

Definition of Computer Graphics:

It is the use of computers to create and manipulate pictures on a display device. It comprises of software techniques to create, store, modify, represents pictures.

Why computer graphics used?

Suppose a shoe manufacturing company want to show the sale of shoes for five years. For this vast amount of information is to store. So a lot of time and memory will be needed. This method will be tough to understand by a common man. In this situation graphics is a better alternative. Graphics tools are charts and graphs. Using graphs, data can be represented in pictorial form. A picture can be understood easily just with a single look.

Interactive computer graphics work using the concept of two-way communication between computer users. The computer will receive signals from the input device, and the picture is modified accordingly. Picture will be changed quickly when we apply command.

Types Of Computer Graphics:

Interactive Computer Graphics: Interactive Computer Graphics involves a two way communication between computer and user. Here the observer is given some control over the image by providing him with an input device for example the video game controller of the ping pong game. This helps him to signal his request to the computer.

The computer on receiving signals from the input device can modify the displayed picture appropriately. To the user it appears that the picture is changing instantaneously in response to his commands. He can give a series of commands, each one generating a graphical response from the computer. In this way he maintains a conversation, or dialogue, with the computer.

Interactive computer graphics affects our lives in a number of indirect ways. For example, it helps to train the pilots of our airplanes. We can create a flight simulator which may help the pilots to get trained not in a real aircraft but on the grounds at the control of the flight simulator. The flight simulator is a mock up of an aircraft flight deck,

containing all the usual controls and surrounded by screens on which we have the projected computer generated views of the terrain visible on takeoff and landing.

Flight simulators have many advantages over the real aircrafts for training purposes, including fuel savings, safety, and the ability to familiarize the trainee with a large number of the world's airports.

Non Interactive Computer Graphics: In non interactive computer graphics otherwise known as passive computer graphics. it is the computer graphics in which user does not have any kind of control over the image. Image is merely the product of static stored program and will work according to the instructions given in the program linearly. The image is totally under the control of program instructions not under the user. Example: screen savers.

Application of Computer Graphics:

1. Education and Training: Computer-generated model of the physical, financial and economic system is often used as educational aids. Model of physical systems, physiological system, population trends or equipment can help trainees to understand the operation of the system.

For some training applications, particular systems are designed. For example Flight Simulator.

Flight Simulator: It helps in giving training to the pilots of airplanes. These pilots spend much of their training not in a real aircraft but on the ground at the controls of a Flight Simulator.

Advantages:

1. Fuel Saving
2. Safety
3. Ability to familiarize the training with a large number of the world's airports.

2. Use in Biology: Molecular biologist can display a picture of molecules and gain insight into their structure with the help of computer graphics.

3. Computer-Generated Maps: Town planners and transportation engineers can use computer-generated maps which display data useful to them in their planning work.

4. Architect: Architect can explore an alternative solution to design problems at an interactive graphics terminal. In this way, they can test many more solutions that would not be possible without the computer.

5. Presentation Graphics: Example of presentation Graphics are bar charts, line graphs, pie charts and other displays showing relationships between multiple parameters. Presentation Graphics is commonly used to summarize

- Financial Reports
- Statistical Reports
- Mathematical Reports
- Scientific Reports
- Economic Data for research reports
- Managerial Reports
- Consumer Information Bulletins
- And other types of reports

6. Computer Art: Computer Graphics are also used in the field of commercial arts. It is used to generate television and advertising commercial.

7. Entertainment: Computer Graphics are now commonly used in making motion pictures, music videos and television shows.

8. Visualization: It is used for visualization of scientists, engineers, medical personnel, business analysts for the study of a large amount of information.

9. Educational Software: Computer Graphics is used in the development of educational software for making computer-aided instruction.

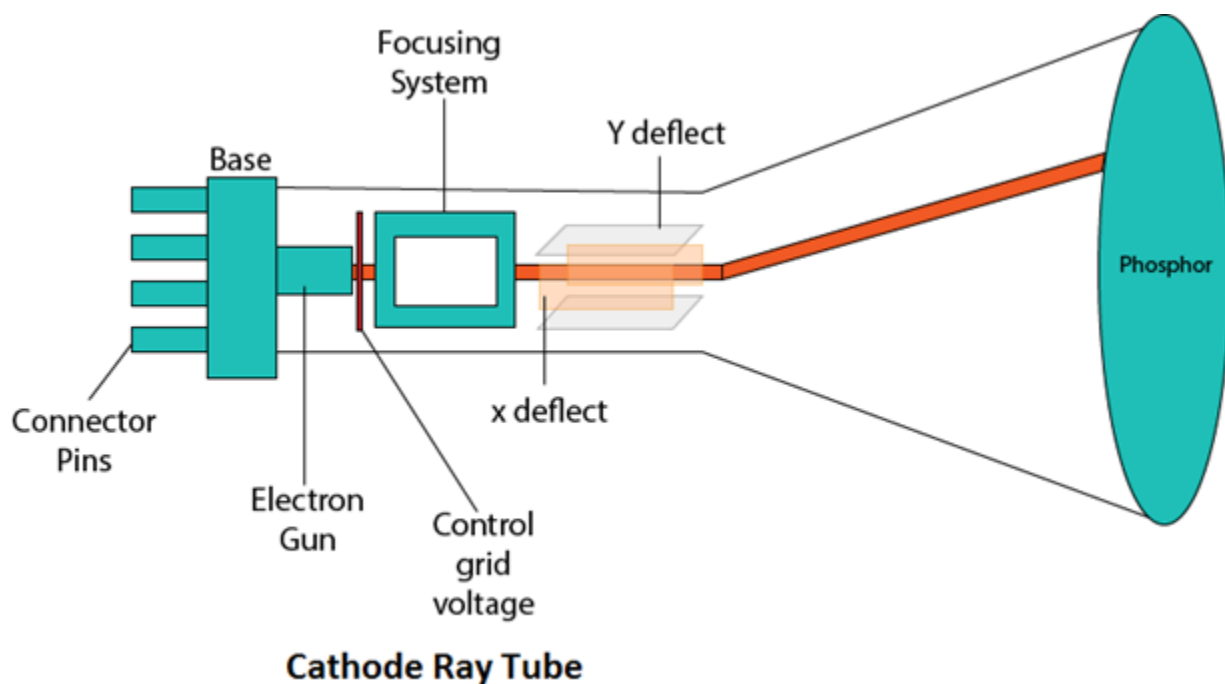
10. Printing Technology: Computer Graphics is used for printing technology and textile design.

Graphics systems:

Cathode-Ray Tubes (CRT):

CRT stands for Cathode Ray Tube. CRT is a technology used in traditional computer monitors and televisions. The image on CRT display is created by firing electrons from the back of the tube of phosphorus located towards the front of the screen.

Once the electron heats the phosphorus, they light up, and they are projected on a screen. The color you view on the screen is produced by a blend of red, blue and green light.



Components of CRT:

Main Components of CRT are:

1. Electron Gun: Electron gun consisting of a series of elements, primarily a heating filament (heater) and a cathode. The electron gun creates a source of electrons which are focused into a narrow beam directed at the face of the CRT.

2. Control Electrode: It is used to turn the electron beam on and off.

3. Focusing system: It is used to create a clear picture by focusing the electrons into a narrow beam.

4. Deflection Yoke: It is used to control the direction of the electron beam. It creates an electric or magnetic field which will bend the electron beam as it passes through the area. In a conventional CRT, the yoke is linked to a sweep or scan generator. The deflection yoke which is connected to the sweep generator creates a fluctuating electric or magnetic potential.

5. Phosphorus-coated screen: The inside front surface of every CRT is coated with phosphors. Phosphors glow when a high-energy electron beam hits them. Phosphorescence is the term used to characterize the light given off by a phosphor after it has been exposed to an electron beam.

Raster Scan:

Raster can be explained as a rectangular collection of dots or points plotted.

An image is subdivided into various horizontal lines which are referred to as scan lines which are then further divided into different pixels which helps in the processing of an image.

Basic working of Raster Scan

- In this system, a beam of an electron is moved across the screen. It moves from top to bottom considering one row at a time.
- As the beam of electron moves through each row, its intensity is alternatively turned on and off which helps to create a pattern of spots that are illuminated.
When each scan of the line is refreshed it returns to the left side of the screen. This motion is known as Horizontal retrace.
- As a particular frame ends, the beam of electron moves to the left top corner of the screen to move to another frame. This motion is referred to as Vertical retrace.
- The picture is then stored in an area of memory which is referred to as the frame buffer or refresh buffer.
- The buffer in a raster scan is that area that is responsible for containing intensity of the various points on the screen.
- The values stored in the buffer are then fetched and traced over scan lines one by one on the screen.

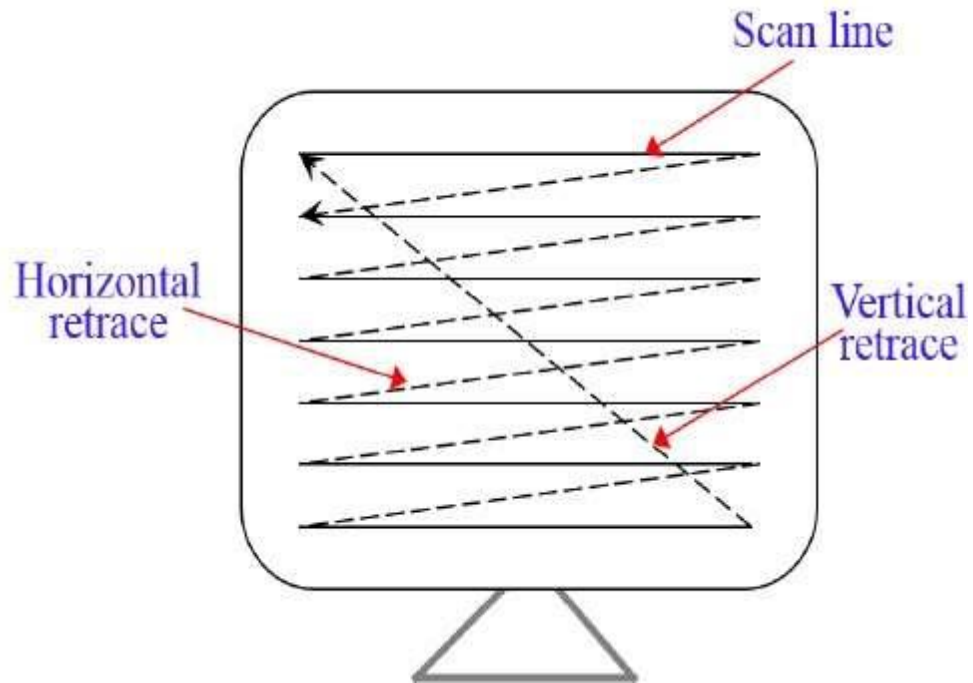


Image source:

https://www.tutorialspoint.com/computer_graphics/computer_graphics_basics.htm

- The image formed through this raster scan is known as a raster image. The quality of this image is determined by the number of pixels which is termed as the resolution of the image.
- The amount of information each pixel represents is known as the color depth of the image.
- The raster graphics system of high quality contains 24 bits per pixel in the frame buffer. This is referred to as a full color or true color system. Refreshing of raster scan displays is carried out at the rate of 60 to 80 frames per second.

Interlacing

A TV video signal is graphically interlaced, which means every full screen of information is made up of two separate fields which include the odd field and even field. First, the odd lines are printed on the graphics screen. Then, the even lines are printed in between the odd lines before the odd lines fade away. This all happens faster than any human eye can perceive.



Random Scan Display

In Random Scan Display a beam of the electron is directed only to the screen areas where any picture has to be displayed or drawn on the screen. It is also termed as vector display, as it displays or draws a picture in the form of one line at a time. It can draw and refresh lines on the screen of a picture in any sequence not particularly specific.

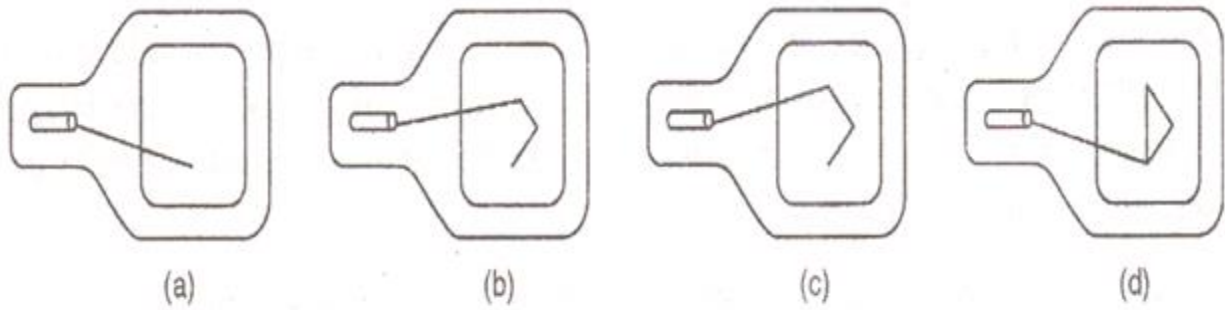


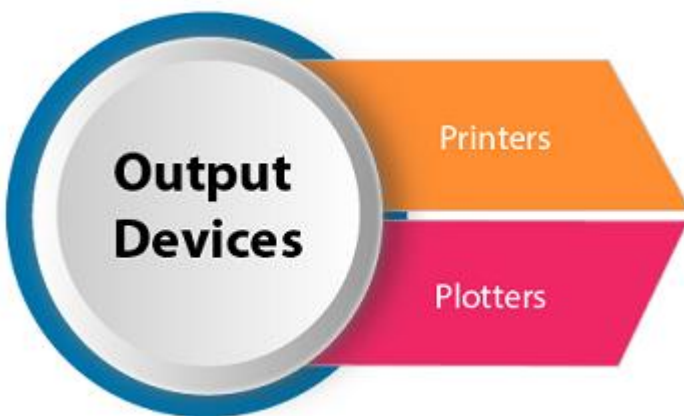
Fig: Random Scan Display

Difference between Raster Scan and Random Scan:

Random Scan	Raster Scan
The resolution of random scan is higher in comparison raster scan.	The resolution of raster scan is lower in comparison to random scan.
It is expensive in comparison to raster scan.	It is inexpensive in comparison to random scan.
Any alterations can be done easily.	Alterations are difficult to make.
The concept of interweaving is not used.	The concept of interweaving is used.
A mathematical function is used to render an image or a picture.	To render image or picture, pixels are used.

It is suited for applications that require polygon drawings.	It is suitable to create realistic scenes.
An example of random scan is a pen plotter.	A TV set is an example of raster scan.
Random scan has lower refresh rate about 30 to 60 times per second.	Raster scan has higher refresh rate about 60 to 80 times per second.

Output Devices



It is an electromechanical device, which accepts data from a computer and translates them into form understand by users.

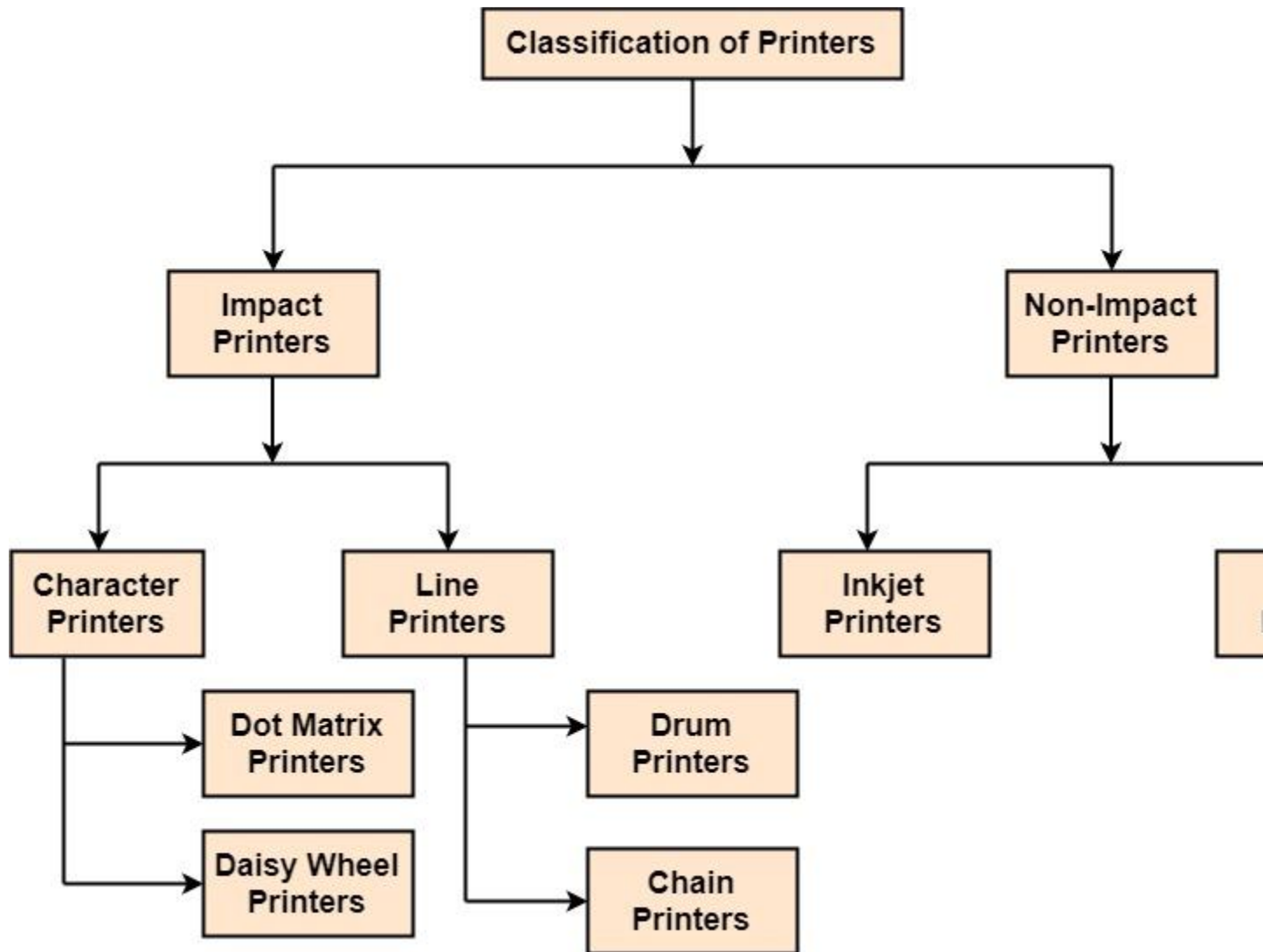
Following are Output Devices:

1. [Printers](#)
2. [Plotters](#)

Printers:

Printer is the most important output device, which is used to print data on paper.

Types of Printers: There are many types of printers which are classified on various criteria as shown in fig:



1. Impact Printers: The printers that print the characters by striking against the ribbon and onto the papers are known as Impact Printers.

These Printers are of two types:

1. Character Printers
2. Line Printers

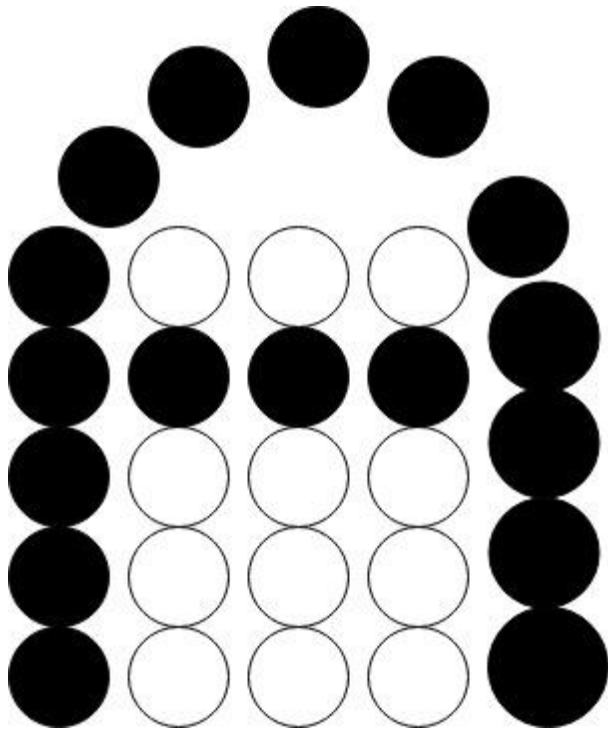
2. Non-Impact Printers: The printers that print the characters without striking against the ribbon and onto the papers are called Non-Impact Printers. These printers print a complete page at a time, therefore, also known as Page Printers.

Page Printers are of two types:

1. Laser Printers
2. Inkjet Printers

Dot Matrix Printers:

Dot matrix has printed in the form of dots. A printer has a head which contains nine pins. The nine pins are arranged one below other. Each pin can be activated independently. All or only the same needles are activated at a time. When needless is not activated, and then the tip of needle stay in the head. When pin work, it comes out of the print head. In nine pin printer, pins are arranged in $5 * 7$ matrixes.



Dot Matrix Printer

Advantage:

1. Dot Matrix Printers prints output as dots, so it can print any shape of the character. This allows the printer to print special character, charts, graphs, etc.
2. Dot Matrix Printers come under the category of impact printers. The printing is done when the hammer pin strikes the inked ribbon. The impressions are printed on paper. By placing multiple copies of carbon, multiple copies of output can be produced.
3. It is suitable for printing of invoices of companies.

Daisy Wheel Printers:

Head is lying on a wheel and Pins corresponding to characters are like petals of Daisy, that's why called Daisy wheel printer.



Daisy Wheel Printer

Advantage:

1. More reliable than DMPs
2. Better Quality

Disadvantage:

1. Slower than DMPs

Drum Printers:

These are line printers, which prints one line at a time. It consists of a drum. The shape of the drum is cylindrical. The drum is solid and has characters embossed on it in the form of vertical bands. The characters are in circular form. Each band consists of some characters. Each line

on drum consists of 132 characters. Because there are 96 lines so total characters are $(132 * 96) = 12,672$.

Drum contains a number of hammers also.

Chain Printers:

These are called as line printers. These are used to print one line at a line. Basically, chain consists of links. Each link contains one character. Printers can follow any character set style, i.e., 48, 64 or 96 characters. Printer consists of a number of hammers also.

Advantages:

1. Chain or Band if damaged can be changed easily.
2. It allows printing of different form.
3. Different Scripts can be printed using this printer.

Disadvantages:

1. It cannot print charts and graphs.
2. It cannot print characters of any shape.
3. Chain Printers is impact printer, hammer strikes so it is noisy.

Non-Impact Printers:

Inkjet Printers:

These printers use a special link called electrostatic ink. The printer head has a special nozzle. Nozzle drops ink on paper. Head contains

up to 64 nozzles. The ink dropped is deflected by the electrostatic plate. The plate is fixed outside the nozzle. The deflected ink settles on paper.



Inkjet Printer

Advantages:

1. These produce high quality of output as compared to the dot matrix.
2. A high-quality output can be produced using 64 nozzles printed.
3. Inkjet can print characters in a variety of shapes.
4. Inkjet can print special characters.
5. The printer can print graphs and charts.

Disadvantages:

1. Inkjet Printers are slower than dot matrix printers.
2. The cost of inkjet is more than a dot matrix printer.

Laser Printers:

These are non-impact page printers. They use laser lights to produce the dots needed to form the characters to be printed on a page & hence the name laser printers.

The output is generated in the following steps:

Step1: The bits of data sent by processing unit act as triggers to turn the laser beam on & off.

Step2: The output device has a drum which is cleared & is given a positive electric charge. To print a page the modulated laser beam passing from the laser scans back & forth the surface of the drum. The positive electric charge on the drum is stored on just those parts of the drum surface which are exposed to the laser beam create the difference in electric which charges on the exposed drum surface.



Laser Printer

Step3: The laser exposed parts of the drum attract an ink powder known as toner.

Step4: The attracted ink powder is transferred to paper.

Step5: The ink particles are permanently fixed to the paper by using either heat or pressure technique.

Step6: The drum rotates back to the cleaner where a rubber blade cleans off the excess ink & prepares the drum to print the next page.

Definition of Graphics Software:

Computer software applications that are used to display, create, and edit computer graphics. While many types of software will “support graphics”, these programs are usually limited in what they can do with graphics; for example, word processors can be used to create simple line art or to display images alongside text, while some spreadsheet and database programs will allow data to be displayed in the form of graphs and charts but neither type of software will give you the ability to edit graphics in detail.