broad categories as : **system software** and **application software**.

- System software** is a generic term for any computer program which is used to run the computer system.
- Application software** allows to perform specific tasks on a computer using the capabilities of a computer.
- System software can be again subdivided into two categories as : **system management programs** and **system development programs**. Fig. Q.38.1 shows the categories of software.



**Fig. Q.38.1 Software categories**

#### **Q.39 Write a note on system software.**

**Ans. :** • System software is a set of programs which are required for controlling, integrating and managing the hardware components of a computer system. It is needed for the functioning of a computer system.

- The system software is to be loaded in the computer system before using the system for performing any task. It usually interacts with hardware or applications. It creates a programming environment for the application programs.
- All the information processing activities in the computer system are managed and supported by the system software.
- Simply, we can say that the system software is the software which makes the computer system functional. The basic functions in the computer system such as file management, device

management are performed by the system software. The examples of system software are :

- Operating systems,
- Device drivers,
- Language translators,
- System utilities.

#### **Q.40 Write any three differences between application software and system software ?**

**Ans. :**

Basis For Comparison	System software	Application software
Basic	System software is computer software designed to operate the computer hardware and to provide a platform for running application software.	Application software is computer software designed to help the user to perform specific tasks.
Language	System software is written in a low-level language, i.e. assembly language.	Application software is written in a high-level language like Java, C++, .net, VB, etc.
Run	System software starts running when the system is turned on, and runs till the system is shut down.	Application software runs as and when the user requests.
Examples	Operating system, compiler, assembler, debugger, driver, etc.	Microsoft office, Photoshop, Animation software, etc.

#### **Q.41 What is an operating system ?**

**Ans. :** • An operating system is a collection of system programs that tells the computer what to do under a variety of conditions.

- When we start the computer system, it occupies the first layer of software loaded into computer memory. The other software gets loaded after loading system software in the memory. The system software provides a software platform and various common core services needed by the other software. It performs resource management and provides an interface between the user and machine. A resource may be the processor, memory or an input/output device. Simply we can say, the operating system organises and controls the

**C Programming for Problem Solving**

hardware. The examples of operating system are DOS, UNIX, WINDOWS and LINUX.

**Q.42 Describe the functionalities of an operating system.****Ans. : Process Management and scheduling**

- Provide an interface between the computer hardware and the programmer that simplifies and makes feasible for coding, creation, debugging and execution of application programs.
- Provide access to the compiler for translating the user program from high level language to machine language.
- Provide a loader program to move the compiled program code to the computer's memory for execution.
- Organise processing time between programs and users.
- Organise priorities between program and users.

**Device Management**

- Recognize input from the keyboard.
- Send output to the display screen.
- Control peripherals such as disk drives and printers.

**File Management**

- Creating and deleting of files.
- Mapping files onto secondary storage.
- Creating and deleting directories.
- Backing up files on stable storage media.
- Supporting primitives for manipulating files and directories.
- Transmission of file elements between main and secondary storage.

**Memory Management**

- Controls transfer of programs in and out of memory.
- Organise the use of memory between programs.
- Control the allocation and use of the computing system's memory among the various users and tasks.

**Handling Users**

- Maintain security and access rights of users with the help of password or access right information.

**Command Interpretation**

- Read, check, interpret and execute user command like copy, print, rename, dir, type, delete, etc.

**Job Accounting and Log Maintenance**

- Compute the resource allocation time for different users, CPU utilization time, keep record of logon and logout times for users etc.

**Security**

- Provide data security among various users and prevent unauthorized access to any of the resources.

**Communication**

- Provide facility to users to communicate and interact with other users.

**Fault Tolerance Management**

- Deal with errors.
- In the event of failure of certain interface or device hand over the affected task to substitute system and keep the process running. In some situations send the appropriate messages to the users about the fault to take necessary action.

**Q.43 State different types of operating system.****OR Give the classification of operating system.**

**Ans. :** The different types of operating systems are

- Batch Processing Operating System
- Multiprogramming Operating System
- Time sharing Operating System
- Distributed Operating System
- Multitasking Operating System
- Multiuser Operating System
- Real Time Operating System
- Interactive Operating System

**1.7 : Concept of Assembler, Compiler, Interpret, Loader and Linker**

**Q.44 Write a note on computer languages.**

**Ans. :** • The computer user has to communicate with a computer using language which it can understand.

That is, programs should be written in computer languages, called **programming languages**.

#### **Types of Programming Languages**

1. **Machine level language** : The computer can understand only machine (binary) language which uses 0s and 1s. In machine language the different instructions to the computer are formed by taking different combinations of 0s and 1s.
2. **Assembly level language** : It uses symbolic instructions and executable machine codes. The meaningful abbreviations are used for machine-specific instructions. An assembler is required for translating assembly language instructions to machine language instructions to run a program on a computer. Machine and assembly languages are also called **low-level languages**.
3. **High-level language** : This language consists of set of English like words and symbols. The specified rules are to be followed while writing programs in high-level language. These programs are called **source programs**. The interpreters or compilers are used for converting these programs into machine-readable form. Let us discuss details about these languages.

#### **Q.45 State the advantages and disadvantages of machine language.**

**Ans. : Advantages of machine language**

1. Translation free
2. High speed

#### **Disadvantages of machine language**

1. Machine dependent
2. Complex language
3. Error prone
4. Tedious
5. Time-consuming and costly.

#### **Q.46 What is the function of assembler ?**

**OR What is an assembler ?**

**Ans. : Functions of an assembler**

1. It translates mnemonic operation codes to machine codes and corresponding register addresses to system addresses.
2. It checks the syntax of the assembly language program and generates diagnostic messages on syntax errors.

3. It assembles all the codes in the main memory for execution.
4. If the assembly language program is large, it provides linking facility among the subroutines.
5. It facilitates the generation of output on required output medium.

#### **Q.47 State the advantages and disadvantages of assembly language.**

**Ans. : Advantages of assembly language**

1. Easy to understand and use
2. Less error prone
3. Efficiency is more than higher level language.
4. More control on hardware.

#### **Disadvantages of assembly language**

1. Machine dependent.
2. Harder to learn.
3. Slow development time.
4. Less efficient than machine level languages.
5. No standardization.
6. No support for modern software engineering technology.

#### **Q.48 State the advantages and disadvantages of high level language.**

**Ans. : Advantages of high-level languages**

1. Readability
2. Machine independent
3. Easy debugging
4. Easier to maintain
5. Low development cost
6. Easy documentation.

#### **Disadvantages of high-level languages**

1. Poor control on hardware
2. Less efficient
3. Porting difficulty.

#### **Q.49 How to translate high level language program to machine language ?**

**Ans. :** • The computer understands only machine language. So, a translator is needed to translate the symbolic statements of a high level language into computer executable machine language.

- The programs that translate high-level programs into machine language are called **interpreters** and **compilers**.

**Q.50 What is compiler and interpreter ?**

**Ans. : Compiler :** A compiler is a program which translates the source code written in a high-level language into computer-readable machine language that can be directly loaded and executed.

**Interpreter :** Unlike compiler, an interpreter translates a high-level language statement in a source program to a machine code and executes it immediately, before translating the next source language statement. When an error is found, the execution of the program is halted and an error message is displayed on the screen of the computer.

**Q.51 Give the comparison between high-level language and low-level language.**

**Ans. :**

Sr. No.	High Level Language	Low Level Language
1.	These are machine independent.	These are machine dependent.
2.	These are easy to learn.	These are difficult to learn.
3.	They are near to human languages.	They are far from human languages.
4.	Programs in high-level languages are slow in execution.	Program in low-level languages are fast in execution.
5.	High level languages do not provide much facility at hardware level.	Low level languages provide facility to write programs at hardware level.
6.	Knowledge of hardware is not required to write programs.	Deep knowledge of hardware is required to write programs.
7.	Program in high level languages are easy to modify.	Programs in low level languages are difficult to modify.
8.	Writing programs in high level language is comparatively easy and fast.	Writing programs in low level language is difficult and time consuming.
9.	Examples : C, C++, FORTRAN, COBOL, BASIC etc.	Examples : Machine language, assembly language.

**Q.52 Why is the C language called middle level language ?**

**Ans. :** C is called middle-level language because it actually bind the gap between a machine language and high-level languages. User can use language to do system programming (for writing operating system) as well as application programming (for generate menu driven customer billing system).

**Q.53 Give the comparison between interpreter and compiler.**

**Ans. :**

Sr. No.	Interpreter	Compiler
1.	It translates a high-level language statement into a machine code and executes it immediately.	It translates entire source code (Program written in high level language) into a set of machine language instruction.
2.	Translation and execution is alternate for each statement encountered in the higher language program	It translate entire source code into a object program and it is not involved in its execution.
3.	The object code is not saved for future use because the translation and the execution processes alternate.	The object code is permanently saved and is used every time the program is to be executed.
4.	An instruction is interpreted and translated into machine language every time it is executed.	Repeated compilation is not necessary for repeated execution of a program.
5.	Interpreters are slower than compilers.	A compiled program runs much faster than interpreted programs.

**Q.54 What is linker and loader ? Discuss their functionalities.**

**Ans. : Linker**

- Generally, a software comprises millions of lines of programming statements or code. It is usually more efficient to divide this code into logical groups and store in different independent modules.

- Due to this, each module can be individually tested, debugged and maintained. When all the modules work, they are linked together to form a large executable program.
- This single, coherent program is formed by linking together the several object modules and libraries by a system program called 'linker'.
- The linker produces a link file which contains the binary codes for all the combined modules. It also produces a link map which contains the address information about the link files.

#### **Loader**

- The loader is a part of the operating system that brings an executable file residing on disk into memory and executes it. It performs the function of scheduling the executable for execution without creating an executable file as an output. It is responsible for loading, linking and relocation.
- The loader performs four basic tasks listed below :

  1. **Allocation** : It allocates the memory space for the programs.
  2. **Linking** : It combines two or more independent object programs and also supplies the address information needed to allow references between them.
  3. **Relocation** : It prepares the program to execute from its storage area.
  4. **Loading** : It places instructions and data (machine codes) into the memory.

## Part II : Algorithms, Flowcharts and Pseudo-code

### 1.8 : Algorithms

 [VTU : Jan.-17, 18, July-17, Marks 6]

**Q.55 What is algorithm ? Discuss basic characteristic of an algorithm.**

**OR What do you understand by the term algorithm ?**

**OR What do you mean by an algorithm ? Explain the properties of algorithm.**

**Ans. :** Algorithm is a finite sequence of explicit and unambiguous steps required to solve the given

problem. When the required input values are provided, it produces an output and then terminates. The steps may repeat or require decisions as per the requirement.

#### **Properties of algorithm**

1. The steps used in algorithm must be unambiguous and precisely defined.
2. The uncertainty about the instruction to be executed next, should be avoided.
3. The steps used in algorithm should be finite and the algorithm should be terminated, that is, it cannot be open-ended.
4. The execution of the algorithm should conclude after a finite number of steps.
5. The algorithm must be general enough to deal with any situation.

#### **Q.56 Explain various representations of algorithms.**

**Ans. :**

1.	Normal English	The algorithm can be easily represented in step by step sequential order in normal english, such algorithms are easy to understand, write and read.
2.	Flowchart	The flowchart is a pictorial representation of an algorithm i.e., the sequential steps in an algorithm can be represented as a flowchart using the standard symbols.
3.	Pseudocode	The flowcharts are only one of the possible formal decision tools, whereas pseudocode is also a formal design tool and utilised very well with the rules of structured design and programming.
4.	Decision Table	A decision table helps a lot in designing a specific segment of a design. It provides another way to look at a complex, nested selection to help clarify the conditions to be tested and how those conditions should be nested to arrive at the proper actions.
5.	Program	The algorithms can be represented as a program using any programming language.

#### **Q.57 State the benefits of algorithm.**

**Ans. :** 1. Algorithm describes the steps and its sequence that should be taken to solve the problem.