

Set-3
B.Pharma-1st semester
Paper-Basic Electronic & Computer Applications
Time 3hour **Maximum marks 80**

NOTE:-Question Number 1 is compulsory. (12X2=24Marks)

1.

I. What is data?

Ans:- Data is a collection of facts, such as values or measurements.

II. Write two application of computer in pharmaceutical and clinical studies?

A pilot study performed on a group of patients with coronary heart disease has disclosed the simplicity of computer application of charting, recording, daily reporting and statistical analysis of clinical data. It has indicated that both physicians and paramedical personnel may make better use of their time by utilizing a computer to perform their daily bookkeeping routines. This report illustrates the requirements and application of a simple computer system to a specific problem of clinical investigation and gives guidelines for the expansion of its use in other areas of medical interest.

III. What is compiler?

Ans:- A program that translates program written in a high-level language into machine language so that it can be executed.

IV. Define LINUX Operating system?

Ans:- linux is open source operating system. Thousands of programmers worldwide continuously enhance its feature and back its development and support. It is a multi-tasking, multi-processing operating system.

V. What is application software?

Ans:- Application software is set of one or more program, which solves a specific task. In other word you can say All the computer software that causes a computer to perform useful tasks beyond the running of the computer itself. Application software includes media players, MS Office, word processors, etc.

VI. What is pixel?

Ans:- Short for Picture Element, a pixel is a single point in a graphic image. Graphics monitors display pictures by dividing the display screen into thousands (or millions) of pixels, arranged in rows and columns. The pixels are so close together that they appear connected.

VII. What is Super Computer?

Ans:- The fastest type of computer. Supercomputers are very expensive and are employed for specialized applications that require immense amounts of mathematical calculations. For example, weather forecasting requires a supercomputer. Other uses of supercomputers include animated graphics, fluid dynamic calculations, nuclear energy research, and petroleum exploration.

VIII. What is WAN?

Ans:- A wide area network (WAN) is a network that covers a broad area (i.e., any telecommunications network that links across metropolitan, regional, or national boundaries) using private or public network transports.

IX. Write arithmetic operators in C programming language.

Ans:-

operator	Description
+	Addition
-	Subtraction
*	multiplication
/	Division
%	Modulo

X. What is multimedia? Give any three examples.

Ans:-When presenter uses more than one medium to present information, then it is called multimedia presentation. For example TV system, multimedia mobile phones, a book having text and diagram.

XI. What is data processing?

Ans:- Data processing most often refers to Computer data processing, computer processes that convert data into information or knowledge.

XII. What is Random access storage device?

Ans:- the most common computer memory which can be used by programs to perform necessary tasks while the computer is on; an integrated circuit memory chip allows information to be stored or accessed in any order and all storage locations are equally accessible.

NOTE:-Attempt any four. (4X14)

2. What is internet? Differentiate between LAN and WAN. Write one example of each.

Ans:- The Internet is a global system of interconnected computer networks that use the standard Internet protocol suite (TCP/IP) to serve several billion users worldwide. It is a network of networks that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless and optical networking technologies. The Internet carries an extensive range of information resources and services, such as the inter-linked hypertext documents of the World Wide Web (WWW), the infrastructure to support email, and peer-to-peer networks.

A LAN is a Local Area Network. Local is generally referred to a network contained within a building or an office or a campus. You might have a LAN for example on a University campus

or between office blocks in an office park. A big corporate perhaps like Anglo American, would generally have a LAN that might span several buildings. To set up a LAN -relatively speaking- is cheap. A WAN is generally slow. If we compare that to a LAN, we said that Ethernet could run up to 1000 Mbps, currently, certainly in South Africa, the fastest WAN is 155 Mbps, so you can see in a LAN we can talk up to 1000 Mbps whereas in a WAN, at the moment, currently, WAN is expensive. If we look at the path of telecommunications, we need to connect two offices, one in Pretoria and one in Johannesburg together - it 's an expensive operation even for a slow line.

LAN:-LAN (Local Area Network) is a computer network covering a small geographic area, like a home, office, or group of buildings

1. Network in an organization can be a LAN
2. Typically owned, controlled, and managed by a single person or organization
3. Typically owned, controlled, and managed by a single person or organization
4. LANs have a high data transfer rate
5. Have a small geographical range and do not need any leased telecommunication lines

one LAN can be connected to other LANs over any distance via telephone lines and radio waves

Example:-Wi-Fi

WAN:-WAN (Wide Area Network) is a computer network that covers a broad area (i.e., any network whose communications links cross metropolitan, regional, or national boundaries

1. Internet is the best example of a WAN
2. WANs (like the Internet) are not owned by any one organization but rather exist under collective or distributed ownership and management
3. WANs tend to use technology like ATM, Frame Relay and X.25 for connectivity over the longer distances
4. WANs have a lower data transfer rate as compared to LANs
5. Have a large geographical range generally spreading across boundaries and need leased telecommunication lines
6. 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

3. Explain computer system architecture with diagram?

A computer can process data, pictures, sound and graphics. They can solve highly complicated problems quickly and accurately. A computer as shown in Fig. performs basically five major computer operations or functions irrespective of their size and make. These are

- 1) it accepts data or instructions by way of input,
- 2) it stores data,
- 3) it can process data as required by the user,
- 4) it gives results in the form of output, and
- 5) it controls all operations inside a computer.

We discuss below each of these Computer operations

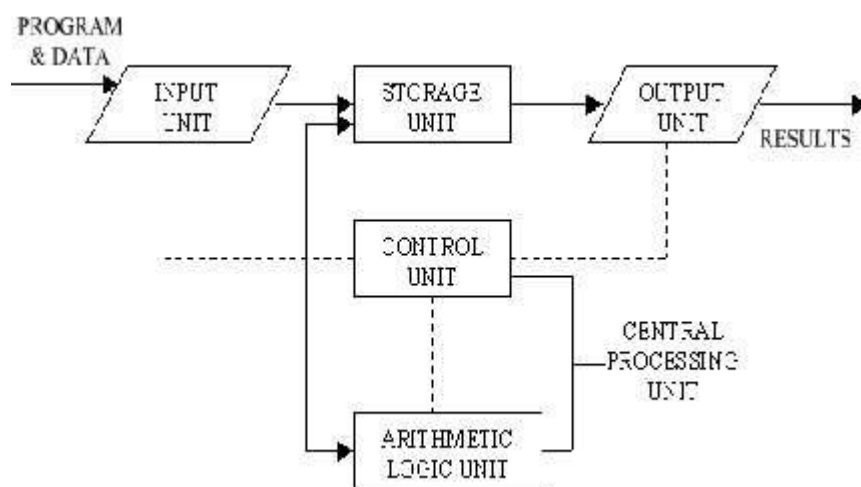


Fig : Basic computer Operations

1. Input: This is the process of entering data and programs in to the computer system. You should know that computer is an electronic machine like any other machine which takes as inputs raw data and performs some processing giving out processed data. Therefore, the input unit takes data from us to the computer in an organized manner for processing.

2. Storage: The process of saving data and instructions permanently is known as storage. Data has to be fed into the system before the actual processing starts. It is because the processing speed of Central Processing Unit (CPU) is so fast that the data has to be provided to CPU with the same speed. Therefore the data is first stored in the storage unit for faster access and processing. This storage unit or the primary storage of the computer system is designed to do the above functionality. It provides space for storing data and instructions.

The storage unit performs the following major functions:

- All data and instructions are stored here before and after processing.
- Intermediate results of processing are also stored here.

3. Processing: The task of performing operations like arithmetic and logical operations is called processing. The Central Processing Unit (CPU) takes data and instructions from the

storage unit and makes all sorts of calculations based on the instructions given and the type of data provided. It is then sent back to the storage unit.

4. Output: This is the process of producing results from the data for getting useful information. Similarly the output produced by the computer after processing must also be kept somewhere inside the computer before being given to you in human readable form. Again the output is also stored inside the computer for further processing.

5. Control: The manner how instructions are executed and the above operations are performed. Controlling of all operations like input, processing and output are performed by control unit. It takes care of step by step processing of all operations inside the computer.

FUNCTIONAL UNITS

In order to carry out the operations mentioned in the previous section the computer allocates the task between its various functional units. The computer system is divided into three separate units for its operation. They are

- 1) arithmetic logical unit
- 2) control unit.
- 3) central processing unit.

Arithmetic Logical Unit (ALU) Logical Unit

Logical Unit :After you enter data through the input device it is stored in the primary storage unit. The actual processing of the data and instruction are performed by Arithmetic Logical Unit. The major operations performed by the ALU are addition, subtraction, multiplication, division, logic and comparison. Data is transferred to ALU from storage unit when required. After processing the output is returned back to storage unit for further processing or getting stored.

CONTROL UNIT (CU)

The next component of computer is the Control Unit, which acts like the supervisor seeing that things are done in proper fashion. Control Unit is responsible for co ordinating various operations using time signal. The control unit determines the sequence in which computer programs and instructions are executed. Things like processing of programs stored in the main memory, interpretation of the instructions and issuing of signals for other units of the computer to execute them. It also acts as a switch board operator when several users access the computer simultaneously. Thereby it coordinates the activities of computer's peripheral equipment as they perform the input and output.

CENTRAL PROCESSING UNIT (CPU)

The ALU and the CU of a computer system are jointly known as the central processing unit. You may call CPU as the brain of any computer system. It is just like brain that takes all

major decisions, makes all sorts of calculations and directs different parts of the computer functions by activating and controlling the operations.

4. What is an output device? List some commonly used output devices. Explain any three.

Ans:- An output device is any electronic or electromechanical equipment connected to a computer and used to transfer data out of the computer in the form of text, images, sounds, or other media. Examples of output devices include speakers, headphones, printer and screen/monitor.

Some commonly used output devices-

1. Speakers
2. Headphones
3. Screen (Monitor)
4. Printer
5. Voice output communication aid
6. Automotive navigation system
7. Projector
8. Plotter

Screen (Monitor)-A monitor or a display is an electronic visual display for computers. The monitor comprises the display device, circuitry and an enclosure. The display device in modern monitors is typically a thin film transistor liquid crystal display (TFT-LCD) thin panel, while older monitors used a cathode ray tube (CRT) about as deep as the screen size.

Multiple technologies have been used for computer monitors. Until the 21st century most used cathode ray tubes but they have largely been superseded by LCD monitors.

CATHODE RAY TUBE

The first computer monitors used cathode ray tubes (CRT). Until the early 1980s, they were known as video display terminals and were physically attached to the computer and keyboard. The monitors were monochrome, flickered and the image quality was poor. In 1981, IBM introduced the Color Graphics Adapter, which could display four colors with a resolution of 320 by 200 pixels, or it could produce 640 by 200 pixels with two colors. In 1984 IBM introduced the Enhanced Graphics Adapter which was capable of producing 16 colors and had a resolution of 640 by 350.

CRT technology remained dominant in the PC monitor market into the new millennium partly because it was cheaper to produce and offered viewing angles close to 180 degrees.

LIQUID CRYSTAL DISPLAY

There are multiple technologies that have been used to implement liquid crystal displays (LCD). Throughout the 1990s, the primary use of LCD technology as computer monitors was

in laptops where the lower power consumption, lighter weight, and smaller physical size of LCDs justified the higher price versus a CRT. Commonly, the same laptop would be offered with an assortment of display options at increasing price points: (active or passive) monochrome, passive color, or active matrix color (TFT). As volume and manufacturing capability have improved, the monochrome and passive color technologies were dropped from most product lines.

TFT-LCD is a variant of LCD which is now the dominant technology used for computer monitors.

The first standalone LCD displays appeared in the mid-1990s selling for high prices. As prices declined over a period of years they became more popular, and by 1997 were competing with CRT monitors. Among the first desktop LCD computer monitors was the Eizo L66 in the mid-1990s, the Apple Studio Display in 1998, and the Apple Cinema Display in 1999. In 2003, TFT-LCDs outsold CRTs for the first time, becoming the primary technology used for computer monitors. The main advantages of LCDs over CRT displays are that LCDs consume less power, take up much less space, and are considerably lighter. The now common active matrix TFT-LCD technology also has less flickering than CRTs, which reduces eye strain. On the other hand, CRT monitors have superior contrast, have superior response time, are able to use multiple screen resolutions natively, and there is no discernible flicker if the refresh rate is set to a sufficiently high value. LCD monitors have now very high temporal accuracy and can be used for vision research.

ORGANIC LIGHT-EMITTING DIODE

Organic light-emitting diode (OLED) monitors provide higher contrast and better viewing angles than LCDs but they require more power when displaying documents with white or bright backgrounds. In 2011, a 25-inch (64 cm) OLED monitor cost \$7500, but the prices are expected to drop.

Speakers-Computer speakers, or multimedia speakers, are speakers external to a computer that disable the lower fidelity built-in speaker. They often have a low-power internal amplifier. The standard audio connection is a 3.5 mm (approximately 1/8 inch) stereo phone connector often color-coded lime green (following the PC 99 standard) for computer sound cards. A few use a RCA connector for input. There are also USB speakers which are powered from the 5 volts at 500 milliamps provided by the USB port, allowing about 2.5 watts of output power. Computer speakers were introduced by Altec Lansing in 1990.

Computer speakers range widely in quality and in price. The computer speakers typically packaged with computer systems are small, plastic, and have mediocre sound quality. Some computer speakers have equalization features such as bass and treble controls.

The internal amplifiers require an external power source, usually an AC adapter. More sophisticated computer speakers can have a subwoofer unit, to enhance bass output, and these units usually include the power amplifiers both for the bass speaker, and the small satellite speakers.

Some computer displays have rather basic speakers built-in. Laptops come with integrated speakers. Restricted space available in laptops means these speakers usually produce low-quality sound.

For some users, a lead connecting computer sound output to an existing stereo system is practical. This normally yields much better results than small low-cost computer speakers. Computer speakers can also serve as an economy amplifier for MP3 player use for those who wish to not use headphones, although some models of computer speakers have headphone jacks of their own.

Printer -In computing, a **printer** is a peripheral which makes a representation of an electronic document on physical media. Individual printers are designed to support local and network users at the same time. Some printers can print documents stored on memory cards or from digital cameras and scanners.

Consumer and some commercial printers are designed for low-volume, short-turnaround print jobs; requiring virtually no setup time to achieve a hard copy of a given document. However, printers are generally slow devices (30 pages per minute is considered fast, and many inexpensive consumer printers are far slower than that), and the cost per page is actually relatively high. However, this is offset by the on-demand convenience and project management costs being more controllable compared to an out-sourced solution. The printing press remains the machine of choice for high-volume, professional publishing. However, as printers have improved in quality and performance, many jobs which used to be done on printing presses are now done by print on demand or by users on local printers; see desktop publishing. Local printers are also increasingly taking over the process of photofinishing as digital photo printers become commonplace.

The world's first computer printer was a 19th-century mechanically driven apparatus invented by Charles Babbage for his difference engine.

A virtual printer is a piece of computer software whose user interface and API resembles that of a printer driver, but which is not connected with a physical computer printer.

5. What is Memory? What are the different types of memory used in a computer?

Explain primary and secondary memory.

Ans:- A memory is just like a human brain. It is used to store data and instructions. Computer memory is the storage space in computer where data is to be processed and instructions required for processing are stored.

The memory is divided into large number of small parts. Each part is called cell. Each location or cell has a unique address, which varies from zero to memory size minus one.

For example, if computer has 64k words, then this memory unit has $64 * 1024 = 65536$ memory location. The address of these locations varies from 0 to 65535.

Memory is primarily of three types:

- Cache Memory
- Primary Memory/Main Memory
- Secondary Memory

CACHE MEMORY

Cache memory is a very high speed semiconductor memory, which can speed up CPU. It acts as a buffer between the CPU and main memory.

It is used to hold those parts of data and program which are most frequently used by CPU. The parts of data and programs are transferred from disk to cache memory by operating system, from where CPU can access them.

ADVANTAGE

- Cache memory is faster than main memory.
- It consumes less access time as compared to main memory.
- It stores the program that can be executed within a short period of time.
- It stores data for temporary use.

DISADVANTAGE:

- Cache memory has limited capacity.
- It is very expensive.

PRIMARY MEMORY (MAIN MEMORY)

Primary memory holds only those data and instructions on which computer is currently working. It has limited capacity and data gets lost when power is switched off.

It is generally made up of semiconductor device. These memories are not as fast as registers. The data and instructions required to be processed earlier reside in main memory. It is divided into two subcategories RAM and ROM.

Characteristic of Main Memory

- These are semiconductor memories.
- It is known as main memory.
- Usually volatile memory.
- Data is lost in case power is switched off.
- It is working memory of the computer.
- Faster than secondary memories.
- A computer cannot run without primary memory.

SECONDARY MEMORY

This type of memory is also known as external memory or non-volatile. It is slower than main memory. These are used for storing Data/Information permanently.

CPU directly does not access these memories, instead they are accessed via input-output routines. Contents of secondary memories are first transferred to main memory and then CPU can access it. For example, disk, CD-ROM, DVD, etc.

Characteristics of Secondary Memory

- These are magnetic and optical memories.
- It is known as backup memory.
- It is non-volatile memory.
- Data is permanently stored even if power is switched off.
- It is used for storage of the data in the computer.
- Computer may run without secondary memory.
- Slower than primary memories.

Primary memory:

RAM (Random Access Memory) and ROM (Read Only Memory) are called the primary memories of the computer. These are the semiconductor memories. RAM memory contains the data which is currently being used by the microprocessor because it is addressable by the microprocessor. The working procedure of s RAM is very faster than the hard disk but slow than the cache memory. It is made up of a green color chip and has a huge grid of tiny switches, each switch stores a single bit of memory, which the processor can access at point by sending an electronic signal to the memory. Every work in the CPU is done with the help of RAM because it runs the programs in the computer therefore RAM is used for quick manipulation of data allowing the program to rapidly execute operations and interact with the user.

1. **PROM (programmable read-only memory):** A PROM is a memory chip on which you can store a program. But once the PROM has been used, you cannot wipe it clean and use it to store something else. Like ROMs, PROMs are non-volatile.
2. **EPROM (erasable programmable read-only memory):** An EPROM is a special type of PROM that can be erased by exposing it to ultraviolet light.
3. **EEPROM (electrically erasable programmable read-only memory):**An EEPROM is a special type of PROM that can be erased by exposing it to an electrical charge.

Secondary memory:

These are the permanent memories in the computer are called magnetic and optical memories. It may be external or internal. These are non volatile memories and Also known as Backup Memory or Auxiliary Memory. E.g. Tapes, Floppies, Hard Discs, CD ROMs, DVDs. Let us take an example of a hard disk as a secondary Memory. It is a device which is used to store data in the memory. A hard disk is made up of a magnetic disk on which you can store computer data or any information. A single hard disk usually consists of several platters. Each platter require read write head one for each. All the read write heads are attached to a single access arm so that they can move independently. Each platter has the same no. of tracks and a track location that cuts across all platters is called a cylinder. A HARD DISK DRIVE (HDD) is a drive for storing and retrieving digital information in the computer. The capacity to store the data is more than the RAM but the hard disk working performance is slower than the RAM. A hard disk can store data up to 1 TERA byte and more than... That depend on you but a personal standard hard disk is of 1 TERA byte. A hard disk can store the data permanently and you also erased the data if you need. A hard disk is big in size than the RAM. It is cheaper than the RAM. AVERAGE ACCESS TIME IN MICROSECONDS EG. HD, CD, MAGNETIC TAPE.

6. What is Computer Graphics? Explain CRT.

Ans:- Refers to any computer device or program that makes a computer capable of displaying and manipulating pictures. The term also refers to the images themselves. For example, laser printers and plotters are GRAPHICS devices because they permit the computer to output pictures. A GRAPHICS MONITOR is a display monitor that can display pictures. A GRAPHICS BOARD (or GRAPHICS CARD) is a printed circuit board that, when installed in a computer, permits the computer to display pictures.

Many software applications include graphics components. Such programs are said to SUPPORT graphics. For example, certain word processors support graphics because they let you draw or import pictures. All CAD/CAM systems support graphics. Some database management systems and spreadsheet programs support graphics because they let you display data in the form of graphs and charts. Such applications are often referred to as BUSINESS GRAPHICS.

The following are also considered GRAPHICS applications:

1. **paint programs** : Allow you to create rough freehand drawings. The images are stored as bit maps and can easily be edited.
2. **illustration/design programs**: Supports more advanced features than paint programs, particularly for drawing curved lines. The images are usually stored in vector-based formats. Illustration/design programs are often called DRAW PROGRAMS.
3. **presentation graphics** software : Lets you create bar charts, pie charts, graphics, and other types of images for slide shows and reports. The charts can be based on data imported from spreadsheet applications.
4. **animation software**: Enables you to chain and sequence a series of images to simulate movement. Each image is like a frame in a movie.
5. **CAD software**: Enables architects and engineers to draft designs.
6. **desktop publishing** : Provides a full set of word-processing features as well as fine control over placement of text and graphics, so that you can create newsletters, advertisements, books, and other types of documents.

In general, applications that support graphics require a powerful CPU and a large amount of memory. Many graphics applications-for example, computer animation systems-require more computing power than is available on personal computers and will run only on powerful workstations or specially designed graphics computers. This is true of all three-dimensional computer graphics applications.

In addition to the CPU and memory, graphics software requires a graphics monitor and support for one of the many graphics standards. Most PC programs, for instance, require VGA graphics. If your computer does not have built-in support for a specific graphics system, you can insert a video adapter card.

The quality of most graphics devices is determined by their RESOLUTION-how many points per square inch they can represent-and their color capabilities.

CRT:- The **cathode ray tube (CRT)** is a vacuum tube containing one or more electron guns (a source of electrons or electron emitter) and a fluorescent screen used to view images. It has a means to accelerate and deflect the electron beam(s) onto the screen to create the images. The images may represent electrical waveforms (oscilloscope), pictures (television, computer monitor), radar targets or others. CRTs have also been used as memory devices, in which case the visible light emitted from the fluorescent material (if

any) is not intended to have significant meaning to a visual observer (though the visible pattern on the tube face may cryptically represent the stored data).

The CRT uses an evacuated glass envelope which is large, deep (i.e. long from front screen face to rear end), fairly heavy, and relatively fragile. As a matter of safety, the face is typically made of thick lead glass so as to be highly shatter-resistant and to block most X-ray emissions, particularly if the CRT is used in a consumer product.

CRTs have largely been superseded by newer display technologies such as LCD, plasma display, and OLED, which have lower manufacturing costs, power consumption, weight and bulk.

The vacuum level inside the tube is high vacuum on the order of 0.01 Pa to 133 nPa.

In television sets and computer monitors, the entire front area of the tube is scanned repetitively and systematically in a fixed pattern called a raster. An image is produced by controlling the intensity of each of the three electron beams, one for each additive primary color (red, green, and blue) with a video signal as a reference. In all modern CRT monitors and televisions, the beams are bent by magnetic deflection, a varying magnetic field generated by coils and driven by electronic circuits around the neck of the tube, although electrostatic deflection is commonly used in oscilloscopes, a type of diagnostic instrument.

7. Write a program to check whether a given number is positive or negative.

```
#include <stdio.h>
#include <conio.h>
void main()
{
    int number;
    clrscr();
    printf("Enter a number\n");
    scanf ("%d", &number);
    if (number > 0)
        printf ("%d, is a positive number\n", number);
    else
        printf ("%d, is a negative number\n", number);
}
```

8. Write short note on:

- a) Mouse
- b) Plotter
- c) Joystick
- d) Laser printer

Ans:-

Mouse :- A device that controls the movement of the cursor or pointer on a display screen. A mouse is a small object you can roll along a hard, flat surface. Its name is derived from its

shape, which looks a bit like a mouse, its connecting wire that one can imagine to be the mouse's tail, and the fact that one must make it scurry along a surface. As you move the mouse, the pointer on the display screen moves in the same direction. Mice contain at least one button and sometimes as many as three, which have different functions depending on what program is running. Some newer mice also include a SCROLL WHEEL for scrolling through long documents.

1. **mechanical:** Has a rubber or metal ball on its underside that can roll in all directions. Mechanical sensors within the mouse detect the direction the ball is rolling and move the screen pointer accordingly.
2. **optomechanical:** Same as a mechanical mouse, but uses optical sensors to detect motion of the ball.
3. **optical:** Uses a laser to detect the mouse's movement. You must move the mouse along a special mat with a grid so that the optical mechanism has a frame of reference. Optical mice have no mechanical moving parts. They respond more quickly and precisely than mechanical and optomechanical mice, but they are also more expensive.

Mice connect to PCs in one of several ways:

1. **Serial mice** connect directly to an RS-232C serial port or a PS/2 port. This is the simplest type of connection.
2. **PS/2 mice** connect to a PS/2 port.
3. USB mice.

Cordless mice aren't physically connected at all. Instead they rely on infrared or radio waves to communicate with the computer. Cordless mice are more expensive than both serial and bus mice, but they do eliminate the cord, which can sometimes get in the way.

Plotter :- The **plotter** is a computer printer for printing vector graphics. In the past, plotters were used in applications such as computer-aided design, though they have generally been replaced with wide-format conventional printers. A plotter gives a hard copy of the output. It draws pictures on paper using a pen. Plotters are used to print designs of ships and machines, plans for buildings and so on.

Joystick:- A **joystick** is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. A joystick, also known as the **control column**, is the principal control device in the cockpit of many civilian and military aircraft, either as a center stick or side-stick. It often has supplementary switches to control various aspects of the aircraft's flight.

Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer. A popular variation of the joystick used on modern video game consoles is the analog stick. Joysticks are also used for controlling machines such as cranes, trucks, underwater unmanned vehicles, wheelchairs, surveillance cameras, and zero turning radius lawn mowers. Miniature finger-operated joysticks have been adopted as input devices for smaller electronic equipment such as mobile phones.

Laser printer:- A **laser printer** is a printer for computers. It uses LED-technology to get small particles of toner from a cartridge onto paper. Very often, this is more economical to use than the ink of inkjet printers.

The laser printer was first invented by a team at Xerox in 1969.

Laser printing is a process which typically involves seven steps:

1. **Raster Image Processing:** the processor inside the printer converts the data to be printed from whatever format it currently exists in, into a bitmap of the page to be printed - this is then stored in raster image memory.

2. **Charging:** An electrostatic charge is then projected onto a revolving photosensitive drum inside the printer.

3. **Writing:** A laser beam is directed at a rotating polygonal mirror, which redirects the beam onto the photosensitive drum. The rasterized data in memory is now read, and used to control whether the laser is on or off, as the beam sweeps across the drum - where the laser beam strikes the drum the charge is reversed, creating a latent electrical image on the surface.

4. **Developing:** The surface of the drum is then exposed to negatively charged particles of toner, which are attracted to the areas where the laser wrote the latent electrical image. The toner will be repelled by the negative charge on areas of the drum where the laser beam did not strike, and hence remove the charge.

5. **Transferring:** The drum is now rolled over paper, transferring the image from the drum to the paper (to aid in this process there is a positively charged roller behind the paper, which pulls the toner off the drum and onto the paper).

6. **Fusing:** The paper is then passed through a fuser, where rollers provide heat and pressure to bond the toner to the paper.

7. **Cleaning:** An electrically uncharged blade and a discharge lamp remove any toner and all the charge remaining on the drum (this will all happen in one revolution of the drum).