



Open and Distance Learning Department

Punjabi University, Patiala

Class : B.Ed.-I

Semester : 2

Paper : XIV (Enriching Learning Through ICT) Unit: 1

Medium : English

Lesson No.

- 1.1 : Computer Fundamentals
- 1.2 : Types of Computers
- 1.3 : Operating System & Application Software
- 1.4 : Information and Communication
Technology (ICT)
- 1.5 : Integration of ICT in Teaching and learning
Role and Challenges of ICT

Department website : www.pbidde.org

Computer Fundamentals**Structure of the Lesson**

- 1.1 Objectives
- 1.2 Introduction
- 1.3 Meaning of computer
 - 1.3.1 Characteristics of computer
- 1.4 Components of Computers
 - 1.4.1 Input device
 - 1.4.2 Central Processing Unit
 - 1.4.3 Output Devices
- 1.5 Summary
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1.1 Objectives

After going through this lesson learners will be able to:

- I. know the meaning of computer.
- II recall the characteristics of computer.
- III describe the various components of computer.
- IV list different input and output devices.
- V describe the functions of CPU.

1.2 Introduction

Computer is one of the wonderful inventions of science and technology in the present century. It has come to change our ways of working. Almost every aspect of our lives, is being affected by it. Its growing effect is being felt in various fields such as medicines, defence, education, business and the home. Day –by day computer is becoming popular.

These days computer is becoming an important tool of communication, study, collection and collecting information, and research and for all types of development. It is a basic instrument in information technology. Therefore it is essential to understand the basic of computer; its strength; its weakness and its internal structure.

1.3 Meaning of computer

The word ‘computer’ has been derived from the word ‘compute’. Initially, these were considered as fast calculating machines. A computer manipulates the number of

symbols which it accepts as input, processes that input and reproduces this as output. Computers are also called 'data processors' as they store, process and retrieve data.

A computer is a device made of electronic circuits and wires etc. more precisely, 'a computer is an electronic device which works under the instructions of stored programs, automatically accepting the supplied data to analyze and process the data to produce the information called the result of that processing. In simple words, a computer is an electronic processing device used to calculate and store the data at large extent and speed with follows the input processing and output sequence.

Charles Babbage is called the "Grand Father" of the computer. The First mechanical computer designed by Charles Babbage was called **Analytical Engine**. It uses read-only memory in the form of punch cards.

Computer is an advanced electronic device that takes raw data as input from the user and processes these data under the control of set of instructions (called program) and gives the result (output) and saves output for the future use. It can process both numerical and non-numerical (arithmetic and logical) calculations.

In layman's language, Commonly Operating Machine Particularly Used for Teaching Educational and Research

Computer:

C: Calculate	Commonly
O: Operate	Operating
M: Memorizing	Machine
P: Print	Particularly
U: Upgrade	Used for
T: Tabulate	Teaching
E: Edit	Education
R: Research	Research

1.3.1 Characteristics of computer

Computers have become part of our life. We use computers on daily basis, in our school, at home, at office. Why we are so dependent on computers? Because they have made our lives easier, they provide us entertainment, they can store our valuable data for as long as we want it to keep. The following are some of the main characteristics of computers.

- **Speed:** - As you know computer can work very fast. It takes only few seconds for calculations that we take hours to complete. You will be surprised to know that computer can perform millions (1,000,000) of instructions and even more per second. Therefore, we determine the speed of computer in terms of microsecond (10⁻⁶ part of a second) or nanosecond (10 to the power -9 part of a second). From this you can imagine how fast your computer performs work.

- **Accuracy:** - The degree of accuracy of computer is very high and every calculation is performed with the same accuracy. The accuracy level is determined on the basis of design of computer. The errors in computer are due to human and inaccurate data.
- **Diligence:** - A computer is free from tiredness, lack of concentration, fatigue, etc. It can work for hours without creating any error. If millions of calculations are to be performed, a computer will perform every calculation with the same accuracy. Due to this capability it overpowers human being in routine type of work.
- **Versatility:** - It means the capacity to perform completely different type of work. You may use your computer to prepare payroll slips. Next moment you may use it for inventory management or to prepare electric bills.
- **Power of Remembering:** - [Computer](#) has the power of storing any amount of [information](#) or data. Any information can be stored and recalled as long as you require it, for any numbers of years. It depends entirely upon you how much data you want to store in a computer and when to lose or retrieve these data.
- **No IQ:** - Computer is a dumb machine and it cannot do any work without instruction from the user. It performs the instructions at tremendous speed and with accuracy. It is you to decide what you want to do and in what sequence. So a computer cannot take its own decision as you can.
- **No Feeling:** - It does not have feelings or emotion, taste, knowledge and experience. Thus it does not get tired even after long hours of work. It does not distinguish between users.
- **Storage:** - Storage capacity is another big characteristic of a computer. A computer can store large amount of data. This data can be used at any time and also from any location. The storage capacity of a computer is measured in [Mega Byte, Gega Byte, Tera Byte](#).
- **Communication:-** Computers have the ability to communicate, but of course there needs some sort of connection (either Wired or Wireless connection). Two computers can be connected to send & receive data. Special softwares are used for text and video chat. Friends & family can connect over the internet and share files, photos & videos online.
- **Multitasking:-** Multitasking is also a computer characteristic. Computers can perform several tasks at a time. For example you can listen to songs, download movies, and prepare word documents all at the same time.

1.4 Components of Computers

The basic components of a modern digital computer are: [Input Device](#), [Output Device](#), [Central Processor Unit \(CPU\)](#), mass storage device and memory. Four Functions about computer are:

accepts data	Input
processes data	Processing
produces output	Output
stores results	Storage

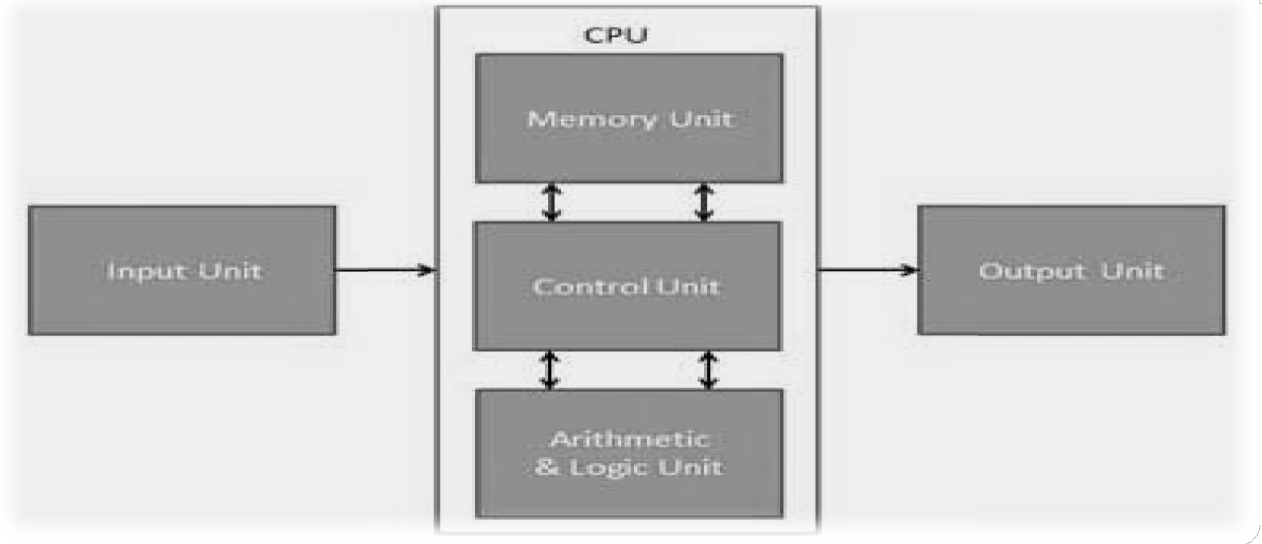


Figure 1. Block Diagram of Computer

- **Input Unit**

This unit contains devices with the help of which we enter data into computer. This unit makes link between user and computer. The input devices translate the information into the form understandable by computer.

- **CPU (Central Processing Unit)**

CPU is considered as the brain of the computer. CPU performs all types of data processing operations. It stores data, intermediate results and instructions(program). It controls the operation of all parts of computer.

CPU itself has following three components

- ALU(Arithmetic Logic Unit)
- Memory Unit
- Control Unit

- **Output Unit**

Output unit consists of devices with the help of which we get the information from computer. This unit is a link between computer and users. Output devices translate the computer's output into the form understandable by users.

1. 4.1 Input device

In computing, an **input device** is a peripheral (piece of computer hardware equipment) used to provide data and control signals to an information processing system such as a computer or information appliance. Examples of input devices include keyboards, mouse, scanners, digital cameras and joysticks.

Following are few of the important input devices which are used in a computer:

1. Keyboard

Keyboard is the most common and very popular input device which helps in inputting data to the computer. The layout of the keyboard is like that of traditional typewriter, although there are some additional keys provided for performing additional functions.

Keyboards are of two sizes 84 keys or 101/102 keys, but now keyboards with 104 keys or 108 keys are also available for Windows and Internet.

The keys on the keyboard are as follows:

Sr.No	Keys	Description
1	Typing Keys	These keys include the letter keys (A-Z) and digit keys (0-9) which generally give same layout as that of typewriters.
2	Numeric Keypad-	It is used to enter numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators.
3	Function Keys	The twelve function keys are present on the keyboard which are arranged in a row at the top of the keyboard. Each function key has unique meaning and is used for some specific purpose.
4	Control keys	These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down, Control(Ctrl), Alternate(Alt), Escape(Esc).
5	Special Purpose Keys	Keyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen.

2. Mouse

Mouse is most popular pointing device. It is a very famous cursor-control device having a small palm size box with a round ball at its base which senses the movement of mouse and sends corresponding signals to CPU when the mouse buttons are pressed. Generally it has two buttons called left and right button and a wheel is present between the buttons. Mouse can be used to control the position of cursor on screen, but it cannot be used to enter text into the computer.

Advantages

- Easy to use
- Not very expensive
- Moves the cursor faster than the arrow keys of keyboard.

3. Joystick

Joystick is also a pointing device which is used to move cursor position on a monitor screen. It is a stick having a spherical ball at its both lower and upper ends. The lower spherical ball moves in a socket. The joystick can be moved in all four directions. The function of joystick is similar to that of a mouse. It is mainly used in Computer Aided Designing(CAD) and playing computer games.

4. Light Pen

Light pen is a pointing device which is similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube. When the tip of a light pen is moved over the monitor screen and pen button is pressed, its photocell sensing element detects the screen location and sends the corresponding signal to the CPU.

5. Track Ball

Track ball is an input device that is mostly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted and by moving fingers on ball, pointer can be moved. Since the whole device is not moved, a track ball requires less space than a mouse. A track ball comes in various shapes like a ball, a button and a square.

6. Scanner

Scanner is an input device which works more like a photocopy machine. It is used when some information is available on a paper and it is to be transferred to the hard disc of the computer for further manipulation. Scanner captures images from the source which are then converted into the digital form that can be stored on the disc. These images can be edited before they are printed.

7. Digitizer

Digitizer is an input device which converts analog information into digital form. Digitizer can convert a signal from the television or camera into a series of numbers that could be stored in a computer. They can be used by the computer to create a picture of

whatever the camera had been pointed at. Digitizer is also known as Tablet or Graphics Tablet because it converts graphics and pictorial data into binary inputs. A graphic tablet as digitizer is used for doing fine works of drawing and image manipulation applications.

8. Microphone

Microphone is an input device to input sound that is then stored in digital form. The microphone is used for various applications like adding sound to a multimedia presentation or for mixing music.

9. Magnetic Ink Card Reader (MICR)

MICR input device is generally used in banks because of a large number of cheques to be processed every day. The bank's code number and cheque number are printed on the cheques with a special type of ink that contains particles of magnetic material that are machine readable. This reading process is called Magnetic Ink Character Recognition (MICR). The main advantages of MICR is that it is fast and less error prone.

10. Optical Character Reader(OCR)

OCR is an input device used to read a printed text. OCR scans text optically character by character, converts them into a machine readable code and stores the text on the system memory.

11. Bar Code Readers

Bar Code Reader is a device used for reading bar coded data (data in form of light and dark lines). Bar coded data is generally used in labelling goods, numbering the books etc. It may be a hand held scanner or may be embedded in a stationary scanner. Bar Code Reader scans a bar code image, converts it into an alphanumeric value which is then fed to the computer to which bar code reader is connected.

12. Optical Mark Reader(OMR)

OMR is a special type of optical scanner used to recognize the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be selected and marked. It is specially used for checking the answer sheets of examinations having multiple choice questions.

1.4.2 Central Processing Unit

Alternately referred to as a processor, central processor, or microprocessor, the CPU (pronounced sea-pea-you) is the Central Processing Unit of the computer. A computer's CPU handles all [instructions](#) it receives from [hardware](#) and [software](#) running on the computer.

CPU itself has following three components.

- i. Memory or Storage Unit
- ii. Control Unit
- iii. ALU(Arithmetic Logic Unit)

i. Memory or Storage Unit

This unit can store instructions, data and intermediate results. This unit supplies information to the other units of the computer when needed. It is also known as internal storage unit or main memory or primary storage or Random access memory(RAM).

Its size affects speed, power and capability. Primary memory and secondary memory are two types of memories in the computer. Functions of memory unit are:

- It stores all the data and the instructions required for processing.
- It stores intermediate results of processing.
- It stores final results of processing before these results are released to an output device.
- All inputs and outputs are transmitted through main memory.

ii. Control Unit

This unit controls the operations of all parts of computer but does not carry out any actual data processing operations.

Functions of this unit are:

- It is responsible for controlling the transfer of data and instructions among other units of a computer.
- It manages and coordinates all the units of the computer.
- It obtains the instructions from the memory, interprets them, and directs the operation of the computer.
- It communicates with Input/Output devices for transfer of data or results from storage.
- It does not process or store data.

iii. ALU (Arithmetic Logic Unit)

This unit consists of two subsections namely

- a) Arithmetic section
- b) Logic Section

a) Arithmetic Section: Function of arithmetic section is to perform arithmetic operations like addition, subtraction, multiplication and division. All complex operations are done by making repetitive use of above operations.

b) Logic Section: Function of logic section is to perform logic operations such as comparing, selecting, matching and merging of data.

1.4.3 Output Devices

An output device is any piece of [computer hardware](#) equipment used to communicate the results of [data processing](#) carried out by an [information processing system](#) (such as a [computer](#)) which converts the electronically generated information into human-readable form. Following are few of the important output devices which are used in a computer.

1. Monitors
2. Graphic Plotter
3. Printer

1. **Monitors** : Monitors, commonly called as Visual Display Unit (VDU), are the main output device of a computer. It forms images from tiny dots, called pixels that are arranged in a rectangular form. The sharpness of the image depends upon the number of pixels.

There are two kinds of viewing screen used for monitors.

- a. Cathode-Ray Tube (CRT)
- b. Flat- Panel Display

a. **Cathode-Ray Tube (CRT) Monitor** :The CRT display is made up of small picture elements called pixels. The smaller the pixels, the better the image clarity, or resolution. It takes more than one illuminated pixel to form whole character, such as the letter 'e' in the word help.

A finite number of characters can be displayed on a screen at once. The screen can be divided into a series of character boxes - fixed location on the screen where a standard character can be placed. Most screens are capable of displaying 80 characters of data horizontally and 25 lines vertically. There are some disadvantages of CRT:

- Large in Size
- High power consumption

b. **Flat-Panel Display Monitor**: The flat-panel display refers to a class of video devices that have reduced volume, weight and power requirement in comparison to the CRT. You can hang them on walls or wear them on your wrists. Current uses of flat-panel displays include calculators, video games, monitors, laptop computer, graphics display.

2. Plotters:

A plotter is a computer hardware device much like a printer that is used for printing [vector graphics](#). Instead of [toner](#), plotters use a pen, pencil, marker, or another writing tool to draw multiple, continuous lines onto paper rather than a series of dots like a traditional printer. Though once widely used for [computer-aided design](#), these devices have more or less been phased out by wide-format printers. Plotters are used to produce a [hard copy](#) of schematics and other similar applications.

Advantages of plotters

- Plotters can work on very large sheets of paper while maintaining high resolution.
- They can print on a wide variety of flat materials including plywood, aluminum, sheet steel, cardboard, and plastic.
- Plotters allow the same pattern to be drawn thousands of time without any image degradation.

Disadvantages

- Plotters are quite large when compared to a traditional printer.
- Plotters are also much more expensive than a traditional printer.

3. **Printers** : Printer is an output device, which is used to print information on paper.

There are two types of printers:

- I. Impact Printers
- II. Non-Impact Printers

I. Impact Printers: The impact printers print the characters by striking them on the ribbon which is then pressed on the paper.

Characteristics of Impact Printers are the following:

- Very low consumable costs
 - Very noisy
- a. **Character Printers: These are further divided into two types:**
- i. Dot Matrix Printer(DMP)
 - ii. Daisy Wheel

i. Dot Matrix Printer(DMP)

In the market one of the most popular printers is Dot Matrix Printer. These printers are popular because of their ease of printing and economical price. Each character printed is in form of pattern of dots and head consists of a Matrix of Pins of size (5*7, 7*9, 9*7 or 9*9) which come out to form a character that is why it is called Dot Matrix Printer.

Advantages

- Inexpensive
- Widely Used
- Other language characters can be printed

Disadvantages

- Slow Speed
- Poor Quality

ii. Daisy Wheel

Head is lying on a wheel and pins corresponding to characters are like petals of Daisy (flower name) that is why it is called Daisy Wheel Printer. These printers are generally used for word-processing in offices which require a few letters to be sent here and there with very nice quality.

Advantages

- More reliable than DMP

- Better quality
- The fonts of character can be easily changed

Disadvantages

- Slower than DMP
- Noisy
- More expensive than DMP

b. Line Printers

Line printers are the printers which print one line at a time.

These are of further two types

- i. Drum Printer
- ii. Chain Printer

i. Drum Printer

This printer is like a drum in shape so it is called drum printer. The surface of drum is divided into number of tracks. Total tracks are equal to size of paper i.e. for a paper width of 132 characters, drum will have 132 tracks. A character set is embossed on track. The different character sets available in the market are 48 character set, 64 and 96 characters set. One rotation of drum prints one line. Drum printers are fast in speed and can print 300 to 2000 lines per minute.

Advantages

- Very high speed

Disadvantages

- Very expensive
- Characters fonts cannot be changed

ii. Chain Printer

In this printer, chain of character sets are used so it is called Chain Printer. A standard character set may have 48, 64, or 96 characters.

Advantages

- Character fonts can easily be changed.
- Different languages can be used with the same printer.

Disadvantages

- Noisy

II. Non-impact Printers

Non-impact printers print the characters without using ribbon. These printers print a complete page at a time so they are also called as Page Printers.

These printers are of two types

- a. Laser Printers
- b. Inkjet Printers

Characteristics of Non-impact Printers

- Faster than impact printers.

- They are not noisy.
- High quality.
- Support many fonts and different character size.

a. 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.

Advantages

- Very high speed
- Very high quality output
- Give good graphics quality
- Support many fonts and different character size

Disadvantages

- Expensive.
- Cannot be used to produce multiple copies of a document in a single printing.

b. Inkjet Printers

Inkjet printers are non-impact character printers based on a relatively new technology. They print characters by spraying small drops of ink onto paper. Inkjet printers produce high quality output with presentable features.

They make less noise because no hammering is done and these have many styles of printing modes available. Colour printing is also possible. Some models of Inkjet printers can produce multiple copies of printing also.

Advantages

- High quality printing
- More reliable

Disadvantages

- Expensive as cost per page is high
- Slow as compared to laser printer

1.5 Summary

This unit discusses the computer fundamentals. A computer is a device that accepts information (in the form of digitalized data) and manipulates it for some result based on a program or sequence of instructions on how the data is to be processed. Computer has different components i.e. input, process, output units.

1.6. Suggested Questions

1. What are computers? What role can they play in the process of teaching and learning?
2. What are computers? How can they be broadly classified?
3. Discuss in brief the various components of your personal computer.
4. Write a short note on the following:
 - a. Input devices

- b. CPU
- c. Output devices

1.7. Suggested Readings and web resources

Agarwal J. C. (2006). *Essential of educational technology, Teaching and learning*. New Delhi:

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Sharma, R. A. (2008). *Technological foundation of education*. Meerut: R.Lall Books Depot.

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Sinha, P.K. & Sinha, P. *Computer Fundamentals*, BPB

Singh, Y. K. (2009). *Teaching Practice*. New Delhi: APH Publishing Corporation

www.slideshare.net/mkhisalg/types-and-components-of-computer-system

www.comptechdoc.org/hardware/pc/begin/hwcomputer.html

<https://en.wikibooks.org/.../Computer.../Components...computer.../Types>.

Types of Computers

Structure of the Lesson

- 1.2.1 Objectives
- 1.2.2 Introduction
- 1.2.3 Types of Computers
 - 1.2.3.1 On the basis of technology working: hardware design
 - 1.2.3.2. On the basis of Purpose
 - 1.2.3.3. On the basis of Size
 - 1.2.3.4. On the basis of Generation
- 1.2.5 Summary
- 1.2.6 Suggested Questions
- 1.2.7 Suggested readings and Web resources

1.2.1 Objectives

After going through this lesson learners will be able to:

- i. know the types of computer.
- ii. recall the different types of computer.
- iii. describe different types of computer.
- iv. classify computers on different basis.

1.2.2 Introduction

A computer is one of the most brilliant inventions of mankind. Thanks to computer technology, we have been able to achieve storage and processing of huge amounts of data. We can rest our brains by employing computer memory capacities for information storage. Owing to computers, we have been able to achieve higher processing speeds, carry out critical transactions and that too with great precision and accuracy.

Computers of the earlier times were of the size of a large room and required to consume huge amounts of electric power. However, with the advancing technology, computers have shrunk to the size of a small watch.

Depending on their processing powers, size and area of use, they have been classified into various types. Based on the operational principle, computers can be classified as analog and digital. Based on their processing powers, they can be categorized as mainframe and microcomputers. Based on the usage, they can be grouped under

desktop computers, laptops, tablets, netbooks, personal digital assistants (PDAs) and even tiny wearable ones. Here's more on the different types of computers.

Since the [advent of the first computer](#) different types and sizes of computers are offering different services. Computers can be as big as occupying a large building and as small as a laptop or a microcontroller in mobile & [embedded systems](#).

1.2.3 Types of Computers

Computers can be classified on different basis: (a) on the basis of technology working: hardware design,(b) on the basis of purpose or utility,(c) on the basis of size and storage capacity,(d) on the basis of generation.

1.2.3.1 On the basis of technology working: hardware design

According to data handling, computers are analog, digital or hybrid. Hybrid computers incorporate the measuring feature of an analog [computer](#) and counting feature of a digital computer. For computational purposes, these computers use analog components and for storage, digital memories are used. According to functionality, computers are classified as :

- **Analog Computer**

Analog computers are used to process analog data. Analog data is of continuous nature and which is not discrete or separate. Such type of data includes temperature, pressure, speed weight, voltage, depth etc. These quantities are continuous and having an infinite variety of values.

It measures continuous changes in some physical quantity e.g. The Speedometer of a car measures speed, the change of temperature is measured by a Thermometer, the weight is measured by Weights machine. These computers are ideal in situations where data can be accepted directly from measuring instrument without having to convert it into numbers or codes.

Analog computers are the first computers being developed and provided the basis for the development of the modern digital computers. Analog computers are widely used for certain specialized engineering and scientific applications, for calculation and measurement of analog quantities. They are frequently used to control process such as those found in oil refinery where flow and temperature measurements are important. They are used for example in paper making and in chemical industry. Analog computers do not require any storage capability because they measure and compare quantities in a single operation. Output from an analog computer is generally in the form of readings on a series of dial (Speedometer of a car) or a graph on strip chart.

- **Digital Computer**

A Digital Computer, as its name implies, works with digits to represent numerals, letters or other special symbols. Digital Computers operate on inputs which are ON-OFF type and its output is also in the form of ON-OFF signal. Normally, an ON is represented by a 1 and an OFF is represented by a 0. So we can say that digital computers process

information which is based on the presence or the absence of an electrical charge or we prefer to say a binary 1 or 0.

A digital computer can be used to process numeric as well as non-numeric data. It can perform arithmetic operations like addition, subtraction, multiplication and division and also logical operations. Most of the computers available today are digital computers. The most common examples of digital computers are accounting machines and calculators.

The results of digital computers are more accurate than the results of analog computers. Analog computers are faster than digital. Analog computers lack memory whereas digital computers store information. We can say that digital computers count and analog computers measures.

- **Hybrid Computer (Analog + Digital)**

A hybrid is a combination of digital and analog computers. It combines the best features of both types of computers, i.e. analog & digital . It has the speed of analog computer and the memory and accuracy of digital computer. Hybrid computers are used mainly in specialized applications where both kinds of data need to be processed. Therefore, they help the user, to process both continuous and discrete data. For example a petrol pump contains a processor that converts fuel flow measurements into quantity and price values. In hospital Intensive Care Unit (ICU), an analog device is used which measures patient's blood pressure and temperature etc, which are then converted and displayed in the form of digits. Hybrid computers for example are used for scientific calculations, in defense and radar systems.

1.2.3.2. On the basis of Purpose

- **General-Purpose computers**

Most computers in use today are **General-Purpose computers** — those built for a great variety of processing jobs. Simply by using a general purpose computer and different software, various tasks can be accomplished, including writing and editing (word processing), manipulating facts in a data base, tracking manufacturing inventory, making scientific calculations, or even controlling organization's security system, electricity consumption, and building temperature. General purpose computers are designed to perform a wide variety of functions and operations.

- **Special-Purpose Computer**

As the name states, a Special-Purpose Computer are designed to be task specific and most of the times their job is to solve one particular problem. They are also known as dedicated computers, because they are dedicated to perform a single task over and over again. Such a computer system would be useful in playing graphic intensive Video Games, traffic lights control system, navigational system in an aircraft, weather forecasting, satellite launch / tracking, oil exploration, and in automotive industries, keeping time in a digital watch, or Robot helicopter. While a special purpose computer may have many of the same features found in a general purpose computer, its applicability to a particular problem is a function of its design rather than to a stored program. The

instructions that control it are built directly into the computer, which makes for a more efficient and effective operation. A drawback of this specialization, however, is the computer's lack of versatility. It cannot be used to perform other operations.

1.2.3.3. On the basis of Size

Since the [advent of the first computer](#) different types and sizes of computers are offering different services. Computers can be as big as occupying a large building and as small as a laptop or a microcontroller in mobile & [embedded systems](#). The four basic types of computers by size are as under:

1. Supercomputer

Supercomputers are the largest, fastest, most powerful, and most expensive computers made. Like other large systems, supercomputers can be accessed by many individuals at the same time. Supercomputers are used primarily for scientific applications that are mathematically intensive. The first supercomputer was built in the 1960s for the United States Department of Defense.

Uses of Supercomputers

- Space Exploration

Supercomputers are used to study the origin of the universe, the dark-matters. For these studies scientist use IBM's powerful supercomputer "Roadrunner" at National Laboratory Los Alamos.

- Earthquake studies

Supercomputers are used to study the Earthquakes phenomenon. Besides that supercomputers are used for natural resources exploration, like natural gas, petroleum, coal, etc.

- Weather Forecasting

Supercomputers are used for weather forecasting, and to study the nature and extent of Hurricanes, Rainfalls, windstorms, etc.

- Nuclear weapons testing

Supercomputers are used to run weapon simulation that can test the Range, accuracy & impact of Nuclear weapons.

Popular Supercomputers

- IBM's Sequoia, in United States
- Fujitsu's K Computer in Japan
- IBM's Mira in United States
- IBM's SuperMUC in Germany
- NUDT Tianhe-1A in China

2. Mainframe computer

Although Mainframes are not as powerful as supercomputers, but certainly they are quite expensive nonetheless, and many large firms & government organizations uses Mainframes to run their business operations. The Mainframe computers can be accommodated in large air-conditioned rooms because of its size. Super-computers are the

fastest computers with large data storage capacity, Mainframes can also process & store large amount of data. Banks educational institutions & insurance companies use mainframe computers to store data about their customers, students & insurance policy holders.

Popular Mainframe computers

- Fujitsu's ICL VME
- Hitachi's Z800

3. Minicomputer

Minicomputers are used by small businesses & firms. Minicomputers are also called as "Midrange Computers". These are small machines and can be accommodated on a disk with not as processing and data storage capabilities as super-computers & Mainframes. These computers are not designed for a single user. Individual departments of a large company or organizations use Mini-computers for specific purposes. For example, a production department can use Mini-computers for monitoring certain production process.

Popular Minicomputers

- K-202
- Texas Instrument TI-990
- SDS-92
- IBM Midrange computers

4. Microcomputer

Desktop computers, laptops, personal digital assistant (PDA), tablets & Smartphone's are all types of microcomputers. The micro-computers are widely used & the fastest growing computers. These computers are the cheapest among the other three types of computers. The Micro-computers are specially designed for general usage like entertainment, education and work purposes. Well known manufacturers of Micro-computer are Dell, Apple, Samsung, Sony & Toshiba.

Desktop computers, Gaming consoles, Sound & Navigation system of a car, Netbooks, Notebooks, PDA's, Tablet PC's, Smart phones, Calculators are all type of Microcomputers.

1.2.3.4. On the basis of Generation

The development of electronic computers can be divided into five generations depending upon the technologies used. The following are the five generations of computers.

1. First Generation of Computers (1942-1955)

The beginning of commercial computer age is from UNIVAC (**Universal Automatic Computer**). It was developed by two scientists **Mauchly** and **Echert** at the Census Department of United States in 1947. **The first generation computers were used during 1942-1955**. They were based on [vacuum tubes](#). Examples of first generation computers are **ENIVAC** and **UNIVAC-1**.

Advantages

- Vacuum tubes were the only electronic component available during those days.
- Vacuum tube technology made possible to make electronic digital computers.
- These computers could calculate data in millisecond.

Disadvantages

- The computers were very large in size.
- They consumed a large amount of energy.
- They heated very soon due to thousands of vacuum tubes.
- They were not very reliable.
- Air conditioning was required.
- Constant maintenance was required.
- Non-portable.
- Costly commercial production.
- Limited commercial use.
- Very slow speed.
- Limited programming capabilities.
- Used machine language only.
- Used magnetic drums which provide very less data storage.
- Used punch cards for input.

2. Second Generation Computers (1955-1964)

The **second generation computers** used [transistors](#). The scientists at Bell laboratories developed transistor in 1947. These scientists include John Barden, William Brattain and William Shockley. The size of the computers was decreased by replacing vacuum tubes with transistors. The examples of second generation computers are **IBM 7094 series, IBM 1400 series** and **CDC 164** etc.

Advantages

- Smaller in size as compared to the first generation computers.
- The 2nd generation Computers were more reliable
- Used less energy and were not heated.
- Wider commercial use
- Better portability as compared to the first generation computers.
- Better speed and could calculate data in microseconds
- Used faster peripherals like tape drives, magnetic disks, printer etc.
- Used Assembly language instead of Machine language.
- Accuracy improved.

Disadvantages

- Cooling system was required
- Constant maintenance was required
- Commercial production was difficult
- Only used for specific purposes

- Costly and not versatile
- Punch cards were used for input.

3. Third Generation Computers (1964-1975)

The **Third generation computers** used the integrated circuits (IC). Jack Kilby developed the concept of integrated circuit in 1958. It was an important invention in the computer field. The first IC was invented and used in 1961. The size of an IC is about $\frac{1}{4}$ square inch. A single IC chip may contain thousands of transistors. The computer became smaller in size, faster, more reliable and less expensive. The examples of third generation computers are **IBM 370, IBM System/360, UNIVAC 1108** and **UNIVAC AC 9000** etc.

Advantages

- Smaller in size as compared to previous generations.
- More reliable.
- Used less energy
- Produced less heat as compared to the previous two generations of computers.
- Better speed and could calculate data in nanoseconds.
- Used fan for heat discharge to prevent damage.
- Maintenance cost was low because hardware failure is rare.
- Totally general purpose
- Could be used for high-level languages.
- Good storage
- Versatile to an extent
- Less expensive
- Better accuracy
- Commercial production increased.
- Used mouse and keyboard for input.

Disadvantages

- Air conditioning was required.
- Highly sophisticated technology required for the manufacturing of IC chips.

4. Fourth Generation Computers (1975-Present)

The fourth generation computers started with the invention of Microprocessor. The Microprocessor contains thousands of ICs. **Ted Hoff** produced the first microprocessor in 1971 for **Intel**. It was known as Intel 4004. The technology of integrated circuits improved rapidly. The LSI (Large Scale Integration) circuit and VLSI (Very Large Scale Integration) circuit was designed. It greatly reduced the size of computer. The size of modern Microprocessors is usually one square inch. It can contain millions of electronic circuits. The examples of fourth generation computers are **Apple Macintosh & IBM PC**.

Advantages

- More powerful and reliable than previous generations.
- Small in size
- Fast processing power with less power consumption

- Fan for heat discharging and thus to keep cold.
- No air conditioning required.
- Totally general purpose
- Commercial production
- Less need of repair.
- Cheapest among all generations
- All types of High level languages can be used in this type of computers

Disadvantages

- The latest technology is required for manufacturing of Microprocessors.

5. Fifth Generation Computers (Present & Beyond)

Scientists are working hard on the **5th generation computers** with quite a few breakthroughs. It is based on the technique of **Artificial Intelligence (AI)**. Computers can understand spoken words & imitate human reasoning. Can respond to its surroundings using different types of sensors. Scientists are constantly working to increase the processing power of computers. They are trying to create a computer with real IQ with the help of advanced programming and technologies. **IBM Watson** computer is one example that outsmarts **Harvard University Students**. The advancement in modern technologies will revolutionize the computer in future.

1.2.4 Summary

This unit discusses types of computers. Computer can be classified on basis of size, purpose, technology and generations. These were most of the different types of computers used today. Looking at the rate of advancement in technology, we can definitely look forward to many more in the coming years.

1.2.5. Suggested Questions

5. Define different types of computers in detail.
6. Write a short notes on the following:
 - a. Computer On the basis of technology.
 - b. Computer On the basis of purpose.
 - c. Computer On the basis of size.
7. Points out various generation of computers alongwith their basic characteristics, advantages and limitations.

1.2.6. Suggested Readings and web resources

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Operating System & Application Software

Structure of the Lesson

1.3.1 Objectives

1.3.2 Introduction

1.3.3 Objectives of Operating System

1.3.4 Characteristics of Operating System

1.3.5 Types of an operating systems

1.3.6 Functions of an operating System

1.3.7 Application Software

1.3.8 Types of Application Software

1.3.8.1 General-purpose packages

1.3.8.2 Integrated packages

1.3.8.3 Specialist application software

1.3.8.4 Tailor-made software

1.3.9 Summary

1.3.10 Suggested Questions

1.3.11 Suggested readings and Web resources

1.3.1 Objectives

After going through this lesson learners will be able to:

- I know the meaning of operating system.
- II recall the objectives of operating system.
- III list the characteristics of operating system.
- IV classify different types of operating system.
- V describe the functions of operating system.
- VI know the meaning of application software.
- VII describe the meaning of application software.
- VIII classify different types of application software.

1.3.2 Introduction

An operating system (OS) is a collection of software that manages computer hardware resources and provides common services for computer programs. The operating system is a vital component of the system software in a computer system.

An operating System (OS) is an intermediary between users and computer hardware. It provides users an environment in which a user can execute programs conveniently and efficiently.

In technical terms, It is a software which manages hardware. An operating System controls the allocation of resources and services such as memory, processors, devices and information.

An operating system is a program that acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs.

1.3.3 Objectives of Operating System

- To make a computer system convenient to use in an efficient manner
- To hide the details of the hardware resources from the users
- To provide users a convenient interface to use the computer system
- To act as an intermediary between the hardware and its users and making it easier for the users to access and use other resources
- To manage the resources of a computer system
- To keep track of who is using which resource, granting resource requests, according for resource using and mediating conflicting requests from different programs and users
- To provide efficient and fair sharing of resources among users and programs

1.3.4 Characteristics of Operating System

- **Memory Management** -- keeps tracks of primary memory i.e. what part of it is in use by whom, what part is not in use etc. and allocates the memory when a process or program requests it.
- **Processor Management** -- allocates the processor (CPU) to a process and deallocates processor when it is no longer required.
- **Device Management** -- keeps track of all devices. This is also called I/O controller that decides which process gets the device, when, and for how much time.
- **File Management** -- allocates and de-allocates the resources and decides who gets the resources.
- **Security** -- prevents unauthorized access to programs and data by means of passwords and similar other techniques.
- **Job accounting** -- keeps track of time and resources used by various jobs and/or users.
- **Control over system performance** -- records delays between request for a service and from the system.
- **Interaction with the operators** -- The interaction may take place via the console of the computer in the form of instructions. Operating System acknowledges the same, does the corresponding action and informs the operation by a display screen.

- **Error-detecting aids** -- Production of dumps, traces, error messages and other debugging and error-detecting methods.
- **Coordination between other software and users** -- Coordination and assignment of compilers, interpreters, assemblers and other software to the various users of the computer systems.

1.3.5 Types of an operating systems

There are different types of operating systems. These are as follows:

1. **Real-time Operating System:** It is a multitasking operating system that aims at executing real-time applications.
2. **Multi-user and Single-user Operating Systems:** The operating systems of this type allow a multiple users to access a computer system concurrently.
3. **Multi-tasking and Single-tasking Operating Systems:** When a single program is allowed to run at a time, the system is grouped under a single-tasking system, while in case the operating system allows the execution of multiple tasks at one time, it is classified as a multi-tasking operating system.
4. **Distributed Operating System:** An operating system that manages a group of independent computers and makes them appear to be a single computer is known as a distributed operating system.
5. **Embedded System:** The operating systems designed for being used in embedded computer systems are known as embedded operating systems.

1.3.6 Functions of an operating System

Following are some of important functions of an operating System.

1. Booting the computer

The process of starting or restarting the computer is known as booting. A cold boot is when you turn on a computer that has been turned off completely. A warm boot is the process of using the operating system to restart the computer.

2. Performs basic computer tasks

The operating system performs basic computer tasks, such as managing the various peripheral devices such as the mouse, keyboard and printers. For example, most operating systems now are plug and play which means a device such as a printer will automatically be detected and configured without any user intervention.

3. Memory Management

Memory management refers to management of Primary Memory or Main Memory. Main memory is a large array of words or bytes where each word or byte has its own address. Main memory provides a fast storage that can be access directly by the CPU. So for a program to be executed, it must in the main memory. Operating System does the following activities for memory management.

- Keeps tracks of primary memory i.e. what part of it are in use by whom, what part are not in use.

- In multiprogramming, OS decides which process will get memory when and how much.
- Allocates the memory when the process requests it to do so.
- De-allocates the memory when the process no longer needs it or has been terminated.

4. Processor Management

In multiprogramming environment, OS decides which process gets the processor when and how much time. This function is called process scheduling. Operating System does the following activities for processor management.

- Keeps tracks of processor and status of process. Program responsible for this task is known as traffic controller.
- Allocates the processor (CPU) to a process.
- De-allocates processor when processor is no longer required.

5. Device Management

OS manages device communication via their respective drivers. Operating System does the following activities for device management.

- Keeps tracks of all devices. Program responsible for this task is known as the I/O controller.
- Decides which process gets the device when and for how much time.
- Allocates the device in the efficient way.
- De-allocates devices.

6. File Management

A file system is normally organized into directories for easy navigation and usage. These directories may contain files and other directions. Operating System does the following activities for file management.

- Keeps track of information, location, uses, status etc. The collective facilities are often known as file system.
- Decides who gets the resources.
- Allocates the resources.
- De-allocates the resources.

7. Other Important Activities

Following are some of the important activities that Operating System does.

- **Security** -- By means of password and similar other techniques, preventing unauthorized access to programs and data.
- **Control over system performance** -- Recording delays between request for a service and response from the system.
- **Job accounting** -- Keeping track of time and resources used by various jobs and users.
- **Error detecting aids** -- Production of dumps, traces, error messages and other debugging and error detecting aids.

- **Coordination between other softwares and users** -- Coordination and assignment of compilers, interpreters, assemblers and other software to the various users of the computer systems.

1.3.7 Application Software

There are two main types of computer software; **system software** and **application software**. System software includes the operating system and utility programs. Application software utilizes the capacities of a computer directly for a dedicated task. Application software is able to manipulate text, numbers and graphics. It can be in the form of software focused on a certain single task like word processing, spreadsheet or playing of audio and video files. Here we look at the application software types along with some examples of application software of each type.

1.3.8 Types of Application Software

Application software carries out user-related tasks and can be classified as **general-purpose, specialist** or **tailor-made**.

1.3.8.1 General-purpose packages

A general-purpose application package is a type of software that can perform many different related tasks.

Word processors, spreadsheets, databases, graphics and presentation software are all examples of application packages.

This type of software is sometimes called **generic software**. This means, for example, that any one of the many different word processing packages that you could buy will all do the same general sorts of tasks as each other.

Most computer users buy application packages '**off-the-shelf**'. There are several good reasons for using this type of ready-made software.

- It is relatively cheap;
- It is readily available and can be installed quickly and easily;
- It will have been thoroughly tested so there will be very little chance of it having any serious faults or 'bugs';
- It will be well supported with a lot of books about how to use it available as well as on-line help and discussions on the Internet.

Common types of general purpose software

- **Database packages** (e.g. MS Access, Lotus Approach, Paradox) are used to store and retrieve information;
- **Spreadsheet packages** (e.g. MS Excel, Lotus 123) are used for tasks that involve a lot of calculations or for the production of graphs and charts;
- **Word processing packages** (e.g. MS Word, WordPerfect) are used to produce text based documents such as letters, reports and memos;
- **Desktop publishing (DTP) packages** (e.g. MS Publisher, PageMaker, PagePlus) are used to produce professional quality publications such as posters, books, newsletters, newspapers and magazines;

- **Graphics packages** (e.g. Paint, PaintBrush, Serif Draw, Corel Draw) are used to produce and manipulate artwork;
- **Computer-aided design (CAD) packages** (e.g. 2D-Design, AutoCAD, TurboCAD) are used to produce engineering designs and architectural plans;
- **Communications software** (e.g. Internet Explorer, Netscape Communicator) is used to access the Internet and send and receive e-mail;
- **Presentation graphics packages** (e.g. PowerPoint, Lotus Freelance) are used to create slide shows and presentations like this one which can be viewed on-screen or with a data or overhead projector;
- **Web page editors** (e.g. MS FrontPage, Macromedia Dreamweaver) are used to create Web pages.

1.3.8.2 Integrated packages

- An integrated package combines many different types of application together in one single package.
- This type of software normally offers facilities for word processing, spreadsheets, databases, graphics, presentation and communications.
- Integrated packages are much cheaper than buying many different application packages but their different applications have a limited number of features compared with individual application packages.
- Microsoft WORKS is an example of an integrated package.

1.3.8.3 Specialist application software

- Specialist application software performs a single very specific type of task.
- Programs to work out driving routes are one common example of specialist application software.
- Other examples include programs to work out payroll, calculate accounts, deal with stock control and handle appointments.

1.3.8.4 Tailor-made software

- Sometimes an organization finds that 'off-the-shelf' software will not do exactly what they want.
- In this case they might decide to have special tailor-made, or bespoke software specially developed for the purpose.
- The main drawbacks of this approach are the high cost and long time that some programs take to develop.

1.3.9 Summary

Operating system is a platform between hardware and user which is responsible for the management and coordination of activities and the sharing of the resources of a computer. It hosts the several applications that run on a computer and handles the operations of computer hardware.

1.3.10 Suggested Questions

1. What is an operating system? Explain different function of operating system.
2. What is application software? Explain different types of application software.
3. Write a shorts on the following:
 - a. Characteristics of operating system
 - b. Types of an operating systems
 - c. Functions of an operating System
 - d. General-purpose packages
 - e. Integrated packages

1.3.11 Suggested readings and web resources

Agarwal J. C. (2006). *Essential of educational technology, Teaching and learning*. New Delhi: Vikas Publishing House Pvt. Ltd.

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INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

Structure of the Lesson

1.4.1 Objectives

1.4.2 Introduction

1.4.3 Meaning and definitions of ICT

1.4.4 Characteristics of ICT

1.4.5 importance of ICT

1.4.5.1. A Importance to the people connected with education

1.4.5.2. A Importance in revolutionizing the system education.

1.4.6 Limitation of ICT

1.4.7 Summary

1.4.8 Suggested question

1.4.9 Suggested readings

1.4.1 Objectives

After going through this lesson learners will be able to:

- i. recall the concept of Information Communication Technology.
- ii. know the meaning of Information Communication Technology.
- iii. list the characteristics of Information Communication Technology.
- iv. describe the importance of Information Communication Technology.
- v. List the limitations of information communication Technology.

1.1.2 INTRODUCTION

ICTs stand for information and communication technologies and are defined, for the purposes of this primer, as a “diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information.” These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony.

In recent years there has been a groundswell of interest in how computers and the Internet can best be harnessed to improve the efficiency and effectiveness of education at all levels and in both formal and non-formal settings. But ICTs are more than just these technologies; older technologies such as the telephone, radio and television, although now given less attention, have a longer and richer history as instructional tools. For instance, radio and television have for over forty years been used for open and distance learning, although print remains the cheapest, most accessible and therefore most dominant delivery mechanism in both developed and developing countries. The use of computers and the

Internet is still in its infancy in developing countries, if these are used at all, due to limited infrastructure and the attendant high costs of access.

Moreover, different technologies are typically used in combination rather than as the sole delivery mechanism. For instance, the Indira Gandhi National Open University in India combines the use of print, recorded audio and video, broadcast radio and television, and audio conferencing technologies. In fact, modern ICT have created a “Global Village” as people can communicate to each other as if they were living next door.

1.4.3 MEANING AND DEFINITIONS OF ICT

In past few decades, information and communication technologies have provided with a variety of new communication capabilities. For example people can communicate with others in different countries using technologies such as instant messaging, video-conferencing and other social networking websites like Facebook which allow users from all over the world to remain in contact and communicate regularly.

According to UNESCO, “Information and Communication Technology (ICT) is scientific, technological and engineering disciplines and the management techniques used in information handling and processing, their application, computers and their interaction with man and machines and associated social, economic and cultural matters.”

According to OECD view, “the term ‘Information and Communication Technology’ is used to cover technologies used in the collection, processing and transmission of information. It includes micro- electronic and info- electronic based technologies incorporated in many products and production processes and increasingly affecting the service sector. It covers interalias computers, electronic office equipment, telecommunication, industrial robots and computer controlled machine, electronic components and software products.”

According to Smith and Cambell’s view, “A mosaic of technologies, products and techniques has combined to provide new electronic dimensions to information management. The mosaic is known by the name of Information and Communication Technology.”

From the above mentioned definitions, it is clear that the term Information and Communication Technology deals with information system, creation, data collection, data storage, access, processing, retrieval, analysis, use and dissemination of information accurately and effectively for the purpose of enriching the knowledge and developing intelligent decision- making as well as problem- solving ability of the user.

It is pertinent at this stage that we make efforts to understand the relationship of all the components of information techniques (theory, techniques and technologies) and components of communication technologies theory, techniques and technologies into synergic form, that is, looking at holistic structure with enhanced effect with a reason that:

- It deals with information and knowledge.

- It is related with techniques for creating, collecting, retrieving and classifying information.
- Evolving new technologies to capture and utilize expanding information and knowledge.
- Its focus from educational perspective is content, curriculum and related aspects whereas CT deals with transmission of information and knowledge.
- It is related with techniques of communication, transmission and receiving the same at both verbal and non-verbal level.
- It also deals with one's ideas, emotion, values, skills and attitudes of people. The focus is receiving other's ideas, intentions, and perceptions through variety of messages (at different levels of communication).
- Evolving new technologies of learning, communication, filtering relevant information (intended & unintended) in a context and situation.
- In educational perspective, working out new tools and technologies based on theories of learning, motivation, emotional & mental intelligence, social psychology with reference to one's traditions, cultural values and attitudes. Here teacher's focus is level & type of instructional communication and evolving the learner to assimilate the content in his psychological repertoire.
- It also deals with one's elevation and ignition of higher human consciousness (divinity) through interaction. It may be face-to-face or virtual classroom or online.

In this background, the synthesis or integration of the technologies with regard to information and communication with a view to cover a large population which is geographically dispersed in a country like India will have to be seen and applied for quality education at different levels of education system.

1.4.4 CHARACTERISTICS OF ICT: The characteristics of ICT as follows:

- Student-centric:** In ICT enable classrooms, students play an active role in their learning and teachers serve as mere guides. They are more facilitators of learning than lecturers. They help students think critically and learn by doing and act as a resource while their students discover and master new concepts. Student-centric classroom environments put students' interests first and are focused on each student's needs, abilities and learning styles.
- Computing devices:** Computers, since they are essential tools for 21st century students and replace the utilities of pen and paper. They not only give students the means to conduct online research and master the technology skills they need, but they also give teachers the opportunity to enhance their lessons. The ability to deftly operate a computer is a critical 21st century skill. Computing

devices greatly assist in teaching and learning and make them more engaging and effective.

- iii. **Active learning:** In modern classrooms, students are actively engaged in what they learn. Students participate in more active learning by working in groups or on computers and complete projects and other interesting activities that help them discover new skills. Students can learn actively by talking and listening, writing, reading and reflecting. When students are encouraged to take an active interest in learning, they are more likely to retain the knowledge they've accumulated.
- iv. **Adaptive learning:** ICT fulfills the needs of different types of learning abilities which often makes it difficult for teachers to make sure that all of them understand the concepts. The modern approach of adaptive learning gives students the freedom to learn at their own pace and in the way they are most comfortable with. There are various kinds of software available for adaptive learning that teachers can use to enhance the learning of their students.
- v. **Invitational environment:** ICT helps in breaking the cramped or overcrowded classrooms. Modern classrooms should have the basic material required for teaching such as, interactive whiteboards and LCD projectors. The BYOD (Bring-Your-Own-Device) approach can be adopted, so that students can bring their laptops or tablets to the classroom for better personalized learning. Teaching with technological material is more effective, stimulates student engagement, eases the work of teachers and makes it easy for students to focus on learning.
- vi. **Mutual respect:** ICT makes teachers and students relationship cordial. As now the role of teachers is no longer to be the sage on the stage, students should not forget their value as they will always receive guidance from them. Also, teachers should encourage students to speak with confidence and value their opinions. In a well-disciplined environment, students should also co-operate with and respect their classmates.
- vii. **Students take responsibility of their learning:** ICT encouraged students to take active participation in their own learning; they become responsible for their learning. Self-directed students not only encourage each other, but also work with their teacher to achieve academic and behavioral goals that they themselves have helped establish. Teachers should employ a variety of strategies to promote responsible decision-making and create self-reliant students.
- viii. **Collaborative learning:** Learning through ICT is one of the most effective forms of learning. Teaching and learning in isolation are very restrictive and hinder progress. Learning in groups enhances the scope of learning and develops critical thinking. Collaborative learning activities include

collaborative writing, group projects, joint problem solving, debates and more. Collaborative learning redefines traditional student-teacher relationship in the classroom.

Some other characteristics:

- Motivate the learners
- Provide greater and deeper understanding of the subject matter
- Improve designing skills in developing course materials.
- Develop critical thinking and reasoning in learners through networks.
- Enhance better social interaction through networks which is otherwise not possible in traditional teaching environment.
- Develop self-confidence and reliance through participation and actually performing practically.
- Encourage innovations and research while searching alternatives for quality performance.
- Provide personalized learning.
- Give both interactive learning along with fun or recreation.
- Help under achievers to achieve more without affecting their self-esteem.
- Re-engage disengaged learners
- Develop powers of comprehension, expression, speed decision making and vocabulary.
- Develop qualities like tolerance, risk taking, scientific temper.

1.4.5 IMPORTANCE OF ICT

The information and communication technology in fact have brought revolution in the field of business, postal banking, telecommunication etc. They have fundamentally changed the way we think, the way we communicate and the way we do most of the things in our life. The field of education is no exception. We can summarize the importance of ICT in the field of education in two different ways namely (A) Importance to the people connected with education and (B) Importance in revolutionizing the system of education.

1.4.5.1. A Importance to the people connected with education

1. **Useful for the students.** Students may get required opportunities and training for receiving and using information for their self-improvement. It may help them to satisfy their urges of curiosity, inventiveness, construction etc. They get acquainted with the relevant sources of information, the ways and means of extracting required information and methods of information processing etc. The training received in proper decision making and problem solving ability makes them able to bring necessary changes in their behavior. It also helps them to get self-paced

auto instruction related to the curricular and non-curricular areas of education. The precision, speed and accuracy in receiving, transforming and communication is well acquired through the ICT, as they become acquainted and trained for handling well the sophisticated electronic appliances, software and techniques used for information and communication purpose.

2. **Useful for the teachers.** Teachers get sufficient help from ICT in their task of teaching. Their acquaintance with the relevant source of information in the form of books, journals and other reading- material, audio- visual material, equipment, electronics and telecommunication media make them able to acquire necessary teaching material and techniques. Programmed learning material, self- learning modules, teaching machines and computers may help them much in this direction.
3. **Useful for counselors.** The counselors working in schools and outside the schools in the community can be greatly benefitted through ICT. They can have proper access to have proper access to the various sources of information through information technology. Use of ICT can enable them to communicate and interact well with their clients for providing desired educational, vocational and personal guidance as well as counseling to the students along with their parents.
4. **Useful for the educational administrators and planners.** ICT may help the educational administrators and planners in the task of exercising their professional responsibilities in an appropriate way. On the one hand, it makes them well informed regarding the development in the field of education, educational administration and planning and on the other hand, they can have proper access to the information data regarding the functioning of the institution, working of the teachers, achievements of their students and other personnel.
5. **Useful to the educational researchers.** The students of education desirous to undertake research projects in the field of education are greatly benefitted through the processes and products of ICT. They need quite diversified, pinpointed and reliable information and this need can be properly fulfilled through the organized sources of information controlled through information technology.
In this way, ICT may prove quite useful in helping all the personnel connected directly or indirectly with the processes and products of education.

1.4.5.2. A Importance in revolutionizing the system education. The use of ICT has great potential in revolutionizing the formal and non- formal system of education in a number of ways like below.

1. It can help in a big way to bring the existing educational systems in to alignment with the knowledge based information- rich society by providing the services of sophisticated tools, techniques and methods at its disposal.
2. The use of ICT has great potential in bringing a paradigm shift in the traditional views and methods of teaching- learning and instruction in the manner given below.
 - It can help in the process of transitioning from broadcast model of learning to interactive learning. As a result it can ensure that students are able to work actively in the knowledge getting processes going inside the classroom collaboratively along with their peers.
 - The use of ICT has enabled students to become more self-reliant and self-directed in the acquisition and application of knowledge and skills as needed on their part for coping up the modern era. With the assistance of ICT now students are able to get exposed through large amount of information and opportunities for +collaborating with other in accomplishing complex tasks and effectively communicating knowledge to others.
 - The potential of ICT in shifting emphasis from teaching to learning has helped in creating a more interactive and engaging learning environment for both the learners and teachers and thus make the teaching- learning process as a quite cooperative enterprise and challenging pursuit for the realization of the common goals in an interesting and purposeful way.
 - It can help in bringing a necessary shift in the role of the teacher from a mere knowledge transmitter to that of learning facilitator, knowledge guide, knowledge navigator and an active co- learner along with his students.
3. ICT can properly infused into the entire teacher education programme (both pre-service and in- service) not only to help them using it for their own education and training but learning to use it creatively and constructively for fastening the educational growth of their students and playing the role of an effective teacher as demanded by the ICT ruled modern society

1.4.6 Limitations of ICT

In every process, innovation, technology there are two aspects, that is, advantages and limitations. No doubt ICT related technologies-information and communication has vast potential to boost up or increase the scope of learning and enhance the capacity of a learner but it has some limitations. These limitations are confined to certain factors like resources, infrastructure, man power, trained professional, and other aspects. Some of the limitations in a growing economy of our country are as under:

1. Proper infrastructure is not available in Indian Schools.
2. Resources are quite meager for large school population.
3. Technically trained personnel are not available to handle ICT related teaching and learning.
4. Courseware designers/e-content developers are not available.
5. Power supply especially in rural and remote areas is not available as per the requirement and during school time.
6. Administrators / Heads of educational institutions lack innovations to make ICT effective.
7. Adequate workshops are not available where maintenance of hardware can be done.

1.4.7 Summary

This unit discusses the meaning, characteristics and importance of Information and Communication Technology. ICT is the combination of technological tools and resources to create, disseminate, store and manage data and information and to be applied in education. ICT can be used in educational institutions either as an application or as a subject or it is integrated in the total education system subject to the realization of goals, resources available and situation demands. Along with latest developments in ICT and its effect on education, thinkers, scholars, researchers, teacher educators, practitioners and stakeholders will have to envisage the type of schools and teacher education institutions. Last but not the least, in this process of evolution and process of ICT human touch may not be lost. A human cultured civil society is to be established.

1.4.8 Suggested Questions

1. What do you mean by the term Information and Communication Technology? Explain the concept clearly.
2. Discuss educational importance of Information and Communication Technology.
3. Write a note on characteristics of Information and Communication Technology.
4. What are the limitations of information and communication technology?

1.4.9. Suggested Reading

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Integration of ICT in Teaching and Learning Role and Challenges of ICT

Structure of the Lesson

1.5.1 Objectives

1.5.2 Introduction

1.5.3 Role of Information Technology in Teaching Learning Process

1.5.4 Key Challenges in Integrating ICTs in School Education

1.5.4.1. Implications of ICT-enhanced education for educational policy and planning

1.5.4.2. Infrastructure-related challenges in ICT-enhanced education

1.5.4.3. Challenges with respect to capacity-building

1.5.4.4. Challenges need to be addressed in the areas of language and content

1.5.4.5. Challenges related to financing the cost of ICT use

1.5.5 Summary

1.5.6 Suggested question

1.5.7 Suggested readings

1.5.1 Objectives

After going through this lesson learners will be able to:

- i. Recall the role of Information Communication Technology in teaching learning process.
- ii List the role of Information Communication Technology in teaching learning process.
- iii Describe the Information Communication Technology in teaching learning process.
- iv Know the Challenges in Integrating ICTs in School Education.
- v Explain various Challenges in Integrating ICTs in School Education.

1.5.2 Introduction

ICT has put its effect on every sphere of life. ICT is shrinking the whole world to a desk. All this is happening just due to the large number of advantages of ICT in every field.

ICT is also helping in the field of education. The role of ICT are for each person who is connected to the process of education directly or indirectly.

1.5.3 Role of Information Technology in Teaching Learning Process

- i. **Helps in easy communication:** Using ICT the students can communicate with their teachers, classmates, friends, and other related person in an easy and quick

- way. The quick communication helps the students to learn more quickly and increase the quality of learning.
- ii. **High quality of teaching:** ICT helps the teacher to maintain a high quality of teaching. the teachers can communicate with their students in easy, attractive and effective way using ICT.
 - iii. **Easy retrieval of information:** using different ways of ICT the students can gather the information from all around the world within few seconds. Thus this information helps in learning and students remain in touch with the latest what's going on in education.
 - iv. **Searching the content:** the concepts of online library, e-books, etc. help the students and teachers to search the related material to their syllabus far away from their place of living.
 - v. **Expert guidance:** the teachers and students can avail the guidance of expert person of their field, using ICT and use them in their teaching.
 - vi. **Works as assistant:** ICT works as an teaching assistant to a teachers as well as students. They get the help of hardware and software to make his functions better and better.
 - vii. **Vocational guidance:** getting into right job is one of major problems raised during entrance to job. ICT helps to have proper knowledge of educational opportunities all round the world.
 - viii. **Effective Presentation:** ICT helps to present the information in an effective way. Certain hardwares and softwares help the student and teacher to information in an attractive way.
 - ix. **Better editing of information:** the gathered information using previously mentioned techniques can be easily edited and thus can be given the desired form.
 - x. **Economical:** ICT is an economical way to disseminate information and communicate with other. It saves time, money and energy of the students.
 - xi. **Latest information:** students and as well teachers remain in touch with the latest information regarding their study using ICT techniques and take the benefits of it in their educational activities.
 - xii. **Promote self learning:** ICT helps to develop a habit of self learning by taking them near to the education world and making their activities easier.
 - xiii. **Motivate to the students:** the use of ICT makes the teaching effective and this creates the interest of the students in the study and they get a motivation from their teacher work.
 - xiv. **Minimization of repetitive activities:** there are certain activities which are repeated during teaching and educational process. Using ICT such types of activities can be conducted without repetition. These activities may include quiz, exams, evaluation etc.

- xv. **Quick decision making:** Easy quick and adequate access of information helps the administrator to make his decision quick and effective.
- xvi. **Record Keeping:** There are certain records and information which are needed to be properly recorded. So that it can be easily and quickly retrieved whenever needed. ICT helps them to have proper recording of such information. This information may include confidential information also.
- xvii. **Improvement of system:** it has been seen that the use of ICT is improving the education system and its sub parts. It helps the better communication between different components and better exchange of information among them. Thus improving the functioning of teaching learning process.

1.5.4 Key Challenges in Integrating ICTs in School Education

Although valuable lessons may be learned from best practices around the world, there is no one formula for determining the optimal level of ICT integration in the educational system. Significant challenges that policymakers and planners, educators, education administrators, and other stakeholders need to consider include educational policy and planning, infrastructure, language and content, capacity building, and financing.

1.5.4.1. Implications of ICT-enhanced education for educational policy and planning

Attempts to enhance and reform education through ICTs require clear and specific objectives, guidelines and time-bound targets, the mobilization of required resources, and the political commitment at all levels to see the initiative through. Some essential elements of planning for ICT are listed below.

- A rigorous analysis of the present state of the educational system. ICT-based interventions must take into account current institutional practices and arrangements. Specifically, drivers and barriers to ICT use need to be identified, including those related to curriculum and pedagogy, infrastructure, capacity-building, language and content, and financing.
- The specification of educational goals at different education and training levels as well as the different modalities of use of ICTs that can best employed in pursuit of these goals. This requires of the policymaker an understanding of the potentials of different ICTs when applied in different contexts for different purposes, and an awareness of priority education needs and financial and human resource capacity and constraints within the country or locality, as well as best practices around the world and how these practices can be adapted for specific country requirements.
- The identification of stakeholders and the harmonizing of efforts across different interest groups.
- The piloting of the chosen ICT-based model. Even the best designed models or those that have already been proven to work in other contexts need to be tested on a small scale. Such pilots are essential to identify, and correct, potential glitches in instructional design, implement ability, effectiveness, and the like.

- The specification of existing sources of financing and the development of strategies for generating financial resources to support ICT use over the long term.

1.5.4.2 Infrastructure-related challenges in ICT-enhanced education

A country's educational technology infrastructure sits on top of the national telecommunications and information infrastructure. Before any ICT-based programme is launched, policymakers and planners must carefully consider the following:

- In the first place, are appropriate rooms or buildings available to house the technology? In countries where there are many old school buildings, extensive retrofitting to ensure proper electrical wiring, heating/cooling and ventilation, and safety and security would be needed.
- Another basic requirement is the availability of electricity and telephony. In developing countries large areas are still without a reliable supply of electricity and the nearest telephones are miles away. Experience in some countries in Africa point to wireless technologies (such as VSAT or Very Small Aperture Terminal) as possible levers for leapfrogging.^[74] Although this is currently an extremely costly approach, other developing countries with very poor telecommunications infrastructure should study this option.
- Policymakers should also look at the ubiquity of different types of ICT in the country in general, and in the educational system (at all levels) in particular. For instance, a basic requirement for computer-based or online learning is access to computers in schools, communities, and households, as well as affordable Internet service.

In general, ICT use in education should follow use in society, not lead it. Education programs that use cutting-edge technologies rarely achieve long term success:

It is cheaper, and easier, to introduce a form of technology into education, and keep it working, where education is riding on the back of large-scale developments by governments or the private sector. Television works for education when it follows rather than precedes television for entertainment; computers in schools can be maintained once commercial and private use has expanded to the point where there is an established service industry.

1.5.3 Challenges with respect to capacity-building

Various competencies must be developed throughout the educational system for ICT integration to be successful.

Teachers: Teacher professional development should have five focus: 1) skills with particular applications; 2) integration into existing curricula; 3) curricular changes related to the use of IT (including changes in instructional design); 4) changes in teacher role(5) underpinning educational theories.^[76] Ideally, these should be addressed in pre-service teacher training and built on and enhanced in-service. In some countries, like India, teaching accreditation requirements include training in ICT use. ICTs are swiftly evolving technologies, however, and so even the most ICT fluent

teachers need to continuously upgrade their skills and keep abreast of the latest developments and best practices.

While the first focus—skills with particular applications—is self-evident, the four other focus are of equal, if not ultimately greater, importance. Research on the use of ICTs in different educational settings over the years invariably identify as a barrier to success the inability of teachers to understand why they should use ICTs and how exactly they can use ICTs to help them teach better. Unfortunately, most teacher professional development in ICTs are heavy on “teaching the tools” and light on “using the tools to teach.”

Teacher anxiety over being replaced by technology or losing their authority in the classroom as the learning process becomes more learner-centered—an acknowledged barrier to ICT adoption—can be alleviated only if teachers have a keen understanding and appreciation of their changing role.

Education administrators: Leadership plays a key role in ICT integration in education. Many teacher- or student-initiated ICT projects have been undermined by lack of support from above. For ICT integration programs to be effective and sustainable, administrators themselves must be competent in the use of the technology, and they must have a broad understanding of the technical, curricular, administrative, financial, and social dimensions of ICT use in education.

Technical support specialists: Whether provided by in-school staff or external service providers, or both, technical support specialists are essential to the continued viability of ICT use in a given school. While the technical support requirements of an institution depend ultimately on what and how technology is deployed and used, general competencies that are required would be in the installation, operation, and maintenance of technical equipment (including software), network administration, and network security. Without on-site technical support, much time and money may be lost due to technical breakdowns.

In the India, for example, one of the major obstacles to optimizing computer use in high schools has been the lack of timely technical support. In some extreme cases involving schools in remote areas, disabled computers take months to be repaired since no technician is available in the immediate vicinity.

Content developers: Content development is a critical area that is too often overlooked. The bulk of existing ICT-based educational material is likely to be in English or of little relevance to education in developing countries (especially at the primary and secondary levels). There is a need to develop original educational content (e.g., radio programs, interactive multimedia learning materials on CD-ROM or DVD, Web-based courses, etc.), adapt existing content, and convert print-based content to digital media. These are tasks for which content development specialists such as instructional designers, scriptwriters, audio and video production specialists, programmers, multimedia course authors, and web-developers are needed. Like

technical support specialists, content developers are highly skilled professionals and are not, with the exception of instructional designers, historically employed by primary and secondary schools. Many universities with distance education programs, and those who otherwise make use of ICTs, have dedicated technical support and content development units.

1.5.4.4 Challenges need to be addressed in the areas of language and content

English is the dominant language of the Internet. An estimated 80% of online content is in English. A large proportion of the educational software produced in the world market is in English. In India where English language proficiency is not high, especially outside metropolitan areas, this represents a serious barrier to maximizing the educational benefits of the World Wide Web.

Even in countries where English is a second language (such as India) it is imperative that teaching and learning materials that match national curriculum requirements and have locally meaningful content, preferably in the local languages, be developed. This would ensure that the Web is a genuinely multicultural space and that peoples of different cultures have an equal stake and voice in the global communities of learning and practice online. Particularly vulnerable to exclusion of this sort are isolated, rural populations, cultural minorities, and women in general. Thus attention must be paid to their special needs.

One encouraging trend has been the emergence of national and regional school networks, or School Nets, that facilitate the sharing of content and information—curriculum guides, teaching and learning resources, telecollaborative project registries, school and teacher directories, training curricula and materials, research and policy papers, technology management guides, and start-up toolkits, among others

In Web-based learning, technical standardization of content has also become a pressing issue. Standardization allows different applications to share content and learning systems. Specifications in content, structure, and test formats are proposed so that interoperability may exist between different management systems, resulting in some cost-efficiencies. Standards must be general enough to support all kinds of learning systems and content.

While some schools and universities may already have agreements that expressly authorize the use of certain materials for classroom purposes, these agreements may not be broad enough to accommodate telecommunications transmission, videotape recording, or the distribution of course-related materials beyond the classroom setting.

1.5.4.5 Challenges related to financing the cost of ICT use

One of the greatest challenges in ICT use in education is balancing educational goals with economic realities. ICTs in education programs require large capital investments and developing countries need to be prudent in making decisions about what models of ICT use will be introduced and to be conscious of maintaining economies of scale. Ultimately it is an issue of whether the value added of ICT use offsets the cost,

relative to the cost of alternatives. Put another way, is ICT-based learning the most effective strategy for achieving the desired educational goals, and if so what is the modality and scale of implementation that can be supported given existing financial, human and other resources?

Why suggests the following potential sources of money and resources for ICT use programs:

1. Grants
2. Public subsidies
3. Private donations, fund-raising events
4. In-kind support (e.g., equipment, volunteers)
5. Community support (e.g. rent-free building)
6. Membership fees
7. Revenues earned from core business:
 - Connectivity (phone, fax, Internet, web pages)
 - Direct computer access to users
 - Office services (photocopying, scanning, audiovisual aids)
8. Revenues earned from ancillary activities:
 - Business services (word-processing, spreadsheets, budget preparation, printing, reception services)
 - Educational services (distant education, training courses)
 - Community services (meeting rooms, social events, local information, remittances from migrant workers)
 - Telework and consulting
 - Specialized activities (telemedicine)
 - Sales (stationery, stamps, refreshments, etc.)

Private sector-public sector partnerships to either pilot or fast track ICT-based projects is a strategy that has gained currency among Ministries of Education in developing countries. These partnerships take many forms, including private sector grants with government counterpart contributions, donations of equipment and education-related content by corporations to state-run schools, and the provision of technical assistance for planning, management, and strengthening human resources at the grassroots level. Multilateral organizations and international aid agencies have also driven many of the most significant ICT in education efforts in the developing world.

But the financial litmus test of ICT-based programs is survival after donor money has run out. Many ICT-based education programs funded by aid agencies or by corporations could not be sustained because government failed to step in with the necessary financing; nor were the local communities in a position to generate the resources needed to continue these programs. Therefore, a two-fold strategy is key: government support and local community mobilization

1.5.5. Summary

If there is one truism that has emerged in the relatively brief history of ICT use in education, it is this: It is not the technology but how you use it! Put another way: “How you use technology is more important than if you use it at all. Unless our thinking about schooling changes along with the continuing expansion of ICTs in the classroom then our technology investment will fail to live up to its potential.”

Technology then should not drive education; rather, educational goals and needs, and careful economics, must drive technology use. Only in this way can educational institutions in developing countries effectively and equitably address the key needs of the population, to help the population as a whole respond to new challenges and opportunities created by an increasingly global economy. ICTs, therefore, cannot by themselves resolve educational problems in the developing world, as such problems are rooted in well entrenched issues of poverty, social inequality, and uneven development. ICTs as educational tools can do, if they are used prudently, is enable developing countries to expand access to and raise the quality of education. Prudence requires careful consideration of the interacting issues that underpin ICT use in the school—policy and politics, infrastructure development, human capacity, language and content, culture, equity, cost, and not least, curriculum and pedagogy.

1.5.6 Suggested Questions

1. Explain the role of information communication technology in teaching learning process.
2. Discuss key challenges in integrated ICTs in school education.
3. How ICT enhanced the School Education?

1.2.7 Suggested Reading and Web Resources

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