



**DR. BABASAHEB AMBEDKAR  
OPEN UNIVERSITY**

# BCA

## BACHELOR OF COMPUTER APPLICATION



**BCAR- 101**

**Fundamentals of Computers & Information Technology**

# **FUNDAMENTALS OF COMPUTER AND INFORMATION TECHNOLOGY**



**DR. BABASAHEB AMBEDKAR OPEN UNIVERSITY  
AHMEDABAD**

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## **ROLE OF SELF-INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING**

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material is completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self-instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual-skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behaviour should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminate interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is

particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self-Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self-instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

## **PREFACE**

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included many tables and examples for easy understanding.

We sincerely hope this book will help you in every way you expect.

All the best for your studies from our team!

# FUNDAMENTALS OF COMPUTER AND INFORMATION TECHNOLOGY

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BCAR-101/  
DCAR-101

# **Fundamentals of Computer and Information Technology**

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## **BLOCK 1 : COMPUTER FUNDAMENTALS**

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UNIT 1 INTRODUCTION TO COMPUTER SYSTEM

UNIT 2 COMPUTER ORGANIZATION AND DATA PROCESSING

UNIT 3 THE NUMBER SYSTEMS

UNIT 4 BINARY ARITHMETICS

# **COMPUTER FUNDAMENTALS**

## **Block Introduction :**

In this current 21<sup>st</sup> century, the working style and personal lifestyle of a human being has been drastically changed due to the applications of computers. Now-a-days, computers are used everywhere – at offices, homes, schools, colleges, hotels, shops and what not. This revolutionary change in a lifestyle has made our life easy and comfortable. For instance, we can perform number of activities using computer based systems – we type a draft on word processor and mail it to others, we do several simple and complex calculations using electronic spreadsheet and also draw graphs based on the data in the spreadsheet accordingly, create database of known people like friends or our own customers with name, phone number, address and e-mail ID etc. It is difficult to perform these activities using existing traditional systems (manual system).

The computer also can be used for other variety of tasks such as word processing, designing (graphics), web site development, database management etc. Therefore, the computer should be referred as a data processor. Data might be of any type like numeric, alphanumeric, alphabetic, voice and graphics so on.

## **Block Objectives :**

The objective of the block is to aware students, about the basics of the computer system. This block will give a brief idea of how 'Computers' comes into existence, what was the idea and thought to build computer system. We will also discuss history of the computer.

Main objective of this block is to aware students, about different types of computer, concept of hardware and software, what different types of hardware's are used in the computer system and what types of software's are available. Students will learn, how process the data and provides information.

Finally, the block will clear the concept of different types of programming languages, different types of software and all fundamentals that you should know before learning any subject of computer science.

## **Block Structure :**

**Unit 1 : Introduction to Computer System**

**Unit 2 : Computer Organization and Data Processing**

**Unit 3 : The Number Systems**

**Unit 4 : Binary Arithmetics**

**UNIT STRUCTURE**

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## **1.0 Learning Objectives :**

In this unit, we will discuss about the basics of computer system.

**After working through this unit, you should be able to :**

- History of computers
- Today's computer, Data and Information.
- Generation of Computers.
- Types of computers and software's.

## **1.1 Introduction :**

The term Computer is derived from the term compute. Compute means doing calculation. Originally, the computer is developed to perform faster calculations like Additions, Subtractions, Multiplications, Divisions and so on. But today we can carry out lot of activities like preparing letter or resume, making presentations, watching movies, listening music, doing chat with our friend who is miles away, sending mails and lot more. In this chapter we will try to focus on the entire process of how the computer system is build and enhanced to fulfil the requirements of 21st Century.

## **1.2 Evolution of Computer Technology :**

The origin of computer technology took place in 19th century. People in those days desired to have a machine that would perform mathematical calculations. ABACUS is considered as the first computer in the world. It was used to perform simple measurements and calculations.

In later period, the scientist named as Pascal developed a machine that could perform mathematical calculations. This machine had number of gears. The movement of gear mechanism used to perform some calculations. He named machine as PASCALINE.

However, the concept of a modern computer was put forward by the scientist and mathematician named Charles Babbage. He first wrote how to use logic and loops in a process execution. Based on the concept of logic and loops, Babbage developed two models for performing computations – Analytical Engine and Difference engine. In those days, electronics was not developed. Therefore, these models proposed by Babbage were having existence only on paper.

However, the ideas given by Babbage were implemented after invention of electronics.

George Boolean developed famous Boolean algebra based on binary numbers. De Morgan put forward theorems on logic gates. These theorems are known as De Morgan 's Theorems.

**Lady Ada is the first computer programmer.**

The real applications of computers began in the late fifties(50s). The computers were used in United States for various applications such as census, defence, R&D universities etc.

### **☐ Check Your Progress – 1 :**

1. \_\_\_\_\_ is considered as the first computer of the world.  
[A] Pascaline      [B] Abacus      [C] Tablet      [D] None of these

2. Scientist \_\_\_\_\_ has developed first machine which can perform calculations based changing of different gears.  
[A] George Bole [B] Charles Babbage  
[C] Pascal [D] Lady Ada
3. Charles Babbage has developed \_\_\_\_\_.  
[A] Analytical Engine [B] Difference engine  
[C] Both [A] and [B] [D] None of the above
4. \_\_\_\_\_ is the first computer programmer.  
[A] George Bole [B] Charles Babbage  
[C] Pascal [D] Lady Ada

### **1.3 What is Computer ?**

As we have discussed that the original aim to develop computer was to develop a machine which can perform faster arithmetic calculation such as Addition, Subtraction, Multiplication and Division. Today we can perform lot of activities like chat with friend, playing games, watching movies or live streaming match, listening music, sending mails, sharing photos with friends, attending online lectures, seminars or conferences in which there is no computation is involved. So, we can define our todays computer as a – data processor.

#### **1.3.1 Data :**

Data means unstructured raw material and unstructured facts which will provide necessary input to the computer system. For example, Attendance of one student on particular day is data. Details of product sold to one customer on a particular date is a data. Data is unstructured format and cannot provide sufficient knowledge on the basis of that one can take the decision.

#### **1.3.2 Computer or System :**

Computer is an electronic machine which can perform arithmetic and logical operations at very fast speed. It can store the data, process the data and gives fruitful information to the user. In short, a computer system is a data processor which takes data from the user, process it and provides useful information to its user. For example, a food processor takes mango pieces, water, milk, sugar etc. ingredients, process the ingredients well and provide us mango juice, we actually want. Similarly, a system takes data (raw material) from the user, process it by following rules and provide information.

#### **1.3.3 Information :**

Processed data is called information. Information is a structure format of data, which helps us in decision making. Attendance of all students of entire semester in the form of percentage is information. Total month wise sale of particular product of entire year is information.

#### **☐ Check Your Progress – 2 :**

1. \_\_\_\_\_ is an unstructured raw–material and unstructured facts which provides necessary information to the computer system.  
[A] Data [B] System  
[C] Information [D] None of the above

2. \_\_\_\_\_ is a processed data.  
[A] Data [B] System  
[C] Information [D] None of the above
3. \_\_\_\_\_ is also known as data processor, which takes data as an input and produce information.  
[A] Computer [B] Data [C] Information [D] All of the above

#### **1.4 Generations of Computers :**

Generation term is usually characterising the major developments in the world of computers. There is no clear-cut boundary between two generations of the computers. We use the term generation to distinguish between different hardware technologies used in the computer system.

##### **1.4.1 First Generation – Computers :**

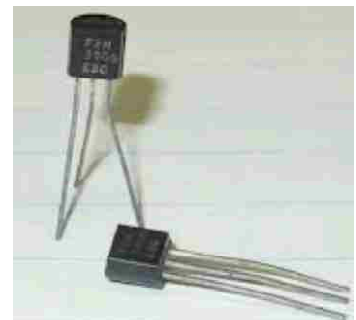
The first electronic computer ENIAC (Electronic Numerical Integrator and Calculator) is developed by Eckert and Mauchly in 1946 in the USA. High-speed vacuum tubes are used as a switching device in it. ENIAC contained more than 20,000 vacuum tubes in it. It weighed more than 30 short tons and consumes 150 kW of energy. It was occupying a room size of space. It could perform 5,000 simple additions or subtractions types of operations or 385 multiplication operations per second. The total cost was about \$487,000, equivalent to \$7,195,000 in 2019. ENIAC could be programmed to perform complex sequences of operations, including loops, branches, and subroutines. However, instead of the stored-program computers that exist today, ENIAC was just a large collection of arithmetic machines, which originally had programs set up into the machine.

##### **1.4.2 Second Generation – Computers :**

First generation computer was based on vacuum tube technology. Because of vacuum tube it was not reliable, consume more energy, took more space and more costly.

In the second generation of the computers in 1959 transistors were used instead of vacuum tubes. Transistors made of germanium semiconductor material and compare to vacuum tubes they were highly reliable. Transistor made switching operations 10 times faster than vacuum tubes. Transistors were smaller in size (one tenth of first generation's vacuum tubes), consumes less electrical consumptions (about one tenth of first generation computers) and was 10 times cheaper than first generation computers.

Magnetic core memories were also developed during this era. Due to the highly reliable larger size of magnetic disk storage development of high-level languages such as FORTRAN (FORmula TRANslation), COBOL (Common Business Oriented Language) are developed during this era.

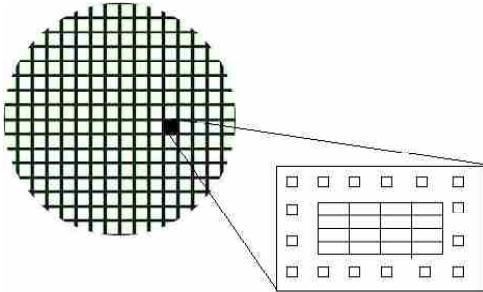


**[Fig : Transistors]**

##### **1.4.3 Third Generation – Computers :**

In the Second Generation, transistor has replaced vacuum tubes of First-Generation computers. This change in technology has increased speed, reduced cost and price, and made computers more reliable than that of First-Generation computers. Third generation computers started in 1965 with germanium transistors

being replaced by silicon transistors. Silicon transistors are much smaller in a size and can be placed on small, thin silicon wafer called integrated circuits (IC). IC has been used in the third-generation computer, which is a thin silicon wafer consisting of several electronic components like capacitors, transistors, resistors etc. along with their interconnections. Because of ICs, third-generation computers became much smaller in size, less costly, faster and more reliable.



**[Fig : Wafer and Chip]**



**[Fig : Integrated Circuits (ICs)]**

#### **1.4.4 Fourth Generation – Computers :**

In the fourth-generation (1971–1985) computers emerged with the Large-Scale Integrated Circuits (LSIc) and Very Large-Scale Integrated Circuits (VLSIc) which contains more than 50,000 transistors in a single chip. During fourth-generation microprocessors has been invented, size of the Disk memory is also increased and Floppy disks and Floppy drives are invented. Computers in fourth-generation became more reliable, faster and cheaper. The term Personal Computer (PC) emerge during fourth-generation because of its affordable price and greater speed.

#### **❑ Check Your Progress – 3 :**

1. First-generation computer was based on \_\_\_\_\_ technology.  
[A] Transistors [B] ICs  
[C] Vacuum Tubes [D] All of the above
2. \_\_\_\_\_ technology was used in the second-generation computers.  
[A] SSIc [B] Transistors [C] VLSIc [D] Vacuum Tubes
3. In third-generation computers, \_\_\_\_\_ technology was used.  
[A] Integrated Circuits [B] Transistors  
[C] Vacuum Tubes [D] None of the above
4. Transistors are made from \_\_\_\_\_ material(s).  
[A] Germanium [B] Silicon  
[C] Both [A] and [B] [D] Metals
5. Germanium and Silicon are \_\_\_\_\_ type of material.  
[A] Good conductor [B] Insulator  
[C] Semi-conductor [D] None of the above

#### **1.5 Classification of Computers :**

According to the size and functioning, computers can be classified into following categories :

- Micro Computers
- Mini Computers

- Mainframe Computers
- Super Computers

### **1.5.1 Micro Computers :**

In late 1970, microcomputers were originated. The first microcomputers were built with 8-bit microprocessor chip. Intel 8080, MOS 6502 and MC 6809 are examples of microcomputers. A microcomputer is based on a microprocessor chip called CPU (Central Processing Unit). The microcomputer consists of a microprocessor, semiconductor memories like RAM (Random Access Memory) and ROM (Read Only Memory) to process the data. In early 1980s 16-bits CPU chips (called Intel 8086 and Intel 8088) were introduced by Intel corporation. 8088 has 8/16-bit chip with 8 bits path to move the data between primary memory (chip) and secondary storage and processor can internally process 16 bits of data. 8086 was 16/16-bit chip with 16-bits of external data movement path between primary and secondary memories and 16-bit of processing capabilities.

Intel 80286 has been introduced with 16/32-bit chip and it can support up to 16MB of primary storage. Recent computers have 64-bits microprocessor chip. General purpose computers which, we are using for our day to day lives, for example PCs and Laptops are examples of microcomputers.

### **1.5.2 Mini Computers :**

A minicomputer is a small general-purpose computer. Minicomputer is more powerful in terms of processing speed than microcomputer. Minicomputer is a small but expensive machine with limited Input/Output support. Minicomputers are mainly design to support multitasking, where multiple users can work simultaneously with the system.

### **1.5.3 Mainframe Computers :**

More powerful computers than minicomputer is generally known as mainframes. The mainframe computers have word length of 32 bits or even more. It can support more than 100 simultaneous users with the time-sharing system. It supports varieties of programming languages. Mainframes are costly computers and larger in size compare to minicomputer and microcomputers. Popular mainframe series computers are : MEDHA, Superry, ICL, DEC etc.

### **1.5.4 Super Computers :**

Super computers are most powerful machine. Super computers are very large in size and having very high processing speed. Generally, it is used for complex scientific computation. Super computers are very costly and price range of super computers ranging from 4 Million to 17 Million of US \$. CRAY XMP, ETA, IBM 3090, NEC and HITACHI S-Series computers are examples of it. Supercomputers can perform more than 25,000 million arithmetic operations per second. India has also developed its own supercomputer named PARAM.

#### **❑ Check Your Progress – 4 :**

1. \_\_\_\_\_ is a Super Computer of India.  
[A] MEDHA [B] DEC [C] SIERRA [D] PARAM
2. Our PCs or Laptops comes under \_\_\_\_\_ computer category.  
[A] Micro [B] Mini [C] Mainframe [D] Super
3. Intel 80286 is \_\_\_\_\_ bits computer.  
[A] 8/8 [B] 8/16 [C] 16/16 [D] 16/32



## **1.6 Types of Computer :**

A computer is an electronic device, operating under the control of instructions stored in the own memory, that can accept data (input), process the data according to specified rules, produces information (output), and store the information for future use. Computer contains many electronic and mechanical components known as hardware.

Electronic components in computers process data using instructions, which are the steps that tell the computer how to perform particular task.

A collection of related instructions organized for a common purpose is referred to as software or a program.

One popular category of computer is the personal computer. A personal computer (PC) is a computer that can perform all of its input, processing, output and storage activities by itself.

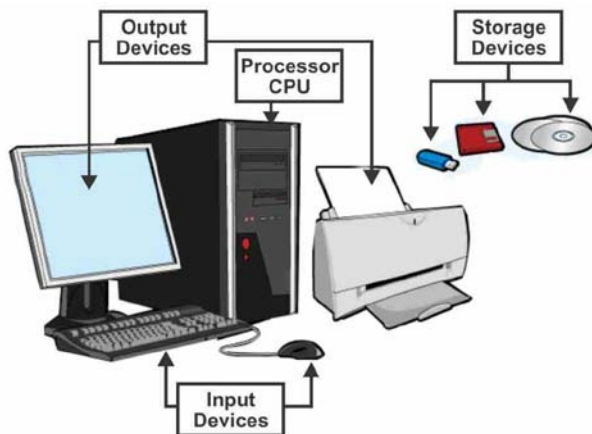
Types of personal computers includes laptop, tablets and desktops. Laptop and tables are sometimes called mobile computers. A mobile computer is a portable personal computer, designed so that a user can carry it from place to place.

### **1.6.1 Desktops and All-In-One Computer :**

A desktop, or desktop computer, is a personal computer designed to be in a stationary location, where all of its components fit on or under a desk or table.

On many desktops, the screen is housed in a display device (Monitor) that is separate from a tower (Cabinet), which is a case that contains the processing circuitry.

Another type of desktop called an all-in-one does not contain a tower and instead uses the same case to house the display and the processing circuitry.



**[Fig : Desktop Computer]**



**[Fig : All-in-One Computer]**

### **1.6.2 Laptop Computer :**

A laptop, is called a notebook computer, is a thin, lightweight mobile computer with a screen in its lid and a keyboard in its base. It is designed to fit on our lap and easy transport, most laptops weight up to 7 pounds (3.1 Kg). It is less than one inch thick. Most laptops can operate on batteries or a power supply or both. Latest Laptop computers comes with built-in speakers, a web-camera and touchpad as a pointing device. Because of Laptop computers has built-in Wi-Fi circuitry, it can connect to wireless network.

### **1.6.3 Tablets :**

Tablets are usually smaller than a laptop but larger than a mobile phone device. A tablet is a thin, lightweight mobile computer that has a touch screen. A popular style of tablet is the slate, which does not contain a physical keyboard. Like laptops, tablets run on batteries or power supply or both. Latest tablets are equipped with Bluetooth, and Wi-Fi connectivity. It has virtual keyboard for text input. Some tablets provide calling features like smart phones, Messaging etc. They are called Phablet, a combination of Phone and Tablets.

### **1.6.4 E-Book Reader :**

An e-book reader or e-reader, is a mobile device that is used primarily for reading e-books. An e-book or digital book, is an electronic version of a printed book, readable on computers and other digital devices.

In addition to books, we can purchase and read other forms of digital media such as newspapers and magazines. Most e-book reader models have a touch screen, and some are Internet capable.

### **1.6.5 Servers :**

A server is a computer dedicated to providing one or more services to other computers or devices on a network. A network is a collection of computers and devices connected together, often wirelessly.

Services provided by servers include storing content and controlling access to hardware, software, and other resources on a network.

A server can support from two to several thousand connected computers and devices at the same time. Servers are available in a variety of sizes and types for both small and large business applications.

### **1.6.6 Wearable Devices :**

A wearable device or wearable is a small, mobile computing consumer device designed to be wore. These devices often communicate with a mobile device or computer. Wearable devices include activity tracker, smartwatches, and smart glasses. Activity tracker monitors heart rate, measure pulse, count steps, and track sleep patterns.

In addition to keeping time, a smartwatch can communicate with smart phone to make and answer phone calls, read and send messages, access the web, play music, work with apps, such as fitness tracker and GPS, and more.

With smart glasses, a user looks into eyeglass-type device to view information or take photos and videos that are projected to a miniature screen in the user's field of vision.

**❑ Check Your Progress – 5 :**

- \_\_\_\_\_ is a light weight portable computer.  
[A] Desktop [B] Laptop [C] All-in-one [D] All or the above
- Laptop computers are also known as \_\_\_\_\_.  
[A] Desktop [B] Tablet [C] Notebook [D] All-in-one
- A powerful machine, provides services to other devices are called \_\_\_\_\_.  
[A] Clients [B] Servers [C] PCs [D] Laptops

**1.7 Let Us Sum Up :**

In this chapter we have seen What is Computer ? And How the different technologies have been contributed to the development of our modern computers. We have discussed generations of the computers, and technology dominating to each generation. We have seen that the originally computer is developed for calculation but today it is being used for data processing purpose. We have also discussed the difference between data and information. We have also seen the classification of computer like Micro-Computers, Mini-Computers, Mainframes and Super-Computer. Finally, we have ended our discussion on different types of computers like Desktops, Laptops, Tablets, E-Book reader, Servers and Wearable computing devices.

**1.8 Glossary :**

- PC** : Personal Computer
- GPS** : Global Positioning System
- Wi-Fi** : Wireless Fidelity
- VLSIc** : Very Large-Scale Integration Circuits
- SSIc** : Small-Scale Integration Circuits

**1.9 Suggested Answers For Check Your Progress**

**❑ Check Your Progress 1 :**

1. [A]          2. [C]          3. [C]          4. [D]

**❑ Check Your Progress 2 :**

1. [A]          2. [C]          3. [A]

**❑ Check Your Progress 3 :**

1. [C]          2. [B]          3. [A]          4. [C]          5. [C]

**❑ Check Your Progress 4 :**

1. [D]          2. [A]          3. [A]

**❑ Check Your Progress 5 :**

1. [B]          2. [C]          3. [B]

**1.10 Assignment :**

- List the advantages of the computers.
- List all disadvantages of the computers.

**1.11 Activity :**

1. Make a list of 10 super computers and note–down important features of it.

**1.12 Case Study :**

Collect at–least 15 features of the smart phone you are using and note down all those features.

**1.13 Further Reading :**

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.

**UNIT STRUCTURE**

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  - 2.2.1 Input
  - 2.2.2 System
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- 2.5 Applications of Computer
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- 2.10 Glossary
- 2.11 Assignment
- 2.12 Activity
- 2.13 Further Readings

**2.0 Learning Objectives :**

In this unit, we will discuss about the basics of computer organization and Data processing :

**After working through this unit, you should be able to :**

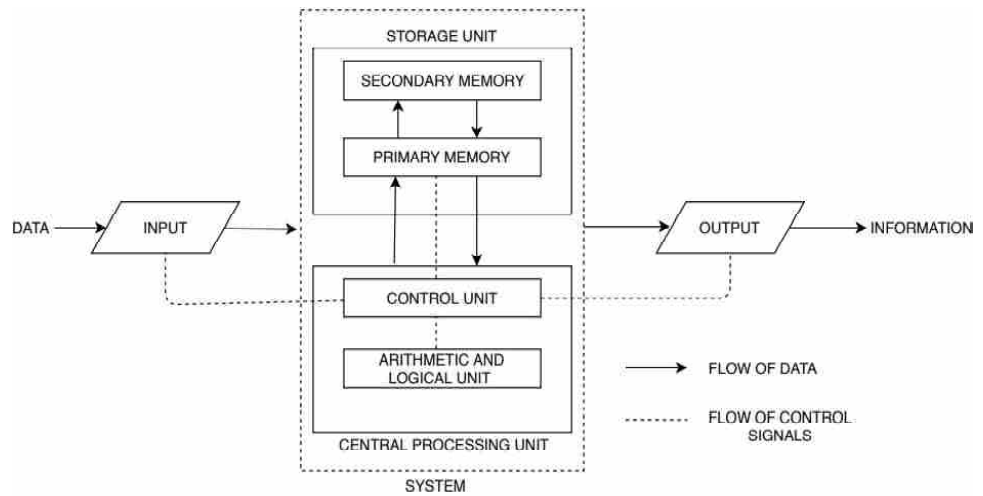
- Understand Block–diagram of computer.
- Know, advantages and disadvantages of computer system
- Understand programming languages and its features
- Know computer data processing

**2.1 Introduction :**

Computer is an electronics machine, which is made by various electronic and mechanical components. In this unit we will focus on various components used in computer, their attributes, uses etc. We will also see the advantages and disadvantages of computer and area of its applications. We will see types of software's and data processing.

## 2.2 Block-Diagram of Computer :

As we have discussed that the computer is a data processor which takes data from the user, using input devices. It processes the data using Central Processing Unit (CPU) and Memories and produces information. User can get the information produces by a System using various output devices.



### 2.2.1 Input :

To input the data to the computer system, user might have to use input devices. These input devices can be a Keyboard or Mouse. With the help of these input devices user can entered the data to the computer system for processing purpose.

### 2.2.2 System :

The computer system will accept the data from the user using input devices like Keyboard, Mouse etc. and stored it into the memory. Computer system consists of [1] Storage Unit and [2] Central Processing Unit.

#### [1] Storage Unit :

Storage Unit consists of memory of the computer system. Which is used to store data entered by the user. After processing of data, system will produce information. This information will also be stored in the storage unit. Storage unit mainly divided into two type : [1] Primary Memory and [2] Secondary Memory.

Computer system has a memory called Random Access Memory (RAM), which provides temporary storage to the computer system. This memory is volatile memory, that mease it is not be able to store the data and information permanently. RAM needs continuous power supply and if we switch off the system, content within this memory will be erased. Therefore, RAM provides temporary storage to store data, information and intermediate results for CPU.

Secondary memory is a permanent memory (non-volatile). It can store the data and information permanently even if we switch off the machine or discontinue the power supply. Generally, computer system has a Hard-disk drive, which is a secondary storage of the computer system. Data and Information stored in the Hard-disk drive will be permeant and can be retrieve back even after we restart the machine. Because of secondary memory is much slower than of primary memory, CPU always use primary memory to process the data. CPU do not interact with the Primary Memories directly. The data stored on the secondary memory will be loaded in to the primary memory first and then CPU will process it.

**[2] Central Processing Unit :**

Central Processing Unit is responsible to process the data and convert it to information with the help of storage unit. The CPU consists of the 3 units : [1] Memory Unit [2] Control Unit and [3] Arithmetic and Logical Unit.

Central Processing Unit of the computer system have a memory unit. Which consists of several registers. Registers are very high-speed memory among all memories resided in the chip of the CPU itself. It is a very costly memory and available in very small size (Bytes). Registers are made from the special circuitry called Flip-Flops.

Central processing unit also have a control unit, which is basically used to control all hardware peripherals such and Input / Output devices, Storage unit and ALU (Arithmetic and Logical Unit which is another unit of the CPU). In the Block-diagram controls lines are represented by a dotted line, which means Control Unit of the CPU controls the various hardware using special control lines available in the computer system.

Central Processing Unit also consists of Arithmetic and Logical Unit (ALU), which is responsible to execute all the instructions. ALU made of various small circuitries which executes all instruction written by a programmer into a computer program. For example, when programmer has written instruction 'a+b' at that time Control Unit of the system will decode the instruction and send a control signal to the circuitry called 'Adder' available in the ALU. Once the signal from CU is received by 'Adder', it executes the instruction and produces result of the instruction 'a+b'. During this moment other circuitry of the ALU will be in inactive state.

**2.2.3 Output :**

After processing the data which is entered by the user, by the CPU, information will be obtained. Information will be stored initially in the Primary Memory. Based on the user request information can be stored in the secondary memory for future use. User can retain this information using output devices such as monitor or printer.

**□ Check Your Progress – 1 :**

1. \_\_\_\_\_ is a volatile memory.  
[A] RAM [B] Hard-disk  
[C] Flash memory [D] All of the above
2. CPU consists of \_\_\_\_\_.  
[A] Memory unit [B] Arithmetic and Logical Unit  
[C] Control unit [D] All of the above
3. \_\_\_\_\_ is an output device.  
[A] Mouse [B] Keyboard [C] Printer [D] Scanner

**2.3 Advantages and Limitations of Computer :**

Compared to traditional systems, computers offer lots of significant features. That's why the traditional systems are being replaced speedily by computer-based systems.

In traditional system human performs the task of writing data in the registers or books and used to perform calculations or making a report apart from

## **Fundamentals of Computer and Information Technology**

this preserving the data in hard copies, files and folders with all human errors. This used to take lot of space to store. Many times, records get destroyed due to natural calamity and theft. The main advantages offered by the computers are as follows :

1. Computer provides access to more information using Internet
2. Computers can complete tasks that might be impossible for humans to complete
3. Computer saves lots of time of human
4. Computer automates lots of repetitive tasks
5. It also allows for greater productivity
6. Computers can be used for better communication and connections
7. It can also be used for entertainment
8. Computer provides large storage, can able to store huge amount of data.

The limitations of the computer system are as follows :

1. Excessive use of computer can result in several medical problems. For example, more use of computer put more strain on eyes.
2. Computer has to be protected from malwares and viruses. If proper precaution is not taken then viruses can destroy data and important files from the computer. Hacker can access your data, without your knowledge if the system is not protected properly.
3. Computers are expensive and you need to pay for proper hardware and software.

### **2.4 Characteristics of Computer :**

- **Automatic :** A machine is said to be automatic, if it works by itself without human intervention.
- **Speed :** A computer is a very fast device. It can perform in a few seconds, the amount of work than a human being can do in an entire year. While talking about the speed of the computer, we do not talk in terms of seconds or even milliseconds ( $10^{-3}$ ). Our units of speed are the microseconds ( $10^{-6}$ ), the nanoseconds ( $10^{-9}$ ), and even the picoseconds ( $10^{-12}$ ).
- **Accuracy :** In addition to being very fast, computers are very accurate. The accuracy of a computer is consistently high, and the degree of accuracy of a particular computer depends upon its design.
- **Diligence :** Unlike human beings, a computer is free from monotony, tiredness and lack of concentration. It can continuously work for hours, without creating any errors.
- **Versatility :** Versatility is one of the most wonderful things about the computer. One moment, it is preparing the result of an examination, the next moment; it is busy preparing electricity bills.
- **Power of Remembering :** A computer can store and recall any amount of information because of its secondary storage capability. Every piece of information can be retained as long as desired by the user, and can be recalled, as when required.
- **No I.Q. :** A Computer is not magical device. It possesses no intelligence of its own. Its I.Q. is zero at least until today.



- **No Feelings** : Computers are devoid of emotions. They have no feelings and instincts because they are machine.

❑ **Check Your Progress – 2 :**

1. Identify the attribute of the computer, which explains that computer can never tired or boarded to do repetitive tasks.  
[A] Versatility [B] Diligence [C] Accuracy [D] No I.Q.
2. Identify the attribute of the computer, which explains that computer can easily switched from one task to another task.  
[A] Versatility [B] Diligence [C] Accuracy [D] No I.Q.
3. Identify the limitation of the computer system from given below :  
[A] Accuracy [B] Versatility  
[C] High cost [D] Better communication

**2.5 Applications of Computer :**

Today's age is described as computer age. The computer-based applications are being widely used in almost all fields. Some of the fields are mentioned below where computers are invariably used.

1. Health care and Insurance sectors
2. Research and Development
3. Defence and Security sectors
4. Air lines and aviation sector
5. Education – schools, colleges, universities
6. Media and Film sector
7. Government – population, taxes, Police, defence
8. Medicine – Manufacturing of medicines, surgery
9. Agriculture– composition of fertilizers.
10. Industry – Design, shipping, process control
11. Home – communication, business work at home, schoolwork, entertainment, Finances
12. Business – Decision Support, Business information systems.

**2.6 Programming Lanaguages :**

To communicate with the Computer, we need programming languages. It is specifically design to give instructions to the Computer system to perform I/O operations, computations and logical operations that control behavior of the system. Programming languages consist of syntax (refers to grammatical rules) and semantics (refers to the meaning of the vocabularies) which provides meaningful instruction to the system. Programming languages provide platform to developer to write the program, which expressed in the algorithm which can be executed on system. Depends on the enhancement and advances done in the programming language it can be classified by following generations.

1. Machine language
2. Assembly language

3. High-level language (3<sup>rd</sup> generation languages)
4. Very high-level languages (4<sup>th</sup> generation languages)

### 2.6.1 Machine Language :

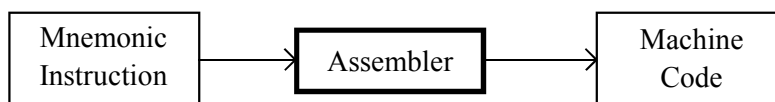
Machine language is a language, which machine can understand directly. To understand the instruction written in this language, machine do not need any kind of translator.

As we know machine is an electronic device and made by number of electronic components which can be in 2 states (charged means 1 or discharged means 0). So, it is a language of only two symbols 1 and 0. This language is also known as binary language. Here the program has number of instructions, and each instruction has unique binary pattern string. Because of each instruction directly written in machine language, translation is not needed. So, it is faster language than all other languages as they don't need translation. It is also known as Low-level language.

It is difficult for the programmer to memorize all instructions of the system in the form of binary strings. Hence, it is difficult to learn machine language. Another drawback of the machine language is, it is machine dependent language. So, program written for one machine cannot be executed on another machine having different architecture.

### 2.6.2 Assembly Language :

Rather writing instruction into the string of binary as in machine language, Assembly language use mnemonic symbols such as to add two number instruction 'ADD' is used. Similarly, 'MOV', 'SUB', 'MUL' kind of mnemonic instruction (instead of Binary) make this programming language easier and more readable, than machine language. Here programmer will write the program using mnemonic codes. After writing the program all instructions will translated into machine language using assembler.



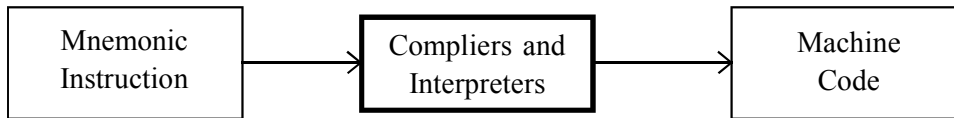
Assembler is a simple translator, which takes one assembly instruction and convert it into one corresponding machine code(instruction). So, it not reducing the length of the program. Furthermore, assembly programs are also machine dependent (as Machine language).

#### ❑ Check Your Progress – 3 :

1. \_\_\_\_\_ is a machine language.  
[A] Binary [B] Assembly  
[C] C-Language [D] None of the Above
2. Machine language is also known as \_\_\_\_\_ language.  
[A] High-Level [B] 4<sup>th</sup> Generation  
[C] Assembly [D] Low-Level
3. \_\_\_\_\_ language use mnemonic code for instructions rather than strings of Binary patterns.  
[A] Machine [B] Assembly [C] High-Level [D] All of the above

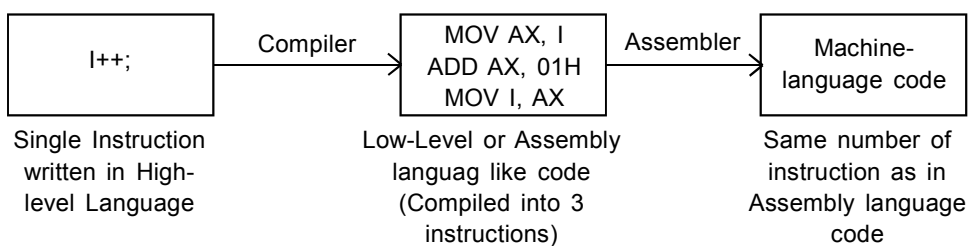
### 2.6.3 High-Level Languages :

Procedural and Object-Oriented languages are high-level languages. C, C++, Java, Visual Basic .NET, C#.NET are High-level languages. Basically, it is easier for the programmer to write the program in the high-level languages. High-level programs are more readable compare to assembly language code. To translate the instruction written in the high-level languages, compilers and interpreters are used. Compilers and Interpreters translates the High-level instruction to the machine understandable code, before the execution starts.



Compare to the assembler, compilers are doing its work in more efficient way. Compilers can take a single high-level instruction and can convert it into one or more instructions in the low-level language. So, compiler reduces number of instructions that programmer needs to write. Hence compiler makes high-level programs more compact. High-level languages are portable and platform independent. So, program written for a computer can be executed in other machines even they have different architecture or operating systems.

In the following figure we have tried to show how one line of high-level code is compiled and translated into 3 lines. In the C-language we have instruction 'I++', which will increment the value of variable 'I' by one. Now variables are declared in the random-access memory, and do not allow to change the value of any variable stored in RAM. It allows only two operations read and write. When programmer writes 'I++' instruction in the C-language, compilers generates 3 line of codes as shown in the figure. Computer will read the value of variable 'I' from the RAM and copy it to some register AX. The 1 will be added to the register AX. Finally, the incremented value of the AX register will be written back to RAM (i.e. variable I will be overwritten by incremented value). Thus, compiler save efforts of the higher-level language programmer, as well as allow programmers to do programming even if they do not have prior knowledge of the computer hardware or architecture.



It is clear that High-level languages reduces programming efforts by reducing number of lines, more readable and platform independent but it takes much time to translate it into machine code and these languages are slower compare to the Machine language and Assembly language.

### 2.6.4 4<sup>th</sup> Generation Language :

4<sup>th</sup> Generation languages like SQL (Structured Query Language) is much simpler and easy to understand. It uses syntax nearer to English like language. For example, to fetch the name of the Employees from the Emp table having salary more than 25000, we can write "SELECT NAME FROM EMP WHERE SALARY > 25000". To perform the same task into the procedural (3rd GL) requires number of instructions like declaration of number of variables, running of the loop for each record, if condition to verify salary > 25000 and so on.

❑ **Check Your Progress – 4 :**

1. Procedural languages are known as \_\_\_\_\_ language.  
 [A] Low-Level [B] High-Level  
 [C] Machine [D] None of the above
2. SQL stands for \_\_\_\_\_.  
 [A] Systematic Query Language [B] System Quantified Language  
 [C] Structured Query Language [D] System Quality Language
3. SQL is \_\_\_\_\_ Language.  
 [A] 4<sup>th</sup> GL [B] Procedural [C] Object oriented [D] Binary

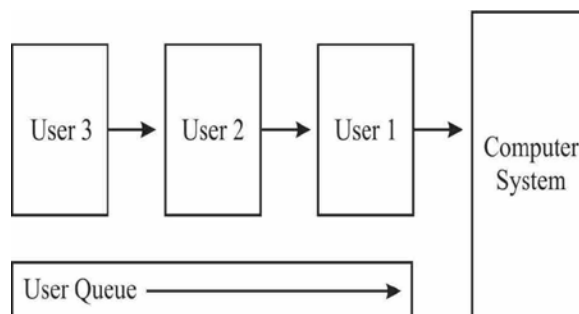
**2.7 Computer Data Processing :**

As we have learnt earlier that computer is a machine which takes data as input, process and gives out put in a user required form. Now we will learn about data processing. Computer data processing referred to the tasks like sort, search, merge, copy, transfer, collate, compare, store, create, enter, perform, compare, display and compute etc. are carried out time to time as per the requirement of the users of the computer. All these tasks are carried out by using different technologies.

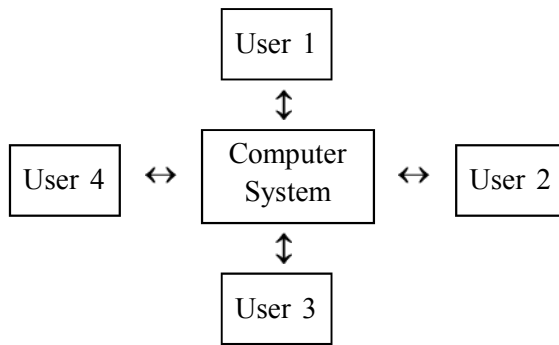
There are mainly three types of data processing technologies available such as :

1. Batch Processing (Off-Line)
2. Time Sharing (Simple On-Line)
3. Real time (quick response, On-Line)

1. **Batch Processing and Time Sharing :** The computer works on basis of either batch processing or time sharing. **Batch Processing :** In batch processing, the computer acts as a standalone unit. As such, it is available for a single user. Therefore, number of tasks can be done one after the other. In a small business unit, only one computer doing the entire task collecting batch wise data accordingly.



2. **Time sharing :** Unlike batch processing, the time sharing offers simultaneous usage of computer. The computer is provided with multiple terminals from which the system can be accessed simultaneously by number of users. User has time slot to process their tasks one after the other.



3. **Real time** : This method of processing done without delay because there are various processors in the main machine available which take the request of the users from various corners and allocate the processor to process the task immediately without delay. Hence processing done quickly. Examples like Radar System in Defence organization, online railway booking, airline booking and online examination and result declaration system etc.

❑ **Check Your Progress – 4 :**

1. Online railway reservation system is a kind of \_\_\_\_\_ processing.  
 [A] Batch [B] Time-sharing  
 [C] Real-time [D] None of the above
2. Multi-user system is a good example of \_\_\_\_\_ processing.  
 [A] Batch [B] Time-sharing  
 [C] Real-time [D] None of the above
3. In \_\_\_\_\_ processing number of tasks are given to computer system to process it as a single unit.  
 [A] Batch [B] Time-sharing  
 [C] Real-time [D] None of the above.
4. \_\_\_\_\_ processing is interactive data processing system.  
 [A] Batch [B] Time-sharing  
 [C] Real-time [D] None of the above.

**2.8 Let Us Sum Up :**

**In this unit, we have :**

- Discussed Block-diagram of computer system
- Elaborated Advantages and Limitations of computer system
- Described characteristics of computer system
- Talked about different types of programming languages
- Discussed about various data processing techniques

**2.9 Suggested Answers For Check Your Progress :**

❑ **Check Your Progress 1 :**

1. [A]                      2. [D]                      3. [C]

❑ **Check Your Progress 2 :**

1. [B]                      2. [A]                      3. [C]

❑ **Check Your Progress 3 :**

1. [A]                      2. [D]                      3. [B]

❑ **Check Your Progress 4 :**

1. [B]                      2. [C]                      3. [A]

❑ **Check Your Progress 5 :**

1. [C]                      2. [B]                      3. [A]                      4. [B]

**2.10 Glossary :**

**ALU :** Arithmetic and Logical Unit. It is a part of CPU which is responsible to execute all the instructions of a program.

**CU :** Control Unit. It is a part of CPU which decode the instructions and instruct to the various hardware to perform.

**RAM :** Random Access Memory. It is a main memory of computer system. It is made from semi-conductor material. Therefore, it is also known as primary memory of the system. It is volatile memory that means content stored within RAM will be erased when we turn off the machine.

**2.11 Assignment :**

1. Draw and Explain Block-diagram of the computer system.
2. List and explain data processing techniques in brief.
3. List and explain different types of programming language in details.

**2.12 Activity :**

We know that the computer system uses RAM as a main memory and store its data into this memory. RAM is a semi-conductor memory and can store only binary data, which uses only two symbols those are '0' and '1'. Explain how the characters (alphabets) are stored in the RAM ?

**2.13 Further Reading :**

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.

**UNIT STRUCTURE**

- 3.0 Learning Objectives
- 3.1 Introduction
- 3.2 Decimal number system
- 3.3 Binary number system
  - 3.3.1 Conversion between Binary and Decimal
- 3.4 Octal number system
  - 3.4.1 Conversion between Octal and Decimal
  - 3.4.2 conversion between Octal and Binary
- 3.5 Hexa-Decimal number system
  - 3.5.1 Conversion between Hexa-Decimal and Decimal
  - 3.5.2 Conversion between Hexa-Decimal and Octal
  - 3.5.3 Conversion between Hexa-Decimal and Binary
- 3.6 Let Us Sum Up
- 3.7 Suggested Answers for Check Your Progress
- 3.8 Glossary
- 3.9 Assignment
- 3.10 Activity
- 3.11 Case Study
- 3.12 Further Readings

**3.0 Learning Objectives :**

After working through this unit, you should be able to :

- Understand different number systems
- How data will be represented in the computer memory
- List different types of Number Systems
- Convert a number from one number system to another

**3.1 Introduction :**

As we have discussed that the computer is an electronic device, which made by using Integrated Circuits (ICs). ICs itself made by millions of small electronic components like capacitors, transistors etc. These devices can be in charge or discharge state. That means they can store only 1 or 0.

That is the reason we have written that the machine can understand only Machine or Binary language. It is a language of two symbols those are 1 and 0.

We have also discussed that the data given by the user as an input will be placed on main memory of the system called Random Access Memory (RAM). RAM is also made by semi-conductor material. Which means whatever data or

information we are storing in the main memory will be stored in the form of Binary. In this chapter we will discuss how can compute binary, not only that apart from binary how many different number systems are available.

**3.2 Decimal Number System :**

There are four number systems are available :

1. Binary Number System
2. Octal Number System
3. Decimal Number System
4. Hexa-Decimal Number System

In our day to day life we use the decimal number system. Decimal number system uses 10 different symbols to represent the number, those symbols are {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}. Because of there are 10 different symbols are used in the decimal number system, the base of decimal number system is 10. Number 5,123 means  $5 * 10^3 + 1 * 10^2 + 2 * 10^1 + 3 * 10^0 = 5 * 1000 + 1 * 100 + 2 * 10 + 3 * 1 = 5,000 + 100 + 20 + 3 = 5,123$ .

**3.3 Binary Number System :**

Binary is the number system, which use only two symbols to represent the number, those are {0, 1}. Therefore, the base of the Binary number system is 2. Consider the following table. In the table, we have given Binary of first 20 decimal numbers.

Decimal	Binary	Decimal	Binary
0	0	11	1011
1	1	12	1100
2	10	13	1101
3	11	14	1110
4	100	15	1111
5	101	16	10000
6	110	17	10001
7	111	18	10010
8	1000	19	10011
9	1001	20	10100
10	1010		

**3.3.1 Conversion between Decimal and Binary :**

To convert any Decimal number into Binary, you need to divide that number by 2 (as the base of Binary number system is 2). After division you have to record quotient and remainder. Again, the quotient part you need to divide by 2 and you need to record further quotient and remainder. This process has to be continued till the number does not becomes 0. Once the number turns to 0, you need to write all remainders in the reverse order and you will get the binary of that number. See the example below in which we shown how to find a binary of decimal number 175).



Therefore, the binary of the decimal number 175 is 1010 1111, which can be written as :

$$(175)_{10} = (1010\ 1111)_2$$

In the previous example we have seen that how can we convert the decimal number into its equivalent binary. We have seen that the binary of decimal number 175 is 1010 1111. Now the question is can we convert the binary to its equivalent decimal ? Let if we have binary '1010 1111', then can we obtain decimal 175 from it ? The answer is 'YES'. See the example given below in which we have explained how a binary number can be converted into its equivalent decimal.

2	175	Remainders
2	87	1
2	43	1
2	21	1
2	10	1
2	5	0
2	2	1
2	1	0
	0	1

1	0	1	0	1	1	1	1
$2^7 = 128$	$2^6 = 64$	$2^5 = 32$	$2^4 = 16$	$2^3 = 8$	$2^2 = 4$	$2^1 = 2$	$2^0 = 1$
128	0	32	0	8	4	2	1

To obtain decimal number from the binary number, each binary digit will be multiplied by  $2^0, 2^1, 2^2, \dots, 2^{n-1}$  from right to left (Where n = total binary digits count). That means each binary digit will be multiplied by 1, 2, 4, 8, 16... as so on. Finally, we need to add all numbers ( $128 + 0 + 32 + 0 + 8 + 4 + 2 + 1$ ) and we will get its equivalent decimal number that is 175.

**Check Your Progress – 1 :**

- $(395)_{10} = (\text{_____})_2$   
 [A] 10011011    [B] 110100011    [C] 110001011    [D] 110110010
- $(434)_{10} = (\text{_____})_2$   
 [A] 10011011    [B] 110100011    [C] 110001011    [D] 110110010
- $(10011011)_2 = (\text{_____})_{10}$   
 [A] 155            [B] 419            [C] 395            [D] 434
- $(110100011)_2 = (\text{_____})_{10}$   
 [A] 155            [B] 419            [C] 395            [D] 434

**3.4 Octal Number System :**

Octal number system uses 8 symbols to represent any number, those are {0, 1, 2, 3, 4, 5, 6, 7}. Therefore, the base of octal number system is 8. In octal number system we are not using symbols 8 and 9. For example, 129 is not a valid octal number as it has one digit 9. The following table represents Decimal, Octal and Binary numbers from 0 to 21.

Decimal	Octal	Binary	Decimal	Octal	Binary
0	0	0	11	13	1011
1	1	1	12	14	1100
2	2	10	13	15	1101
3	3	11	14	16	1110
4	4	100	15	17	1111
5	5	101	16	20	10000
6	6	110	17	21	10001
7	7	111	18	22	10010
8	10	1000	19	23	10011
9	11	1001	20	24	10100
10	12	1010	21	25	10101

**3.4.1 Conversion between Octal and Decimal :**

To convert any given decimal number into its equivalent octal number, you need to divide that number by 8 till the number does not become 0. Each time you have to note down the remainder. Finally, write down all remainder into reverse order. For example, if we want to convert octal of decimal number 175 then,

8	175	Remainders
8	21	7
8	2	5
8	0	2

↑

Therefore, the octal of the decimal number 175 is 257, which can be written as :

$$(175)_{10} = (257)_8$$

The octal of the decimal number 319 is 477, which can be written as :

8	39	7
8	4	7
	0	4

↑

$$(319)_{10} = (477)_8$$

To convert any octal number to decimal number, we need to multiply each digit of an octal by  $(8^0, 8^1, 8^2, \dots, 8^{n-1})$  from right to left (where n is a count of number of digits in an octal number). That means, each digit of an octal number has to be multiplied by (1, 8, 64 ... and so on) from right to left. Finally, we need to sum all multiples to obtain its equivalent decimal.

For Example, if we want to compute decimal of octal number 257, then

<b>2</b>	<b>5</b>	<b>7</b>
$8^2 = 64$	$8^1 = 8$	$8^0 = 1$
<b>128</b>	<b>40</b>	<b>7</b>

$2 * 84 = 128, 5 * 8 = 40$  and  $7 * 1 = 7$ . Sum of  $128 + 40 + 7 = 175$ . That means  $(257)_8 = (175)_{10}$ .

Similarly, octal number 477 can be converted into its equivalent decimal as follows :

4	7	7
$8^2 = 64$	$8^1 = 8$	$8^0 = 1$
256	56	7

$$\begin{aligned}
 (477)_8 &= (4 * 8^2 + 7 * 8^1 + 7 * 8^0)_{10} \\
 &= (4 * 64 + 7 * 8 + 7 * 1)_{10} \\
 &= (256 + 56 + 7)_{10} \\
 &= (319)_{10}
 \end{aligned}$$

□ **Check Your Progress – 2 :**

1.  $(395)_{10} = (\text{_____})_8$   
 [A] 316            [B] 266            [C] 613            [D] 662
2.  $(434)_{10} = (\text{_____})_8$   
 [A] 316            [B] 266            [C] 613            [D] 662
3.  $(763)_8 = (\text{_____})_{10}$   
 [A] 489            [B] 499            [C] 419            [D] 434
4.  $(643)_8 = (\text{_____})_{10}$   
 [A] 419            [B] 499            [C] 395            [D] 434

**3.4.2 Conversion between Octal and Binary :**

One obvious method to convert any octal number into the binary is : [1] Convert the given octal number into decimal and, [2] Convert that decimal number into binary. For Example :  $(257)_8$  will be converted first into  $(175)_{10}$  and then  $(175)_{10}$  will be converted into  $(1010 1111)_2$ .

But is there any easier method is there ? Obviously, yes. To convert any octal number into binary, or to convert any binary number to octal memorise 3–bits binary of all octal symbols. Now one question will come in your mind that why 3–bits binary of all octal symbols ? The answer is, in octal number system, we have 8 different symbols, and in binary we have 2 symbols. To represent 8 different octal symbols, we need 3–bits (as  $2^3 = 8$ ).

Octal	Binary	Octal	Binary
0	000	4	100
1	001	5	101
2	010	6	110
3	011	7	111

To convert any octal number directly into the binary you need to write 3–bits of binary for each of its octal digit :

For Example, if we want to convert  $(257)_8$  into the binary then :

Binary of 2 = 010, Binary of 5 = 101 and Binary of 7 = 111. Mixed up all binaries and remove all zeros from the left hand–side.

$(257)_8 = (\underline{010} \underline{101} \underline{111}) = 010101111 = (10101111)_2$  [Remove all zeros from the left side].

Similarly, to convert any binary number to octal you need make pair of 3–bits. If total number of bits are not in multiple of 3 then you can append 1 to 2 zeros at the left side. Now write single digit octal code for each 3–bits binary from the table given above.

For Example, to convert  $(10011011)_2$  into octal, we need to make pair of 3–bits from right to left that is : 10 011 011. Now to complete 3–bits binary of 10 append one zero to left side. So, after adding one zero to the left side we have : 010 011 011.

Now from the table we can see that 010 is a binary of : 2, 011 is a binary of : 3 and 011 is a binary of : 3. Therefore,  $(10011011)_2 = (233)_8$ .

**□ Check Your Progress – 3 :**

1.  $(613)_8 = (\text{—————})_2$   
[A] 110001011 [B] 011001101 [C] 110001110 [D] 111000101
2.  $(5371)_8 = (\text{—————})_2$   
[A] 101011111001 [B] 110011111001  
[C] 101110111011 [D] 001111011101
3.  $(101011111001)_2 = (\text{—————})_8$   
[A] 5471 [B] 5371 [C] 5741 [D] 5714
4.  $(11001101110)_2 = (\text{—————})_8$   
[A] 3516 [B] 1356 [C] 6334 [D] 3156

**3.5 Hexa–Decimal Number System :**

Hexa–decimal number system uses 16 different symbols, those are {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F}. Refer the following table in which we have given Decimal, Hexa–decimal, Octal and Binary from 1 to 32.

D	H	O	B	D	H	O	B	D	H	O	B
0	0	0	0	11	B	13	1011	22	16	26	10110
1	1	1	1	12	C	14	1100	23	17	27	10111
2	2	2	10	13	D	15	1101	24	18	30	11000
3	3	3	11	14	E	16	1110	25	19	31	11001
4	4	4	100	15	F	17	1111	26	1A	32	11010
5	5	5	101	16	10	20	10000	27	1B	33	11011
6	6	6	110	17	11	21	10001	28	1C	34	11100
7	7	7	111	18	12	22	10010	29	1D	35	11101
8	8	10	1000	19	13	23	10011	30	1E	36	11110
9	9	11	1001	20	14	24	10100	31	1F	37	11111
10	A	12	1010	21	15	25	10101	32	20	40	100000

In the above table D represent Decimal number, H represents Hexa–Decimal number, O represents Octal number and B represents Binary number.

3.5.1 Conversion between Hexa-Decimal and Decimal :

To convert any number from decimal to hexa-decimal, you need to divide that number by 16 (as the base of the hexa-decimal number system is 16) and you have to record remainder till that number turns to 0. Once the number becomes 0, you need to write all remainders in reverse order. Make sure if the remainder is 10 then you need to write 'A', if it is 11 then you need to write 'B' and in that way if remainder is 15 then you need to write 'F'.

For example, if you want to convert decimal 242 into hexa-decimal then,

The hexa-decimal of given decimal 242 is F2. That can be written as :

$$(242)_{10} = (F2)_{16}$$

16	242	Remainders	
16	15	2	2
	0	15	F

The hexa-decimal of given decimal 986 is 3DA. That can be written as :

$$(986)_{10} = (3DA)_{16}$$

16	986	Remainders	
16	61	10	A
16	3	13	D
	0	3	3

If you want to convert any hexa-decimal number into decimal then you need to multiply each digit of hexa-decimal with  $16^0, 16^1, 16^2 \dots 16^{n-1}$ , where n is the total number of digits of hexa-decimal number from right to left. That means the last digit will be multiplied with 1, second last digit will be multiplied with 16, third last digit will be multiplied with 256 and so on. If you have hexa-decimal digit 'A' then you have considered it as 10, 'B' then consider it as 11, and so on. The last hexa-decimal digit 'F' means 15.

Consider the following 2 examples :

$$\begin{aligned}
 [1] \quad (F2)_{16} &= (F * 16^1 + 2 * 16^0)_{10} \\
 &= (F * 16 + 2 * 1)_{10} \\
 &= (15 * 16 + 2 * 1)_{10} \\
 &= (240 + 2)_{10} \\
 &= (242)_{10}
 \end{aligned}$$

$$\begin{aligned}
 [2] \quad (3DA)_{16} &= (3 * 256 + A * 16 + A * 1)_{10} \\
 &= (3 * 256 + 13 * 16 + 10 * 1)_{10} \\
 &= (768 + 208 + 10)_{10} \\
 &= (986)_{10}
 \end{aligned}$$

□ Check Your Progress – 4 :

1.  $(1F9)_{16} = (\underline{\hspace{2cm}})_{10}$
2.  $(FF)_{16} = (\underline{\hspace{2cm}})_{10}$
3.  $(777)_{10} = (\underline{\hspace{2cm}})_{16}$
4.  $(495)_{10} = (\underline{\hspace{2cm}})_{16}$

### 3.5.2 Conversion between Hexa-decimal and Octal :

As we know that in the base of the hexa-decimal number system is 16. To represent 16 symbols, we need 4-Bits (as  $2^4=16$ ). Refer the following table to convert given decimal number into hexa-decimal number.

Hexa-Decimal	Binary		Hexa-Decimal	Binary
0	0000		8	1000
1	0001		9	1001
2	0010		A	1010
3	0011		B	1011
4	0100		C	1100
5	0101		D	1101
6	0110		E	1110
7	0111		F	1111

So, if you want to convert hexa-decimal 3AD into binary then,

3	A	D	3AD
0011	1010	1101	1110101101

[Remove all zeros from the left side of the obtained binary number]

Similarly, if you want to convert any binary number into hexa-decimal number then we need to make pair of 4-Bits from the right to left. If the left most pair doesn't have 4-Bits, then add 0s at the left side to complete pair of 4. Now, put equivalent hexa-decimal digit from the table given above to make your hexa-decimal number.

For example, if we want to compute  $(1010101111)_2$  into hexa-decimal then we will make pair of 4-Bits from right side.

10 1010 1111

Now to complete the pair of 4-Bits at the left most pair add two 0s to it at left side.

0010 1010 1111 Now, put equivalent hexa-decimal digit from the table. From the table we can see that  $0010 = 2$ ,  $1010 = A$  and  $1111 = F$ .

Therefore, the hexa-decimal number of the binary number  $(1010101111)_2$  is  $(2AF)_{16}$ .

#### □ Check Your Progress – 5 :

- $(1F9)_{16} = (\text{————})_2$
- $(FF)_{16} = (\text{————})_2$
- $(10110110101)_2 = (\text{————})_{16}$
- $(110101111001)_2 = (\text{————})_{16}$

### 3.5.3 Conversion between Hexa-decimal and Binary :

To convert Hexa-decimal number into octal, first you convert the given hexa-decimal number into binary. Once you get the binary then you convert the binary number into octal. We have already discussed how can we convert a hexa-decimal number into binary as well as how to convert a binary number into octal in the previous sections :

Consider the following examples :

[1]  $(1F9)_{16} = (\text{—————})_8$   
 $(1F9)_{16} = (0001\ 1111\ 1001)_2$   
 $= (000\ 111\ 111\ 001)_2$   
 $= (771)_8$  [Write octal for each pair and discard first 0]

[2]  $(5F)_{16} = (\text{—————})_8$   
 $(5F)_{16} = (0101\ 1111)_2$   
 $= (01\ 011\ 111)_2$   
 $= (001\ 011\ 111)_2$   
[Add one 0 to left side to complete pair of 3–Bits]  
 $= (1\ 3\ 7)_8$  [Write octal for each pair of 3–bits]

Similarly, if you want to convert any octal number into hexa–decimal number then first write 3–bits of binary for each octal digit, to convert given octal number into binary. Once you get the binary, make group of 4–Bits from right to left. Write hexa–decimal for each group of 4–bits and you will get hexa–decimal number.

For Example :  $(137)_8 = (001\ 011\ 111)_2 = (0\ 0101\ 1111)_2 = (5F)_{16}$ .

**❑ Check Your Progress – 6 :**

1.  $(1D9)_{16} = (\text{—————})_8$
2.  $(F3A)_{16} = (\text{—————})_8$
3.  $(613)_8 = (\text{—————})_{16}$
4.  $(5371)_8 = (\text{—————})_{16}$

**3.6 Let Us Sum Up :**

**In this unit, we :**

- Understand Decimal, Binary, Octal and Hexa–Decimal number systems.
- Have learn how to convert Decimal number to Binary and Binary number to Decimal.
- Have learn how to convert Octal numbers to Decimal and Decimal to Octal.
- Studied how to convert Octal numbers to Binary and Binary numbers to Octal
- Discussed how to convert Hexa–Decimals to Decimals and Decimal to Hexa–Decimal numbers.
- Learn how to convert Hexa–Decimal numbers to Binary and Binary numbers to Hexa–Decimal numbers.
- Studied how to convert Hexa–Decimal numbers into Octal and Octal numbers into Hexa–Decimal numbers.

**3.7 Suggested Answers For Check Your Progress :**

**❑ Check Your Progress 1 :**

1. [C]                      2. [D]                      3. [A]                      4. [B]

**❑ Check Your Progress 2 :**

1. [C]                      2. [D]                      3. [B]                      4. [A]

❑ **Check Your Progress 3 :**

1. [A]                      2. [A]                      3. [B]                      4. [D]

❑ **Check Your Progress 4 :**

1. 505                      2. 255                      3. 309                      4. 1EF

❑ **Check Your Progress 5 :**

1. 1 1111 1001      2. 1111 1111      3. 5B5                      4. D79

❑ **Check Your Progress 6 :**

1. 731                      2. 7472                      3. 18B                      4. AF9

**3.8 Glossary :**

**Decimal :** It is a number system with 10 symbols, those are : {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}

**Binary :** It is a number system with 2 symbols, those are {0, 1}. All electronics devices are store data and information using binary number system.

**Octal :** It is a number system with 8 symbols, those are : {0, 1, 2, 3, 4, 5, 6, 7}

**Hexa-Decimal :** It is a number system with 16 symbols, those are : {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F}

**3.9 Assignment :**

1. What is Decimal number system ? Explain it with an example.
2. What is Binary number system ? How can we convert a decimal number to Binary ?
3. What is Hexa-Decimal number system ? List all symbols used in it.

**3.10 Activity :**

1.  $(5723)_{10} = (\text{————})_2 = (\text{————})_8 = (\text{————})_{16}$
2.  $(101111010)_2 = (\text{————})_{10} = (\text{————})_8 = (\text{————})_{16}$
3.  $(3725)_8 = (\text{————})_2 = (\text{————})_{10} = (\text{————})_{16}$
4.  $(A65D)_{16} = (\text{————})_2 = (\text{————})_8 = (\text{————})_{10}$

**3.11 Case Study :**

Find, how can we convert a decimal number with floating points into Binary. Convert  $(443.125)_{10}$  into its equivalent binary number.

**3.12 Further Reading :**

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.



**UNIT STRUCTURE**

- 4.0 Learning Objectives
- 4.1 Introduction
- 4.2 Representation of Data
  - 4.2.1 Binary Coded Decimals [BCDs]
- 4.3 Representation of Alphabets
- 4.4 Representation of Numeric Data
  - 4.4.1 Representation of Integer Numbers
  - 4.4.2 Complements
- 4.5 Addition of Binary Numbers
- 4.6 Subtraction of Binary Numbers
  - 4.6.1 Subtraction Using 1's Complement Method
  - 4.6.2 Subtraction Using 2's Complement Method
- 4.7 Let Us Sum Up
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- 4.9 Glossary
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- 4.11 Activities
- 4.12 Case Studies
- 4.13 Further Readings

**4.0 Learning Objectives :**

After working through this unit, you should be able to :

- Understand Binary Coded Decimal (BCD) System.
- Know, representation of alphabets and numbers into the memory.
- Understand how negative numbers are represented in the memory.
- Get the knowledge about how computer system adds or subtracts binary numbers.

**4.1 Introduction :**

In our previous unit, we have seen that the machine can understand only machine language, which is often known as binary language. We have discussed how can we convert a decimal number into binary and any binary number into decimal. We have seen binary, octal decimal and hexa–decimal number systems. In this unit we will start with another type of binary representation, which is called binary coded decimal (BCD).

We will also discuss how the alphabets strings and numbers will be stored in the computer memory.

We will discuss how computer process the binary numbers and how two binary numbers are added or subtracted. Finally, we will see how computer can detect or correct the error in the binary format of data.

## 4.2 Representation of Data :

In the previous unit we have seen different number systems. In this unit we will focus on how data will be stored in the computer memory. From the discussion made in the previous unit, you know that the data are stored in the memory in the form of binary digits called bits. In this unit we will try to find out answer of how computer perform arithmetic operations such as addition or subtraction on these bits. Along with this we will also see how alphabets or strings will be stored inside the computer memory.

### 4.2.1 Binary Coded Decimals (BCD) :

The binary number system is a natural language for computers because they are made from two state electronic devices like transistors. Unfortunately, we humans do not use binary number system. We are using decimal number system for our day to day tasks. Then how computer system performs arithmetic ? One obvious answer to this question is computer takes decimal from user, converts them into binary, process it and at the time of output it again converts binary into decimal.

But is there any other method is there ? Obviously Yes. There exists another alternative method of performing computation in the form of decimals but it requires that the decimal number has to be coded in the form of binary, so that computer can perform arithmetic operations on it. This method of representing each decimal digit in binary form is called Binary Coded Decimal (BCD).

In our decimal system, a number is made from digits (symbol). In decimal number system we use 10 symbols to represent a digit. If we use 4-bits (binary) then we have total  $2^4=16$  different combinations, which are enough to represent our 10 symbols. For that reason, in BCD system we represent each decimal digit of a number using a pair of 4-bits of binary. For example, a number 125.29 can be represented as : 0001 0010 0101. 0010 1001. Consider the following table in which we have given decimal, binary and BCD codes.

Decimal	Binary	BCD	Decimal	Binary	BCD
0	0	0000	8	1000	1000
1	1	0001	9	1001	1001
2	10	0010	10	1010	0001 0000
3	11	0011	11	1011	0001 0001
4	100	0100	12	1100	0001 0010
5	101	0101	13	1101	0001 0011
6	110	0110	14	1110	0001 0100
7	111	0111	15	1111	0001 0101

BCD takes more memory as you can see in the table. 15 is represented with the help of 4-bits in binary but takes 8-bits of memory in the BCD system. But because of its ease implementation and faster processing it is mostly used in computers.

❑ **Check Your Progress – 1 :**

- BCD stands for \_\_\_\_\_.  
 [A] Bits Coded Decimals            [B] Binary Coded Decimals  
 [C] Binary Computation Decimals   [D] Binary Code of Data
- How many bits are required to represent a digit in BCD system ?  
 [A] 1 bit            [B] 2 bits            [C] 4 bits            [D] 8 bits
- $(19)_{10}$  can be written as \_\_\_\_\_ in BCD system.  
 [A] 10011            [B] 0001 1011            [C] 10001            [D] 0001 1001

**4.3 Representation of Alphabets :**

We can represent any decimal number using binary or BCD. We can computer binary of any number or any digit of a number by dividing it by 2. We are dividing number or digit by 2 and collect the remainder. We are doing this process till the number or digit do not turns to 0. Finally, we write the remainders in reverse order to get the binary.

But what happed to alphabets ? Can we divide alphabet 'A' by 2 ? Obviously, the answer is No. Then how can we find a binary of alphabet ?

It is true that we can find binary or BCDs only of numbers, not the alphabets. Due to that reason, each symbol (alphabets, digits and special symbols like @, #, \$ etc.) available on the keyboard has its own unique number. This set where each symbol of keyboard represents a unique number is called ASCII (American Standard Code for Information Interchange). This code use 7-bits to represent 128 characters. Now an extended ASCII is using 8-bits representation for alphabets on Micro-computers.

If you store 'a' then computer is storing 97 (a binary of 97) in the memory. 97 is the ASCII value for character 'a'. Similarly, the ASCII value of 'b' is 98 and so on. The ASCII value for 'A' is 65, 'B' is 66 and that way the ASCII value of 'Z' is 90. Similar to the alphabets, we can represent colours, musical notes etc. can easily store in the computer memory.

❑ **Check Your Progress – 2 :**

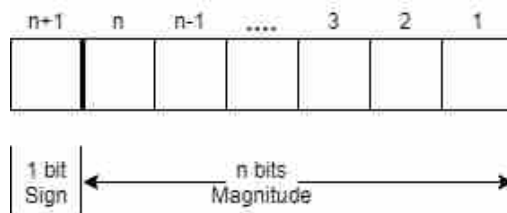
- ASCII stands for \_\_\_\_\_.  
 [A] American Standard Code for Information Interchange  
 [B] American Scientific Code for Information Interchange  
 [C] American Scientific Code for Interchanging Information  
 [C] American Standard Code for Interchanging Information.
- How many bits are used in extended ASCII to represent a symbol.  
 [A] 1 bit            [B] 2 bits            [C] 7 bits            [D] 8-bits
- What is the ASCII value of 'A' ?  
 [A] 65            [B] 97            [C] 60            [D] 90

**4.4 Representation of Numeric Data :**

Till now we have discussed different types of number system, BCD representation and how alphabets are represented in the computer memory. Now we will discuss how the numbers are actually stored in the memory so that computer system can perform arithmetic and scientific operations on it.

#### 4.4.1 Representation of Integer Numbers :

To store n-bits numbers computer uses n + 1 bit of memory space. The actual number of n-bits is called Magnitude. One extra bit is used to represent sign (whether the number is positive or negative). This bit is known as a sign bit or a number. One sign bit is sufficient because a number can be positive (sign bit is 0) or negative (sign bit is 1). Representation of an integer number is shown in the figure given below :



Before going into the details that, how computer performs arithmetic operations such as addition and subtraction, let us discuss the term called 'Complements'. Complements can be used to represent negative numbers in our digital computers.

#### 4.4.2 Complements :

For any number system of base 'k', there are two types of complements are there called k's complement and (k - 1)'s complement. For example, for the decimal system (base = 10) we have 10's complement and (10 - 1)'s = 9's complement. Let us discuss how can we find 9's and 10's complement for given number.

##### 9's complement :

To find the 9's complement of a given number we need to subtract each digit of a number from 9 (the highest digit value). For example, if we want to find a 9's complement of decimal number 382 then :

$$\begin{array}{r}
 \text{9's complement of 382 :} \quad 9 \quad 9 \quad 9 \\
 \quad \quad \quad \quad \quad -3 \quad -8 \quad -2 \\
 \hline
 \quad \quad \quad \quad \quad =6 \quad 1 \quad 7
 \end{array}$$

##### 10's complement :

So, we have seen that the to obtain 9's complement of a number 382, we need to subtract 382 from 999. 617 is the 9's complement of a number 382. Now adding 1 to the 9's complement we will get 10's complement. Therefore the 10's complement of 382 will be 617 (9's complement of 382) + 1 = 618.

In binary number system, base is 2. So, we can find 2's complement and 1's complement for any given binary number.

##### 1's complement :

1's Complement for the Binary numbers are similar to the 9's complement of Decimal number system. In 9's complement we have subtracted each digit of a decimal number from 9, similarly to find 1's complements each digit (bit) of binary number we need to subtract from 1 (the highest digit value). For example, if we want to find 1's complement of a binary number 0010 1101 then,

$$\begin{array}{r}
 \text{1's Complement of 0010 1101 :} \quad 1 \ 1 \ 1 \ 1 \quad 1 \ 1 \ 1 \ 1 \\
 \quad \quad \quad \quad \quad -0 \ 0 \ 1 \ 0 \quad 1 \ 1 \ 0 \ 1 \\
 \hline
 \quad \quad \quad \quad \quad 1 \ 1 \ 0 \ 1 \quad 0 \ 0 \ 1 \ 0
 \end{array}$$

Therefore, 1101 0010 is the complement of binary 0010 1101. If you see the 1's complement and the binary number, you can notice that 1's complement is nothing but each bit is inverted. That means for any binary number if we replace every 0 with 1 and every 1 with 0 you will get the 1's complement of that binary number.

**2's complement :**

2's complement of any binary number is nothing but adding 1 to the 1's complement. Recall 10's complement. In 10's complement we have added 1 to the 9's complement.

2's complement of a binary number 0010 1101 is :

$$\begin{array}{r}
 1\ 1\ 0\ 1\ 0\ 0\ 1\ 0 \quad [1's\ complement\ of\ binary\ 0010\ 1101] \\
 +\ 1 \\
 \hline
 1\ 1\ 0\ 1\ 0\ 0\ 1\ 1 \quad [2's\ complement\ of\ binary\ 0010\ 1101]
 \end{array}$$

Is there any other direct method is there to find 2's complement directly without finding its 1's complement and then by adding 1 to it ? Obviously, the answer is Yes. To do this you need to find first 1 from the right side of the given binary number. From right to left you need to keep all bits same, and from first 1 onwards all bits have to be inverted (0 will becomes 1, and 1 will becomes 0).

To find the 2's complement directly of binary number 0010 1101, you need keep same underlined bits. In this example only one bit (last bit) 1 will remain as it is that is 1, and rest of the bit will be inverted. Therefore 2's complement will be : 1101 0011.

**Example : Find 2's complement of binary number : 0110 1000.**

To find 2's complement we will find first 1 from right to left. So, in this example last 4-bits 1000 will remain as it is and another 4-bits 0110 will be complemented to 1001. Therefore, 2's complement will be 1001 1000.

$$\begin{array}{l}
 0110\ \underline{1000} \quad [From\ right\ to\ left\ all\ bits\ will\ remain\ same\ till\ first\ 1]. \\
 \leftarrow \\
 0110\ \underline{1000} \quad [After\ first\ 1,\ all\ bits\ will\ be\ inverted\ to\ 0]. \\
 \leftarrow
 \end{array}$$

**❑ Check Your Progress – 3 :**

1. Find 10's complement of a decimal number 763.  
 [A] 763            [B] 236            [C] 237            [D] 367
2. Find 2's complement of a binary number 0110 1010.  
 [A] 0110 1011    [B] 1001 0101    [C] 1001 0110    [D] 1111 1111
3. Find 1's complement of a binary number 0110 1010  
 [A] 0110 0110    [B] 1001 1011    [C] 1001 0101    [D] 0000 1111

**4.5 Addition of Binary Numbers :**

We know that when we input the decimal number in the computer system, the number will be stored in the form of binary into computer memory. Now one obvious question will come to your mind that how the computer will perform arithmetic operations like addition or subtraction on it ?

The answer for this question is there is some built-in circuitries are there called adder which can do the addition and subtraction of binary numbers. To understand how arithmetic addition will carried out by these circuitries memorise the following truth table of addition :

Input Bit : 1	Input Bit : 2	Sum Bit	Carry Bit
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

For example, if we want to do the addition of two 8-bit numbers 47 and 29 then,

Carry :		1	1	1	1	1	1	
Binary of 47 :	0	0	1	0	1	1	1	1
Binary of 29 :	0	0	0	1	1	1	0	1
Sum 47 + 29 :	0	1	0	0	1	1	0	0

Make sure, in binary  $0 + 0 = 0$ ,  $0 + 1 = 1$ ,  $1 + 0 = 1$ ,  $1 + 1 = 10$  (1 carry and sum bit 0),  $1 + 1 + 1 = (10 + 1) = 11$  (1 carry and sum bit is also 1).

So, the sum of (47) : 0010 1111 and (29) : 0001 1101 = 0100 1100. Now try to convert binary 0100 1100 into decimal you will get  $0 + 64 + 0 + 0 + 8 + 4 + 0 + 0 = 76$ .

**❑ Check Your Progress – 4 :**

- Addition of Binaries 0011 1010 and 0010 1011 is \_\_\_\_\_.  
[A] 110 0101 [B] 0110 0111 [C] 0110 0101 [D] 0110 1010
- Addition of Binaries 0101 0100 and 0011 0110 is \_\_\_\_\_.  
[A] 1100 1010 [B] 1000 1010 [C] 1101 1011 [D] 1000 0101

**4.6 Subtraction of Binary Numbers :**

Subtraction of two binary numbers is quite interesting. Do you know computer use same circuitry for addition and subtraction ? Yes, computer use same circuitry to do addition and subtraction that is adder. Computer doesn't have circuit for subtraction. Now, you might think, how adder can be used to subtract two numbers ?

See, if you want to subtract 25 from 47, we write :  $47 - 25$ . But computer understand this expression as :  $47 + (-25)$ . Means computer understand  $-25$  has to be added to number 47. Here, computer use the same circuit called adder. But now you think, how can we negate 25 ? To negate 25, computer uses 1's complement or 2's complement. For example, the binary of 25 is : 0001 1001. Then  $-25$  can be represent by its 1's complement that is : 1110 0110 or 2's complement that is : 1110 0111.

Let us understand how computer use 1's complement and 2's complement to compute subtraction of two numbers.

**4.6.1 Subtraction Using 1's Complement Method :**

Let us take two numbers 25 and 30. We want to find  $30 - 25$ . The computer will take this expression as :  $30 + (-25)$ . Means binary of 30 is added to 1's complement of 25. Binary of 30 : 0001 1110 and Binary of 25 : 0001 1001

The leftmost bit for both the numbers are 0. Leftmost bit represents sign of a number (it also called sign bit). Sign bit of both the numbers are 0, that means both numbers are positive. The binary of the number  $-25$  is 1's complement of 25.

Binary of - 25 : 1110 0110

You may notice that the sign bit is 1. That means 1110 0110 represent negative number. Now, add 30 and -25 that means add 0001 1110 and 1110 0110.

$$\begin{array}{r}
\text{Carry : } \quad 1\ 1\ 1\ 1\ 1\ 1 \\
30 : \quad \quad 0\ 0\ 0\ 1\ 1\ 1\ 1\ 0 \\
-25 : \quad \quad 1\ 1\ 1\ 0\ 0\ 1\ 1\ 0 \quad [1's\ complement\ of\ (25)\ 0001\ 1001.] \\
\hline
\quad \quad 1\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0 \\
\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \rightarrow 1 \\
\hline
5 : \quad \quad \quad 0\ 0\ 0\ 0\ 0\ 1\ 0\ 1
\end{array}$$

You will get binary 0000 0100 and 1 as a carry. Add final carry to the binary 0000 0100 you will get 0000 0101. Check the binary obtained, it is of which decimal number ? Yes, it is 5. Similarly, if you want to compute 25 - 30 then,  $25 - 30 = 25 + (-30)$ .

$$\begin{array}{r}
\text{Carry : } \quad \quad \quad 1 \\
25 : \quad \quad 0\ 0\ 0\ 1\ 1\ 0\ 0\ 1 \\
-30 : \quad \quad 1\ 1\ 1\ 0\ 0\ 0\ 0\ 1 \quad [1's\ complement\ of\ (30)\ 0001\ 1110.] \\
\hline
-5 : \quad \quad \mathbf{1}\ 1\ 1\ 1\ 1\ 0\ 1\ 0
\end{array}$$

In the result sign bit (Left most bit) is 1, that means the result negative. Once you know the result is negative, find 1's complement of the result. You will get 0000 0101. It is a binary of 5. Therefore, we can say that the result is negative and value is 5, so result is -5. Let us do  $(-30) + (-25)$ .

$$\begin{array}{r}
\quad \quad \quad 1\ 1 \\
-30 : \quad \quad 1\ 1\ 1\ 0\ 0\ 0\ 0\ 1 \quad [1's\ complement\ of\ (30)\ 0001\ 1110.] \\
-25 : \quad \quad 1\ 1\ 1\ 0\ 0\ 1\ 1\ 0 \quad [1's\ complement\ of\ (25)\ 0001\ 1001.] \\
\hline
\quad \quad 1\ 1\ 1\ 0\ 0\ 0\ 1\ 1\ 1 \\
\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \rightarrow 1 \quad [Add\ final\ carry\ to\ the\ result] \\
\hline
-55 : \quad \quad \mathbf{1}\ 1\ 0\ 0\ 1\ 0\ 0\ 0 \quad [Result\ after\ adding\ carry\ 1].
\end{array}$$

The sign bit (Leftmost bit) is 1. Therefore, the result is negative. If the result is negative the find the complement of the resultant binary, we get 0011 0111. It is a binary of 55 and we know that the result is negative so the answer is -55.

**❖ Points to Remember :**

- To subtract to binary numbers, you need to add both binary numbers. For the first number you have to consider its binary and for second (negative) number you have to consider 1's complement.
- After addition you have to check sign bit. If sign bit is 1 that means the answer is negative in this case you need to find 1's complement of the resultant binary. Convert that 1's complement into decimal. Suppose the decimal value is X then the final value of the subtraction is -X.
- If sign bit is 0, then result of the subtraction is positive. In this case you need to find decimal value of the binary and it will be the answer of your subtraction.
- If after addition carry is produced then add that carry to the sum.

#### 4.6.2 Subtraction Using 2's Complement Method :

The problem with 1's complement method is, it has two representations for 0. To represent +0 you need to use binary 0000 0000, where as to represent -0 its 1's complement 1111 1111 is used. Now, we know that +0 and -0 are same. Therefore, subtraction by using 2's complement is more efficient method than of 1's complement method. In 2's complement method +0 is represented as 0000 0000, and -0 is nothing but 2's complement of it that is 0000 0000. Therefore, in 2's complement +0 and -0 will be represented only by a single binary that is 0000 0000.

In this method negative numbers will be represented as 2's complement. For example : If you want to compute  $30 - 25$  then we need to do :  $30 + (-25)$ .

Binary of 30 : 0001 1110

Binary of 25 : 0001 1001

$$\begin{array}{r}
 \text{Carry :} \quad 1\ 1\ 1\ 1\ 1\ 1 \\
 30 : \quad 0\ 0\ 0\ 1\ 1\ 1\ 1\ 0 \\
 -25 : \quad \underline{1\ 1\ 1\ 0\ 0\ 1\ 1\ 1} \quad [2's\ complement\ of\ (25)\ 0001\ 1001.] \\
 5 : \quad \underline{\underline{1\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 1}}
 \end{array}$$

After addition 1 carry is produced, you need to discard that carry (recall in 1's complement method we have added the carry to the result). After discarding carry the resultant binary is 0000 0101. In this binary sign bit is 0, that means number is positive and if we convert this binary into decimal, we are getting 5. Therefore, the result of the subtraction is : + 5.

Now, suppose if we want to subtract 30 from 25 then :  $25 - 30 = 25 + (-30)$ .

$$\begin{array}{r}
 \text{Carry :} \\
 25 : \quad 0\ 0\ 0\ 1\ 1\ 0\ 0\ 1 \\
 -30 : \quad \underline{1\ 1\ 1\ 0\ 0\ 0\ 1\ 0} \quad [2's\ complement\ of\ (30)\ 0001\ 1110.] \\
 \quad \quad 1\ 1\ 1\ 1\ 1\ 0\ 1\ 1
 \end{array}$$

After addition we are getting binary 1111 1011. In this binary sign bit is 1 therefore the result is negative. In this case find the 2's complement of the resultant binary. 2's complement of the binary 1111 1011 is 0000 0101 which is nothing by binary of 5. Therefore, the result is : - 5.

If we want to do  $(-30) + (-25)$  then,

$$\begin{array}{r}
 \text{Carry :} \quad 1\ 1\ 1\ 1 \\
 -25 : \quad 1\ 1\ 1\ 0\ 0\ 1\ 1\ 1 \quad [2's\ complement\ of\ (25)\ 0001\ 1001.] \\
 -30 : \quad \underline{1\ 1\ 1\ 0\ 0\ 0\ 1\ 0} \quad [2's\ complement\ of\ (30)\ 0001\ 1110.] \\
 \quad \underline{\underline{1\ 1\ 1\ 0\ 0\ 1\ 0\ 0\ 1}}
 \end{array}$$

After discarding carry, we get 1100 1001, in which sign bit is 1, so result is negative. If result is negative, we need to find 2's complement of the binary 1100 1001, which is 0011 0111. This is nothing but binary of 55. Therefore, the final answer of the subtraction is - 55.



**❑ Check Your Progress – 5 :**

1. To represent negative number in binary subtraction \_\_\_\_\_ is used.  
 [A] 1's complement                      [B] 2's complement  
 [C] Both A and B                         [D] None of the above
2. \_\_\_\_\_ is used in binary subtraction of two numbers.  
 [A] Adder            [B] Subtractor    [C] Multiplier [D] divisor

**4.7 Let Us Sum Up :**

**In this unit, we :**

- Discussed how numbers are presented in the memory
- Explained how alphabets and special symbols are presented in the memory.
- Learnt, how negative numbers are presented in the memory.
- Elaborated addition will be done by the system
- Talked about how subtraction is performed by the system.

**4.8 Suggested Answers For Check Your Progress :**

**❑ Check Your Progress 1 :**

1. [B]                      2. [C]                      3. [D]

**❑ Check Your Progress 2 :**

1. [A]                      2. [D]                      3. [A]

**❑ Check Your Progress 3 :**

1. [C]                      2. [C]                      3. [C]

**❑ Check Your Progress 4 :**

1. [C]                      2. [B]

**❑ Check Your Progress 5 :**

1. [C]                      2. [A]

**4.9 Glossary :**

**ASCII :** American Standard Code for Information Interchange. A global standard to provide numeric value to all alphabets and special symbols.

**BCD :** Binary Coded Decimal. It is another way to represent number into the memory. Here instead of binary we store the binary of each digit of a number.

**Complement :** It is a method to represent negative numbers into the computer's memory.

**4.10 Assignment :**

1. What BCD ? Explain it in brief.
2. Explain 1's complement with an example.
3. Explain 2's complement with an example.

**4.11 Activity :**

Perform following binary additions :

- [1] 28 + 35      [2] 17 + 29      [3] 45 + 19      [4] 21 + 34

Perform following binary subtraction using 1's complement method :

[1]  $28 - 35$       [2]  $17 - 29$       [3]  $45 - 19$       [4]  $21 - 34$

Perform following binary subtraction using 2's complement method :

[1]  $28 - 35$       [2]  $17 - 29$       [3]  $45 - 19$       [4]  $21 - 34$

**4.12 Case Study :**

- What happened if we do binary addition of 55 and 75. Are you get the correct answer ? If not try to find out the reason for this.

**4.13 Further Readings :**

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.

## **BLOCK SUMMARY :**

## **Binary Arithmetic**

- Computer is a machine which can perform arithmetic and logical operations at very fast speed, it can store the data, process the data and retrieve the data as per user's requirement.
- Data is unstructured raw material and unstructured facts which provides necessary input to the computer system.
- Processed data is called Information.
- First generations machines are based on vacuum tubes. They are very costly, slow in speed consume more electricity and larger in size.
- Second generation machines are based on transistors. Transistors are two state device, which can be charged or discharged. Second generation computers are smaller in size, less-costly and more powerful than first generation machines.
- Third generation computers are more powerful and based on IC (Integrated Circuits).
- Fourth generation computers are based on VLSI technology, they are compact less-costly and more powerful machines.
- Computers can be classified into Micro-computers, Mini-Computers, Mainframes, and Super-Computers.
- Desktops and Laptops are Micro-Computers. Super-Computers are very costly, Most powerful and very large size machines.
- Machine can understand only language of 1's and 0's. It is called a binary language.
- Assembly language uses mnemonic code instead of strings of binaries.
- Assembly codes are translated in machine-code by Assembler. Assembly language is more convenient language than binary.
- C-Language, FORTRAN, COBOL etc. are High-Level languages. Which are easier to program. They use compiler to translate high-level codes into machine language.
- There are 4 number systems are there. Binary, Octal, Decimal and Hexa-Decimal.
- Binary language includes only two symbols 0 and 1. It is also known as machine language. The base of the binary number system is 2.
- Decimal number system is that which we are using in our daily life. There are 10 symbols are used in decimal number system therefore the base of the decimal number system is 10.
- The base of the Octal number system is 8 and base of Hexa-Decimal number system is 16.
- Any type of data is stored in the computer's memory is stored in the form of Binary.

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- Each alphabets and special symbols are available on the keyboard has unique number called ASCII. ASCII stands for American Standard Code for Information Interchange. It used 7 bits. Extended version of ASCII uses 8–bits to represent any character.
- To represent negative numbers 1's complement or 2's complement methods are used.
- In 1's complement method there are two different representations are there for  $-0$  and  $+0$ .
- Whereas, in 2's complement system, only one representation is there to represent  $+0$  and  $-0$ .
- 2's complement system is more effective that 1's complement system.
- To do addition and subtraction same circuit is used called Adder.
- To do the subtraction negative numbers are considered in the form of 1's complement or 2's complement form.

### **BLOCK ASSIGNMENT :**

#### ❖ **Short Answer Questions :**

- (1) Define term 'Computer'
- (2) Differentiate data and information
- (3) Give the name of the technology used in First Generation, Second Generation and Third Generation computers
- (4) List names of computer classification
- (5) List named of different types of number system
- (6) List all symbols used in Hexa–decimal number system
- (7) What is base for octal number system ? Why ?

#### ❖ **Long Questions :**

- (1) Draw and explain computer organization chart
- (2) Explain computer classification in brief
- (3) List and explain different types of number system in detail
- (4) List and explain different types of programming languages in detail
- (5) Explain how to convert decimal number into binary and binary number into decimal with example.
- (6) Explain how to convert decimal number into hexa–decimal and hexa–decimal number into decimal with example.

❖ **Enrolment No. :**

1. How many hours did you need for studying the units ?

Unit No.	1	2	3	4
No. of Hrs.				

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

3. Any other Comments

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DCAR-101

# **Fundamentals of Computer and Information Technology**

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## **BLOCK 2 : MEMORY AND IO DEVICES**

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UNIT 5 MEMORY ORGANISATION-I

UNIT 6 MEMORY ORGANISATION-II

UNIT 7 INPUT DEVICES

UNIT 8 OUTPUT DEVICES

# ***MEMORY AND IO DEVICES***

## **Block Introduction :**

In this unit we will focus on : "How actually computer works ?". As we know computer is a Data Processor which process the data into information. But to do this variety of components like memory, storage, input devices and output devices are used. We will focus on these different types of devices, and their role in the computer system.

In the Unit-5, We will see different types of Primary memories. Why the primary memories are essential and what different types of primary memories are there. In the Unit-5 you will also learn the use of Cache memory.

In the Unit-6, We will discuss different types of storages. Basically, main memory is volatile in nature, so that to store the data permanently, computer system uses another memory which is called secondary memory or storage.

To process the data, we need to accept data from the user. To accept the data for the computer system we need to use input devices like keyboard, mouse etc. In the Unit-7 of this block we have discussed different types of Input devices in details.

Finally, after processing the data, Information will be produces by the system. To obtain information from the system user need to use various output devices. In the final unit of this block (Unit-8), we have tried to give idea of different types of output devices.

## **Block Objectives :**

The objective of the block is to aware students, about the how computer actually process the data and produces information. To process the data computer system needs memory and to store data and information permanently system needs storage. After going through Unit : 5 and Unit : 6 of this Block, student will gain sufficient knowledge about different types of primary memories and secondary storages of the computer.

Main objective of this block is to aware students, about different types Memories and IO devices. In the Unit : 4 and Unit : 8 of this block, students will learn what different types of Input and Output devices of the computer system.

Finally, the block will clear the concept of different types memories, different types Input devices and Output devices that you should know before learning any subject of computer science.

## **Block Structure :**

**Unit 5 : Memory Organisation – I**

**Unit 6 : Memory Organisation – II**

**Unit 7 : Input Devices**

**Unit 8 : Output Devices**

**UNIT STRUCTURE**

- 5.0 Learning Objectives
- 5.1 Introduction
- 5.2 Categories of Memory
- 5.3 Characteristics of Memory Devices
- 5.4 Primary Memories
- 5.5 RAM : Random Access memory
  - 5.4.1 Dynamic RAM
  - 5.4.2 Static RAM
- 5.6 ROM : Read Only Memory
  - 5.4.1 PROM
  - 5.4.2 EPROM
  - 5.4.3 EEPROM
  - 5.4.4 Flash EPROM
- 5.7 Cache Memory
- 5.8 Let Us Sum Up
- 5.9 Glossary
- 5.10 Suggested Answer for Check Your Progress
- 5.11 Assignment
- 5.12 Activities
- 5.13 Case Study
- 5.14 Further Readings

**5.0 Learning Objectives :**

In this unit, we will discuss about the primary memories of computer system.

**After working through this unit, you should be able to :**

- Learn characteristics of the different memories
- Understand types of memories.
- Know about primary memories.
- Understand the use of cache memory.

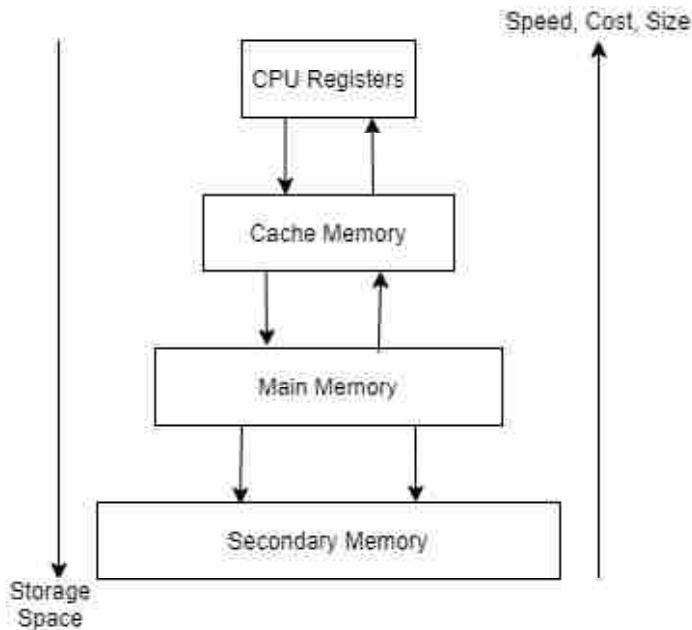
**5.1 Introduction :**

Computers needs to store data inputted by the user, computer process the data and produces information. To store the data, to process it and to store information, computer needs memory storage. A computer system needs variety of storage devices to store data, and instructions given to it. In most cases



computer stores data/information and instructions into the memory. A wide range of memories are available. Unfortunately, faster memories are very costly, it needs continuous power supply and available in larger size. To save cost, physical size and to save data permanently we use secondary memory. On the other hand, CPU is very fast and it always need faster memory. CPU do not deal with slower memory directly.

To deal with this anomaly of access time versus cost, a hierarchy of memories are used in the computer system. This hierarchy enable us to design a computer system which will be cost effective without compromising speed. This hierarchy is shown in the following figure.



As shown in the figure, if we move toward CPU Register to Secondary memory, storage space will increase. For example, registers are available in Bytes, Cache memory in MBs (Mega Bytes), Main memory is available in GBs (Giga Bytes) and secondary storage like hard–disks of the system are available in TBs (Tera Bytes). Similarly, if we move towards Secondary storage to CPU registers, speed will increase. Secondary memory is slower and CPU Registers are fastest memory. CPU registers are most expensive and take more physical size as they are made from special binary cell circuits called Flip–Flops. If we move towards CPU Register to Secondary memory cost of the memory will be reduced.

**☐ Check Your Progress – 1 :**

1. \_\_\_\_\_ is the fastest memory.
 

[A] Main memory	[B] CPU Registers
[C] Cache memory	[D] Secondary memory
2. From the given below, which is less–expensive memory ?
 

[A] Main memory	[B] CPU Registers
[C] Cache memory	[D] Secondary memory
3. \_\_\_\_\_ memory is available with Tera–Bytes of storage space.
 

[A] Hard Disk	[B] RAM
[C] Cache Memory	[D] None of the above

4. \_\_\_\_\_ memory is made from Flip–Flops.
- |                   |               |
|-------------------|---------------|
| [A] CPU Registers | [B] RAM       |
| [C] Hard–disk     | [D] Pen–drive |

### 5.2 Categories of Memory :

Memories of a computer system can be categorised in three main groups. There are :

- [1] **Internal Processor Memory** : These consists of a set of memories available in smaller size and higher speed. CPU Registers and Cache memory are internal processor memories as they are present in the chip of CPU. Both memories are made from Flip–Flops. They offer higher speed but available in smaller size. Cache memory is used in the modern computer between CPU Registers and Main memory of the system to reduce speed mismatch problem between them.
- [2] **Main Memory** : Main memory is a large memory that is fast, but not as fast as CPU Registers and Cache memory. CPU of the system can directly access this memory. It is mainly based on Integrated Circuits (ICs).
- [3] **Secondary Memory** : Secondary memory is also called an Auxiliary memory. It is available in larger size. This memory is cheaper compare to all other memories. It is slower than main memory and CPU can not access this memory directly. It normally stores programs, other instructions and data files. Because the CPU can not access this memory directly data, programs or instructions stored in this memory will be transferred into Main memory and then CPU can access it.

### 5.3 Characteristics of Memory Devices :

To compare different memories usually we compare their characteristics. The terms discussed below are important to compare two memories.

- **Storage Capacity** : Storage capacity of a memory represent memory size. The capacity of internal memory is in words, Bytes or in MBs (Mega Bytes). Main memory is usually available in MBs or in GBs (Giga–Bytes). The capacity of secondary storage is in GBs or TBs (Tera–Bytes).
- **Access Time** : The access time is the time required to access the particular memory. It is a time between the request is made for read/write operation till the time data is made available or written on specific location of the memory. Usually a memory having less access time is a faster memory.
- **Permanent Storage** : Some memories can not store the data permanently as they need continuous power supply. Once you dis–continue power supply or simply switch off the machine, the content stored within the memory is disappeared. Such type of memory is called volatile memory. For example, RAM (Random Access Memory) is volatile memory in nature. Whereas, Hard–disk drive can store the data permanently. Even though you turn off the machine or discontinue the power supply, still the content stored in the Hard–disk drive will remain as it is.
- **Access Mode** : The data stored in the memory is resided at various memory locations. Depends on how can we access data from various memory locations, memories can be divided into three types :
  - o **Sequential Access Memory** : Memories which can be accessed in a predefined sequence is called sequential access memory. For

example, songs can be accessed sequentially one after another. A good example of sequential memory is Magnetic Tape. To access the data from particular location we need to rewind or forward. We can not access particular memory location directly. Generally, this type of memories is slower in nature and mostly used for data backup purpose.

- o **Random Access Memory :** It is the mode in which any memory location can be accessed in any order within the same amount of time. Memory made by IC technology, which is made from semi-conductor kind of material is known as Random Access Memory. The storage locations from the memory can be read or write, independently from each other. Usually, this type of memories is faster in nature.
- o **Direct Access Memory :** Sometimes, the information neither accessed sequentially nor random. In this type of memory, separate heads are there on each track of the disk. Depends on which track has to be read/written particular head will be activated and then the data will be accessed sequentially from that track by rotating the disk.
- o **Physical Characteristics :** Depends on the material from which the memory is constructed is a physical characteristic of the memory. Depends on physical characteristic memory can be categorised in four categories, those are : electronic, magnetic, mechanical and optical.

□ **Check Your Progress – 2 :**

1. \_\_\_\_\_ memory is available in smaller size (in Bytes).  
[A] RAM [B] Registers [C] Memory card [D] Hard-disk
2. As per the physical characteristic memory can be \_\_\_\_\_.  
[A] Electronic [B] Optical [C] Magnetic [D] All of the above
3. In \_\_\_\_\_ memory data can be access directly from particular memory location.  
[A] Random Access [B] Direct Access  
[C] Sequential Access [D] None of the above

Different types of memories can be classified into two major categories :

- [1] **Primary Memory :** Primary memory usually made from semi-conductor typed material. Usually, it is available in the form of electronic chip. This memory is faster memory. A Computer system consists of RAM (Random Access Memory) and ROM (Read Only Memory) which are the examples of Primary memory. In this chapter we will focus only on primary memories used in computer system.
- [2] **Secondary Memory :** Secondary memory can be a magnetic or optical memory. For example, Floppy disk, Hard-disk, CD-ROM (Compact Disk Read Only Memory), DVD (Digital Versatile Disk) etc. With the advancement in the technology, now a days some secondary memories which is made from electronic circuits are also available for example memory card, pen drive or SSD Hard-disk. Compare to the primary memory secondary memory can store the data permanently. It is cheaper than primary memory and available with large size storage capacity. We

will discuss different types of secondary memories in the next unit of this block.

### **5.4 Primary Memories :**

Primary memories are often called as main memory of the system, which stores instructions and data during processing of microcomputers. Primary memory stores the data inputted by the user and the processed data called information. It is also used to store intermediate results produced during data processing by CPU. Primary memory is an essential component in any digital computer since it is needed for storing the programs that are executed by the CPU. The CPU of the system can directly communicate with the primary memory as they offer higher speed than secondary memory. There are two types of primary memory : [1] RAM : Random Access Memory and [2] ROM : Read Only Memory.

#### **❑ Check Your Progress – 3 :**

1. \_\_\_\_\_ is a primary memory.  
[A] Read Only Memory [B] CD-ROM  
[C] DVD [D] Hard-disk
2. Compare to. primary memory, secondary memory is \_\_\_\_\_.  
[A] Cheaper [B] Available with large storage  
[C] Slower in speed [D] All of the above
3. CPU directly interact with \_\_\_\_\_.  
[A] Primary memory [B] Secondary memory  
[C] Both [A] and [B] [D] None of the above

### **5.5 RAM : Random Access Memory :**

Random Access Memory chip is made with Metal Oxide Semiconductor (MOS). It allows to select any location on the memory chip randomly and can be used that location to store or retrieve, data or instructions directly. A memory unit is a collection of storage registers with the associated circuits, needed to transfer information in and out of the registers. These memory registers can be accessed for information transfer as required and hence the name Random Access Memory abbreviated as RAM.

A memory unit of RAM stores data, instructions and information in the form of binaries in the group of bits called words. Each word is store in a separate register. A word in memory is an entity of n-bits that moves in and out from the memory unit. A word (group of bits) of 8-bits is called byte. Data in any format (Text, Numbers, Image, Video or Audio) are stored in the RAM using binary coded representation. Random Access Memory can be divided in two types :

#### **5.5.1 Dynamic RAM :**

In the chip of Dynamic RAM multiple cells are there which are stores the data in the form of binary-coded. Each cell of Dynamic RAM can store 1-bit of data. Each cell is made by a transistor. We have already discussed that transistors are two-state device which can be charged or discharged. Depending upon it's charged and discharged state binary bit 1 or 0 is to be assumed.

Transistors which are placed in the Dynamic RAM chip are loose their content with time. To preserve the data in these binary cells Dynamic RAM has refresh circuitry. This circuitry read the content of each cells many times in a

second. This will refresh the content stored in each binary cell of Dynamic RAM chip, so that the content stored in the cell will remain as it is. Due to this reason this memory is a volatile memory. Once you discontinue the power supply or turn off the machine, content stored within the cells will be erased and Dynamic RAM chip will become clear (has no data).

Dynamic RAM has overhead of refresh circuitry, and also volatile in nature. Even though, these drawbacks it is widely used in digital computer because of it's cost-effectiveness. The following figures gives you the idea how Dynamic RAM looks like.



**5.5.2 Static RAM :**

Static RAM chips are also volatile in nature but as they are supplied power, they do not need special regenerator or refresh circuits to retain the data stored in it. Compare to Dynamic RAM, Static RAM takes more transistors and other electronic components to store a bit. Due to that reason static RAM is more costly than Dynamic RAM. Static RAMs are more reliable than Dynamic RAM, but because of it is costly, it is used in specialised applications while Dynamic RAMs are used as a primary storage in most of the computers.

**We can summarize types of RAM as :**

- Two common types of RAM are dynamic RAM and static RAM.
- Dynamic RAM (DRAM) chips must be reenergized constantly or they lose their contents. Many variations of DRAM chips exist, most of which are faster than the basic DRAM.
- Static RAM chips are faster and more reliable than any variation of DRAM chips. These chips do not have to reenergized as often as DRAM chips; hence the term, static SRAM chips, however they are more expensive than DRAM chips. SRAM is used in cache memory.

SDRAM (Synchronous RAM)	<ul style="list-style-type: none"> <li>• Synchronized to the system clock</li> <li>• Much faster than DRAM</li> </ul>
DDR SDRAM (Double Data Rate SDRAM)	<ul style="list-style-type: none"> <li>• Transfer data twice, instead of once, for each clock cycle</li> <li>• Faster than SDRAM</li> </ul>
DDR2	<ul style="list-style-type: none"> <li>• Second generation of DDR</li> <li>• Faster than DDR</li> </ul>
DDR3	<ul style="list-style-type: none"> <li>• Third generation of DDR</li> <li>• Designed for computers with multi-core processors</li> <li>• Faster than DDR2</li> </ul>
DDR4	<ul style="list-style-type: none"> <li>• Fourth generation of DDR</li> <li>• Faster than DDR3</li> </ul>
RDRAM (Rambus DRAM)	<ul style="list-style-type: none"> <li>• Much faster than SDRAM</li> </ul>

❑ **Check Your Progress – 4 :**

1. \_\_\_\_\_ RAM is costly used in specialised applications.  
[A] Static [B] Dynamic  
[C] Serial [D] None of the above
2. \_\_\_\_\_ RAM is cheaper used as a primary storage of modern computers.  
[A] Static [B] Dynamic  
[C] Both [A] and [B] [D] None of the above
3. \_\_\_\_\_ RAM is faster than DDR4.  
[A] SD-RAM [B] DDR3  
[C] RD-RAM [D] DDR SD-RAM

**5.6 ROM : Read Only Memory :**

A Read Only Memory, as name suggest used only for reading purpose. ROM does not have a writing capability. This implies that the binary information stored in a Read Only Memory is made permanent during the production of the hardware chip. Once the memory chip is produced at that time the program (set of instructions) will be written on it and it can not be altered after. RAM is a general-purpose memory allow to change the content during the computational process of the system, whereas a ROM is restricted to only reading the words that are permanently written in the memory module.

The most important ROM chip, which is available in every computer system is BIOS (Basic Input Output System). BIOS is a kind of ROM in which a specialised program called BOOT STRAP LOADER is written. Every time when you turn on your computer, the program written on BIOS starts its execution. BIOS is responsible to load operating system from secondary memory to primary memory called Booting process.

**Some important points about the Read Only Memories are :**

- Read Only Memory (ROM) refers to memory chip storing permanent data and instructions. The data on most ROM chips cannot be modified – hence, the name read-only.
- ROM is non-volatile, which means its contents are not lost when power is removed from the computer.
- Manufacturers of ROM chips often record data, instructions, or information on the chips when they manufacture the chips. These ROM chips, called firmware, contain permanently written data, instructions, or information, such as a computer or mobile device's start-up instructions.

**5.6.1 PROM :**

PROM stands for Programmable Read Only Memory. Unlike ROM at the time of manufacturing, manufacturer of the chip do not write any program on the chip. That means the blank chip is available in the market. You can buy the chip from any vendor and can program it as per your need (it is not that much easy, as it needs specialized hardware to write the chip). But once the chip is written, the content written on the chip can not be altered. As it allows the user to write customized program on it once, it is called a Programmable ROM.

**5.6.2 EPROM :**

EPROM stands for Erasable Programmable Read Only Memory. This a special type of ROM, which allows to erase the content stored in it and programmed it again with the help of special equipment. An EPROM has a window on its top, which if exposed to ultraviolet light, allows data to be erased. Most EPROM's have a label covering the window.

**5.6.3 EEPROM :**

EEPROM stands for Electrically Erasable Programmable Read Only Memory. EPROM allows to erase the content from the chip using ultraviolet rays. But when ultraviolet rays are applied to the chip, it will erase the content of entire chip. EPROM does not allow, to erase the content or rewrite the content on a particular part of the chip. EEPROM on the other hand allow to select particular content of the chip to erase and rewrite electronically.

**5.6.4 Flash EPROM :**

This is latest type of ROM which is becoming very popular. But running a special program, a manufacturer can make changes to the flash EPROM while it remains in the PC.

**5.7 Cache Memory :**

Cache memories are small fast memories placed between the processor and the main memory of the system. Cache memory is faster than main memory. Then one question will arise in your mind that, why do we need main memory ? Well it because of cost. For example, 128KB or 256KB size of cache memory is sufficient for the Intel Pentium based machine having 4 to 128 MB of RAM or even more. Thus, small cache memories are sufficient to provide fast speed of memory retrieval without spending more cost for the memory. Based on 'principle of locality' if particular memory location is accessed at a time then it is highly likely that its near by locations will be accessed in the near future. Cache memory contains a copy of that particular portion of main memory. When particular memory location to be read/write, it has to be first searched in the cache memory. If the data is available in the cache, CPU will directly used it. If it is not, CPU that particular data will search in the main memory. From the main memory the data will be copied in the cache memory and then CPU will access it. The reason of bringing the data into cache is again principal of locality of reference. We can expect the same data can be accessed again, in the near future.

For example, if memory read cycle takes 100 nano second and a cache memory takes, 20 nano second. Suppose user access the same piece of data for 4 times then,

The time taken with cache memory	= (100 + 20) ns	+ (20 * 3)
	For the first read operation	For last 3 read operation
	= 120 + 60 = 180 ns	
Time taken without cache memory	= 100 * 4 ns	
	= 400 ns	

Clearly, we can see that if the same piece of data is accessed by the user for 4 times, then total time taken to access the data in the system having cache memory is 180ns, where as the same task will be done in the system, which does not have cache memory takes 400ns.

❑ **Check Your Progress – 5 :**

1. \_\_\_\_\_ memory is placed between CPU and main memory.  
[A] RAM [B] Cache  
[C] Flash memory [D] EEPROM
2. \_\_\_\_\_ is a type of ROM, allows to erase the data electronically.  
[A] EPROM [B] EEPROM [C] PROM [D] Flash memory
3. \_\_\_\_\_ is a blank chip, in which you can write customized content into it for only one time.  
[A] EPROM [B] EEPROM [C] PROM [D] Flash memory
4. Special type of ROM, responsible to start the computer system and load the operating system (booting).  
[A] EPROM [B] BIOS [C] PROM [D] Flash memory

**5.8 Let Us Sum Up :**

In this chapter we have seen hierarchy of memories is used in a computer system. Mainly, memory can be divided into two categories. Primary memories are those which can usually made by electronic circuits, faster and high-cost. Usually, in most computer systems, Dynamic – Random Access Memory (D-RAM) is used as a main memory which is of volatile in nature. To store the data permanently secondary memories are used. We have discussed important characteristics of memory which can be used to compare memories. Finally, we have ended our discussion with cache memory, and learn how a small size of cache memory can increase the speed of the system. In fact, in this unit we have discussed primary memories. Secondary memories we will discuss in the next unit in detail.

**5.0 Glossary :**

**RAM :** Random Access Memory. It is a primary memory of the system. It is also known as main memory.

**ROM :** Read Only Memory. It is a primary memory used to read the instructions. The content resided in it is not be alterable.

**PROM :** Programable ROM. It allows to write customizable content in it. Once it has been written it will behave like a ROM and it will become non-alterable.

**EPROM :** Erasable PROM. Content of the ROM can be erased using ultraviolet rays.

**EEPROM :** Electrically Erasable PROM.

**BIOS :** Basic Input Output System. A kind of ROM helps system to load operating system in the main memory from secondary memory (Booting).

**SDRAM :** Synchronous Dynamic RAM.

**DDR SDRAM :** Double Data Rate SDRAM

**5.10 Suggested Answers For Check Your Progress :**

❑ **Check Your Progress 1 :**

1. [B]
2. [D]
3. [A]
4. [A]



❑ **Check Your Progress 5 :**

1. [B]                      2. [D]                      3. [A]

❑ **Check Your Progress 3 :**

1. [A]                      2. [D]                      3. [A]

❑ **Check Your Progress 4 :**

1. [A]                      2. [B]                      3. [D]

❑ **Check Your Progress 5 :**

1. [B]                      2. [B]                      3. [C]                      4. [B]

**5.11 Assignment :**

1. Write a short note on Random Access Memory.
2. What is ROM ? List and explain different types of ROM you know.

**5.12 Activity :**

- Draw the Block-Diagram of RAM and ROM.

**5.13 Case Study :**

Make a small note with diagram which explains Addressing block of RAM.

**5.14 Further Reading :**

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.

**UNIT STRUCTURE**

- 6.0 Learning Objectives
- 6.1 Introduction
- 6.2 Characteristics of Secondary storage
  - 6.2.1 Storage Capacity
  - 6.2.2 Access Time
- 6.3 Hard Drives
  - 6.3.1 Hard Disk
  - 6.3.2 SSDs
  - 6.3.3 External Hard Disk
  - 6.3.4 RAID
- 6.4 Portable Flash Memory Storage
  - 6.4.1 Memory Cards
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- 6.5 Optical Discs
  - 6.5.1 CDs
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- 6.6 Other Types of Storage
  - 6.6.1 Magnetic Strip Cards
  - 6.6.2 Smart Cards
  - 6.6.3 RFID Tags
- 6.7 Let Us Sum Up
- 6.8 Suggested Answer for Check Your Progress
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- 6.10 Assignment
- 6.11 Activity
- 6.12 Further Readings

**6.0 Learning Objectives :**

In this unit, we will discuss about the basics of secondary memories and Storage devices :

**After working through this unit, you should be able to :**

- Understand Secondary memories of computer.
- Know, Characteristics of Secondary Storage.
- Understand types and functioning of Hard drives.
- Know about optical memories.

## 6.1 Introduction :

In the previous unit we have discussed primary memories. Primary memories are usually faster, costly and available in smaller size. It is intended to help CPU by providing faster memory space. Unfortunately, primary memory is volatile in nature, so that we need to use secondary memories. Secondary memories are intended to provide permanent storage or portability. Usually, secondary memories are cheaper compared to primary memory, it is available in large size and provide permanent (non-volatile) storage. In this unit we will discuss variety of secondary storage memories.

## 6.2 Characteristics of Secondary Storage :

A secondary storage is the physical device on which computer system keeps data, information, programs or applications. Hard-disk, SSDs, USB Flash drive, CD-ROMs, DVDs, Smart-cards, RFID, NFC Tags etc. are examples of secondary storage.

By nature, secondary memories are slower and CPU do not interact with secondary memory directly. When data is accessed from the secondary memory then it gets transferred (copied) into the main memory first and then CPU will process it. The term 'writing' for the secondary memory means – transferring data, information or program to the secondary memory from the main memory. Similarly, the term 'Reading' means – transferring data, information and program from secondary memory to main memory.

The following characteristics are to be considered while comparing of different secondary memories.

### 6.2.1 Storage Capacity :

Capacity of the storage means the number of bytes (characters) can hold (store) by that particular secondary memory. We know that the smallest unit for measuring the memory is bit. A Bit is single digit binary number that can be either 0 or 1. Collection of 8 bits, is called a Byte. Refer the following given table, in which higher units for memory storage are given.

1 Byte	8 bits	$2^3$
1 KB (Kilo Bytes)	1024 Bytes	$2^{10}$
1 MB (Mega Byte)	1024 KBs	$2^{20}$ = Million Bytes / Characters
1 GB (Giga Byte)	1024 MBs	$2^{30}$ = Billion Bytes / Characters
1 TB (Tera Bytes)	1024 GBs	$2^{40}$ = Trillion Bytes / Characters
1 PB (Peta Byte)	1024 TBs	$2^{50}$

While comparing secondary storages, that storage having higher capacity is preferable, because it can store more data.

### 6.2.2 Access Time :

The speed of the storage device can be measure in terms of access time. The time taken by a storage device, to retrieve the data from the memory or to write the data to the storage is called access time. Access time is a sum of Seek time and Latency time.

1. **Seek Time :** Time taken to place movable disk on a particular (desired) track in movable head disk or Time taken to take decision to activate particular head by the circuitry in a fixed head disk is called seek time.

2. **Latency Time** : Once the head is placed on a particular track (movable head disk) or activated head (fixed head disk), then disk has to be rotated so that particular sector of the track comes below read/write head. The time taken in disk rotation so that intended sector comes below read/write head is called Latency time.

$$\text{Disk Access Time} = \text{Seek time} + \text{Latency time}$$

Usually, that secondary storage is preferable which takes less access time. If the access time is less that means that memory is faster. Generally, it is seen that the memory access time for memory chips (primary memory) is in nanosecond (billionth of a second), while the access time for secondary storage device is in millisecond (thousandths of a second).

**❑ Check Your Progress – 1 :**

1. Time taken to place read/write head on a desire tract is called \_\_\_\_\_.  
[A] Seek time [B] Latency time  
[C] Access time [D] None of the above
2. Time taken to rotate the disk so that desire sector will come below read/write head is called \_\_\_\_\_ time.  
[A] Seek time [B] Latency time  
[C] Access time [D] None of the above
3. One billion bytes = \_\_\_\_\_.  
[A] 1 MB [B] 1 GB [C] 1 TB [D] 1 PB

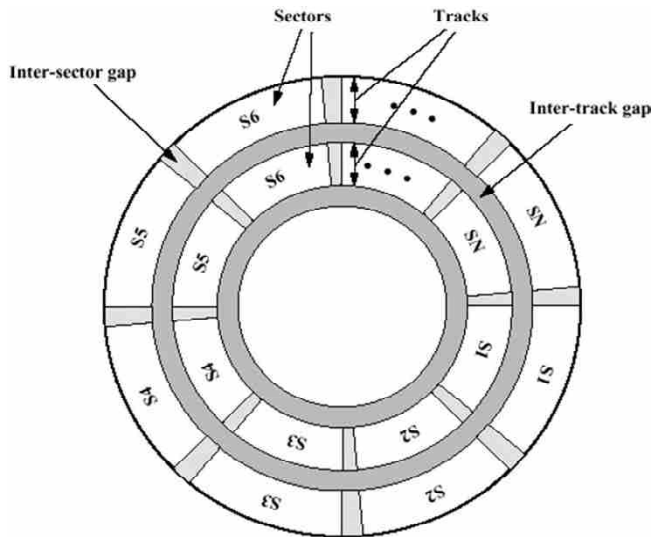
**6.3 Hard Drives :**

The term hard drives, refers collectively for two types of storages which are HDD (Hard Disk Drive) and SSDs. HDDs or SSDs can be of internal or external.

**6.3.1 Hard Disk :**

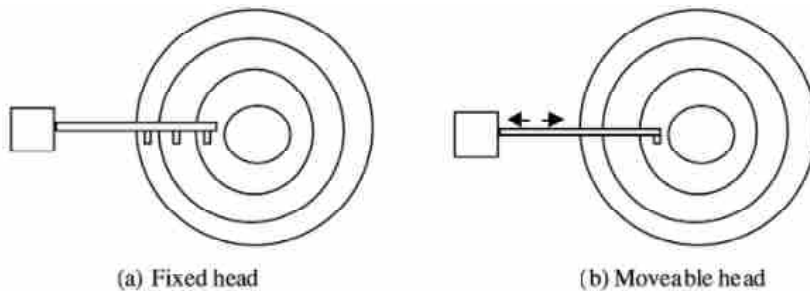
Hard disk drive (HDD) is a secondary storage device that contains one or more circular platters that has magnetic particles on its surface to store data, information, programs or applications. In desktop and laptop computers at least one hard disk or SSD have been included. The storage capacity of HDD can vary, depending upon number of platters present in the storage.

A platter of the HDD is made of either aluminium, glass or ceramic and it has a thin coating of alloy (magnetized) material that allows data items to be recorded on its surface magnetically. The surface of the disk is divided into number of concentric circles. These circles are called tracks. Furthermore, each track is divided into number of pie shaped segments. These segments are called sectors. Formatting is the process of dividing the disk into number of tracks and sectors. Typically, on a hard disk drive, a sector stores up to 512 bytes of data. The following figure will give you a brief idea of tracks and sectors on the disk.

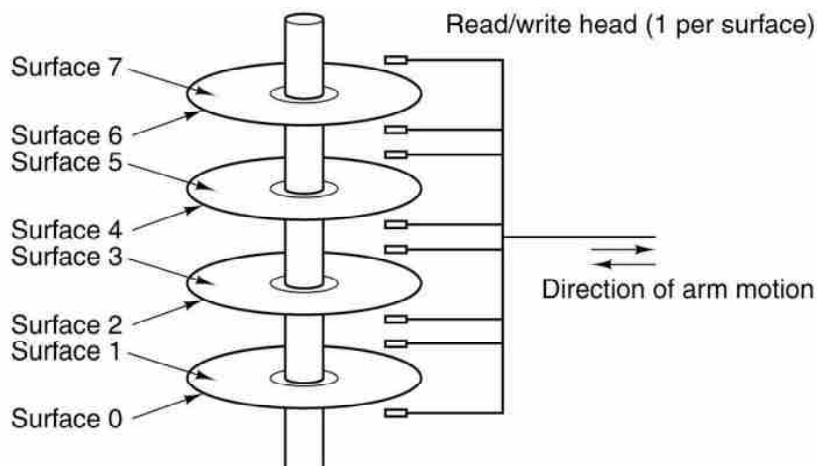


[Hard-Disk Platter]

Usually, a hard disk has multiple platters stacked on top of each other, Each platter has two read/write head, to read/write the data on each surface of the disk platter. There are two type of disks are available. [a] Fixed head disk and [b] Movable head disk. In Fixed head disk, the arm is not movable, but for each track there will be a separate head is there. Using special circuit, the head of desired track will be activated. In movable head disk there is only one read/write head is there on the arm. Depends on which track the data has to be read or written, the head arm will be moved.



As we have discussed, in a hard disk drive, multiple disk platters are stacked, one on another with a central shaft (spindle). The spindle will be rotated with help of mechanical motor with speed of 5,400 to 15,000 rotations per minutes(rpms). The layout of multiple disk platters is shown in the following figure.



Hard disk with four disk platters

### 6.3.2 SSDs :

SSD (Solid State Drive) is a storage device drive based on flash memory technology. Flash memory is a type of non-volatile memory, allow user to rewrite the content electronically. Here, flash memory chips work as solid-state storage media. SSDs are costly than HDD. SSDs are faster than HDDs because in this memory we do not have to move head arm from one track to another track, and we do not have to rotate the disk. Due to this reason access time of the SSD is very less compare to HDD. SSDs are more reliable, because of there is no moving part is there.

#### ❑ Check Your Progress – 2 :

1. In \_\_\_\_\_ memory, Flash memory chips are used, instead of magnetic platters.  
[A] HDD [B] SSD  
[C] CD-ROM [D] None of the above
2. Disk platter of the HDD is divided into number of concentric circles are called \_\_\_\_\_.  
[A] Track [B] Sector [C] Cluster [D] Cylinder
3. Each sector of the HDD stores, \_\_\_\_\_ data.  
[A] 1 Byte [B] 5000 Bytes [C] 512 Bytes [D] 4096 KBs

### 6.3.3 External Hard Drives :

An external hard drive is a separate freestanding storage device that can be connected to the system via cable and USB port. Both type of hard disks HDDs and SSDs are available as external hard disk drive.

External hard-disks are available in different sizes and with different storage capacities. Smaller, light-weight external hard-disk are also used as a portability (to move large amount of data from one device to another). External hard-disk drives are also useful for taking back-up of the data.

### 6.3.4 RAID :

RAID (Redundant Array of Independent Disks), is a group of two or more disks. It is a collection of multiple hard-disk drives fitted in a device. Because of multiple hard-disks are used, it provides huge storage capacity. RAID has multiple configurations. Some configurations of the RAID provide reliability. If any one hard goes out of order then we can replace it with new hard-disk in the RAID and it will recover the data of the disk (which is removed from the RAID) by applying some computational procedures.

## 6.4 Portable Flash Memory Storage :

Even though HDDs and SSDs discussed in the previous section, are two widely used storage types, Flash memory storage like memory cards and USB flash drives are also very popular memory storage.

### 6.4.1 Memory Cards :

Memory cards enable mobile users to move digital photos, media files like music or movies or any other type of files from one device to another device. A memory card is a kind of removable flash memory storage, usually smaller than 1.5 inches can be inserted into mobile phones, tablets, digital cameras, PCs or laptop to read or write the data.

Many types of memory cards are available in the market such as SDHC (Secure Digital High Capacity), SDXC (Secure Digital Expanded Capacity), microSDHC, miniSD, xD Picture card, CF (Compact Flash) and M2 (Memory stick Micro). Mobile phones, Tablets and Digital Cameras have dedicated slots for memory card. Some laptops come with memory card reader slot in which we can insert the memory card and can read or write data in it.

#### 6.4.2 USB Flash Drives :

USB flash drive is also known as thumb drive or pen drive, it is a flash memory storage device that can be plugs in USB port of the computer of laptop. USB Flash drives provides greater flexibility to the mobile user as it is lightweight and available in various styles and shapes. With USB Flash drive user can carry any type of file like Documents, PDFs, audio or video files, photos or images etc. USB Flash drives are plug-and-play devices, do not require any type setup or driver installation into the device.

#### ❑ Check Your Progress – 3 :

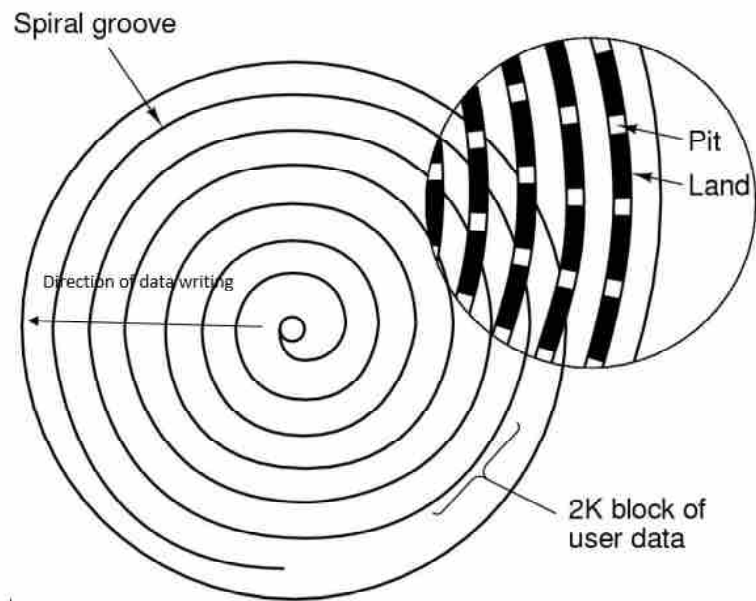
- \_\_\_\_\_ is a plug-and-play device.  
 [A] USB Flash drives                      [B] Internal HDD  
 [C] Internal SSD                              [D] None of the Above
- From the given below identify valid type of memory card.  
 [A] SDXC      [B] SDHC      [C] miniSD      [D] All of the above
- \_\_\_\_\_ is a plug and play storage device, can be plugged into USB port.  
 [A] Memory card                              [B] USB Flash drive  
 [C] Keyboard                                  [D] Cloud storage

#### 6.5 Optical Disks :

Optical discs are also a type of portable storage medium, available in flat, rounded shape, thin and light-weight made from metal and plastic material. The data to be read from, and write to the disk using optical laser light beam. Optical discs used in the computers are typically 4.75 inches in diameter and 0.05 inch thick. A mini optical disc is also available having 3 inches of diameter. Three widely used types of optical discs are : [1] CDs (Compact Disks) [2] DVDs (Digital Versatile Disk) and [3] Blu-ray Discs.

Optical disc is a thin disc made of plastic and coated at one side with metal. This metal coating layer has tiny pits, which are visible only under a microscope, which are burnt into a thin coating of metal deposited on a disc. The pattern of pits represents the stream of digital data that are used to encode pictures or sound. When optical disc is placed into the CD-Drive, a beam of laser light is used to read the patterns of pits and convert those patterns into the audio-visual signals. When the optical discs are written, high laser beam is used, which alter the surface of the discs and create flat and bumpy areas called lands and pits at the bottom of the disk. These lands and pits are representing the data written on the disc.

Unlike magnetic disk, optical disc has only one long spiral track, which is divided into same length of multiple sectors. When the data is written on the optical disc then it will be written from inner most sector towards sectors of outer side.



[Track layout of optical discs]

### 6.5.1 CDs (Compact Discs) :

A CD-ROM can store 700 MB of data in an optical disc. There are three types of CDs are available which are discussed below.

- **CD-ROM (Compact Disk Read Only Memory) :** is a type of optical disk that user can just read, but not erase or alter the content on it. Manufacturers write the content on the disk at time of manufacturing the disc. The music CDs available in the market is a kind of CD-ROM. We can read (play) the music many times but disc do not allow any type of alteration.
- **CD-R (CD-recordable) :** It is an optical disc available in market, with no prewritten data (blank). You can bring this CD and write the data according to your need. But once the data is written to the disc it will becomes read only and you are not allowed to erase or alter the data again. This type of disc is also known as WORM (Write Once Read Many) disc.
- **CD-RW (CD-Rewritable) :** It is an erasable optical disc allows user to write or erase the data multiple time. Reliability of the disc tends to drop, however with each successive rewrite operation.

### 6.5.2 DVDs (Digital Versatile Discs) :

A DVD is an optical disc, which can store the data more densely on the optical disc compare to CD-ROM. That is the reason that DVD can store the data up to 4.7 GB on a disc. Because a single DVD can store the data of 7 CD-ROMs, it provides high quality to video. Similar to CD-ROM, DVDs are also available in three formats as discussed below :

- **DVD-ROM :** It is a read-only, high-capacity optical disc that user can read but can't alter. DVD-ROMs are used to store high quality movies, music, videos, huge database and applications.



- **DVD-R and DVD+R** : It is available in WORM format, which allows user to write customize data on it, but once it is written it will become read-only and the content cannot be alter.
- **DVD-RW, DVD+RW and DVD+RAM** : It is a DVD optical disc allow user to rewrite the data multiple times. It allows user to erase the disc and can rewrite again.

**6.5.3 Blu-ray Discs :**

Blu-ray is an optical disc which can store the data on the disc in even more dense format than of DVD. A single Blu-ray disc can store 25GB of data. It basically used to provide high-definition video, audio etc.

**□ Check Your Progress – 4 :**

1. \_\_\_\_\_ optical disc has highest amount of storage capacity.  
 [A] CD-ROM [B] DVD  
 [C] Blu-ray disc [D] None of the above.
2. The capacity of DVD is near about \_\_\_\_\_.  
 [A] 700MB [B] 4.7 GB [C] 25 GB [D] 1 TB
3. \_\_\_\_\_ format of DVD is not alterable.  
 [A] DVD-ROM [B] DVD-RW [C] DVD+RW [D] DVD+RAM
4. From the given below, \_\_\_\_\_ format of compact disc is also called as WORM disc.  
 [A] DVD-ROM [B] DVD-R [C] DVD+RW [D] DVD+RAM

**6.6 Other Types of Storage :**

**6.6.1 Magnetic Strip Card :**

A magnetic strip card can be a credit card, debit or ATM card of the bank, or any other type of card which contains information identifying you. The issuer of the card like banks or any other financial organization mention the information related to you like your name, account number etc. in encoded form, on a magnetic strip placed on the card. When the card is swiped by you on any merchant outlet, magnetic strip card reader device will automatically retrieve the encoded information from the card. Magnetic card is shown in the following figure.



**[Magnetic strip based Smart card]**

### 6.6.2 Smart Card :

A smart card, is an alternative card to magnetic stripe-based card. It has an integrated chip embedded on the card which encapsulate the data encoded by the issuer organization. You can find the chip circuit of smart-card on the figure given above. There two types of smart cards are available : [1] Chip based smart card and, [2] Contactless smart card. With the chip based smart card, you have to insert the smart card in the device called smart card reader till the transaction does not completed. With the contactless smart card, you don't have to insert the card into the machine, but when you bring the smart card closer to the reader device it automatically recognises your data and transaction will be done (without inserting smart card into the card reader device).

### 6.6.3 RFID Tags :

RFID is a technology uses radio signals to communicate with a tag attached to any person, animal, vehicle or any other object. The RFID tag has an antenna and memory chip. Memory chip store the data about that object and antenna is used to produce radio signals to transmit the data to the RFID reader devices. RFID reader device is connected to the computer using network, which will receive and store the data.

RFID tags can be of type active or passive. In Active RFID tag, a battery is embedded with the tag, which enables the chip circuitry to generate and propagates radio signals. Passive RFID do not have battery embedded in the RFID tag, so that passive RFID tag cannot generate the radio signals, but the reader activates the antennas of tag by sending electromagnetic waves.

RFID has many applications. It can be used in schools or in organization to take attendance. It can also be used in vehicle tracking or object tracking systems.

#### ❑ Check Your Progress – 5 :

1. RFID tag devices use, \_\_\_\_\_ electromagnetic waves for communications.  
[A] Radio [B] Microwave [C] Infrared [D] Ultraviolet rays
2. A chip with the client information is embedded on \_\_\_\_\_ card.  
[A] Magnetic strip [B] Smart  
[C] Real-time [D] None of the above
3. \_\_\_\_\_ RFID tag do not have embedded battery.  
[A] Active [B] Hyper-active  
[C] Passive [D] None of the above.
4. \_\_\_\_\_ is used in object tracking or to take attendance of students or employees.  
[A] Smart-card [B] Magnetic-strip card  
[C] RFID tag [D] Memory-card

### 6.7 Let Us Sum Up :

#### In this unit, we have :

- Discussed use of secondary storage devices
- Elaborated HDDs and SSDs

- Described optical memories
- Talked about Magnetic strip and smart card.
- Discussed about RFID tags

### 6.8 Suggested Answers For Check Your Progress :

#### ❑ Check Your Progress 1 :

1. [A]                      2. [B]                      3. [B]

#### ❑ Check Your Progress 2 :

1. [B]                      2. [A]                      3. [C]

#### ❑ Check Your Progress 3 :

1. [A]                      2. [D]                      3. [B]

#### ❑ Check Your Progress 4 :

1. [C]                      2. [B]                      3. [A]                      4. [B]

#### ❑ Check Your Progress 5 :

1. [A]                      2. [B]                      3. [C]                      4. [C]

### 6.9 Glossary :

**CD-ROM** : Compact Disk Read Only Memory, it is a kind of optical memory.

**DVD** : Digital Versatile Disk, it is a kind of optical disc with higher storage capacity.

**HDD** : Hard Disk Drive. It is a secondary storage of any computer or Laptop system. It is a non-volatile memory storage.

**SSD** : Solid State Drive. It is a secondary storage make from Flash memory chip. It is non-volatile memory. It is faster and costlier than of HDD.

### 6.10 Assignment :

1. Draw a chart of different types of memory used in computer system by its categories.
2. List and explain features of HDD.
3. List and explain different types of optical memories.

### 6.11 Activity :

Do search on Internet about RAID. Make a list of different configurations of RAID and make a note of each configuration of RAID.

### 6.12 Further Reading :

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.

**UNIT STRUCTURE**

- 7.0 Learning Objectives
- 7.1 Introduction
- 7.2 Keyboards
- 7.3 Pointing Devices
  - 7.3.1 Mouse
  - 7.3.2 Trackballs
  - 7.3.3 Joystick
  - 7.3.4 Touch Screen
  - 7.3.5 Light Pen
- 7.4 Scanning Devices
  - 7.4.1 Optical Scanner
  - 7.4.2 Bar-Code Reader
- 7.5 Cameras
  - 7.4.3 Digital Camera
  - 7.4.4 Web Camera
- 7.6 Voice Recognition System
- 7.7 Let Us Sum Up
- 7.8 Suggested Answers for Check Your Progress
- 7.9 Glossary
- 7.10 Assignment
- 7.11 Activity
- 7.12 Case Study
- 7.13 Further Readings

**7.0 Learning Objectives :**

After working through this unit, you should be able to :

- Specify the types of I/O devices and their use in computer systems
- State the basic principle of working of keyboard and its various types
- Name various types of key switches
- Enlist various types of mouse used in computer systems
- Explain the principle of working of mouse, joystick, OCRs and trackball

**7.1 Introduction :**

As we have discussed that the role of the computer system is to take input the data from the user, process it and produces output. To input the data to the computer system various Input devices and to obtained output from the computer

system various output devices are used. In this unit we will discuss various input devices and in the next unit we will discuss various output devices of the computer system.

## **7.2 Keyboard :**

One of the general and most common ways to input data is by keyboard. The Keyboards convert or translate numbers, letters and special characters that people understand into electrical signals. These electrical signals are sent to and processed by the system unit.

There are wide varieties of different keyboard designs. They range from the traditional keyboards to ergonomic keyboards to space saving or flexible keyboards.

There are four types of keyboards on basis of type of key switch – Mechanical, Membrane, and Capacitor and Hall Effect keyboards. Let us discuss these types :

### ❖ **Mechanical Keyboard :**

As the name suggested, the mechanical keyboard comprises of mechanical key switches. In mechanical switch keys, two pieces of metal are pushed together when the key is pressed. The switch elements are made up of phosphor bronze alloys with gold plating on contact areas. The key switch is provided with a spring to return the key to the non–pressed position. The small piece of foam is provided to help damp out bouncing.

**Advantage :** The main advantage is a low cost.

**Disadvantage :**

1. The mechanical key switches suffer from contact de–bounce. The pressed key may make and break contact several times before it makes a solid contact.
2. Over the period of aging, the contacts may become oxidized or dirty. As a result, the key switches become sluggish and insensitive.

**Life :** The life of higher–quality mechanical key switches is about 1 million keystrokes.

### ❖ **Membrane Keyboard :**

The membrane key switches comprise of three–layer plastic or rubber sandwich. The top layer has a conductive line of silver ink running under each row of keys. The middle layer has a hole under each key position. The bottom layer has a conductive line of silver ink running under each column of keys.

When you press the key, you push top ink line through the hole to contact the bottom ink line.

**Advantage :** The advantage of such type of keyboards is that they can be made very thin, sealed units.

**Disadvantage :** These keyboards have a limited usage. You have seen these keyboards in mobile phones, calculators, billing machines etc. However, you cannot use these keyboards as general–purpose keyboards.

**Life :** The life of these keyboards varies over a wide range.

❖ **Capacitive Keyboard :**

As name indicates, this type of keyboard comprises of capacitive type of key switches. The capacitive key switch has two small metal plates on printed circuit board and another metal plate at the bottom of piece of foam. When you press the key, the movable plate is pushed closer to the fixed plate. This changes the capacitance between two plates. This change in capacitance is detected by the sense amplifier circuit. This generates a logic level signal that indicates that the key has been pressed.

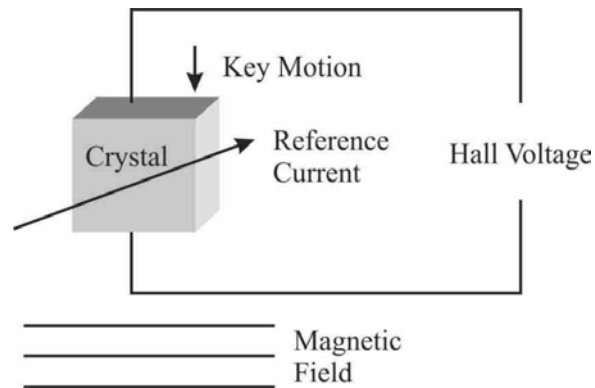
**Advantage :** There are no mechanical contacts to become oxidized or dirty.

**Disadvantage :** The sense amplifier circuit should be able to identify the key closure at all the times.

**Life :** The life of capacitive key switches is about 20 million keystrokes.

❖ **Hall Effect Keyboard :**

The other type of key switch has no mechanical contacts. It takes advantage of deflection of moving charge by a magnetic field.



**Fig. 7.1 : Hall Effect Keyboard**

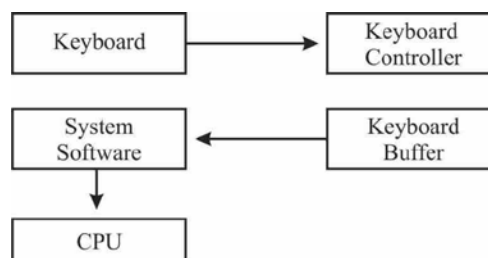
The working of the Hall Effect key switches is shown in Fig. 7.1. The reference current is passed through a semiconductor crystal between two opposing faces. When the key is pressed a crystal is moved through a magnetic field which has its flux lines perpendicular to the direction of current flow in the crystal. Moving crystal through magnetic field causes a small voltage to be developed between two of the opposing faces of the crystal. This voltage is amplified and used to indicate that the key is pressed.

**Advantage :** There are no mechanical contacts to become oxidized or dirty.

**Disadvantage :** Hall Effect keyboards are more expensive because of more complex switch mechanisms.

**Life :** The life of capacitive key switches is about 100 million keystrokes.  
Working of Key Board (How computer accepts input from Keyboard)

The working of keyboard takes place as shown in the functional block diagram. (Fig 7.2)



**Fig. 7.2 : Working of a keyboard**

**The various steps are as follows :**

1. The key is pressed on keyboard.
2. The scan code sent by keyboard controller for the key to the keyboard buffer.
3. The interrupt request sent by keyboard buffer to the system software.
4. System software then responds to the interrupt by reading scan code from the buffer of the keyboard.
5. Then the system software passes the scan code towards the CPU.

When you press any key on keyboard, the chip keyboard controller comes to know that the key is pressed. The keyboard controller places a code corresponding to pressed key, into part of its memory unit is known as keyboard buffer. Buffer is mainly a temporary storage area that holds data until it can be processed. Then, the keyboard controller delivers a signal to the system software. When the system software gets or receive signal to generate relevant response, the keystroke occurs to the system that reads the memory location in the keyboard buffer which contains code of the key that was pressed. The system software then sends that code to CPU.

The keyboard buffer can store many keystrokes at a time. This is necessary because sometimes, there are elapses between pressing of the key and computer's reading of that key from the keyboard buffer. With keystrokes stored in the buffer, the program can react with them when it is convenient.

**❖ IBM Enhanced Keyboard :**

The keyboard conforming to IBM standard is known as IBM enhanced Keyboard. The keyboard has about 100 keys. Each key when pressed generates a separate signal for CPU. The 100 keys are arranged in five groups. The keys on keyboard are having following sections :

1. **Alphanumeric Keys :** This section comprises of alphabetical keys viz. A, B, C .... Z and numeric keys viz. 0, 1, 2...9
2. **Modifier Keys :** The SHIFT, ALT (Alternate) and CTRL (Control) keys are called Modifier Keys, because they modify input received from the other keys.
3. **Numeric Keypad :** It is located at the right side of the keyboard. It looks like a calculator's keypad. It has 10 numeric keys and mathematical operator keys (+, -, \* and /). The numeric key pad can be activated by using NUM LOCK key.
4. **Function Keys :** There are 12 function keys viz. F1, F2, F3.... F12, situated at top of the keyboard. Each key has a purpose as per program being used. Usually F1 key gives help menu.
5. **Cursor Movement Keys :** The four arrow keys are provided for movement of cursor on the screen. These four keys are up, down, right and left arrow keys.
6. **Special Purpose Keys :** The special keys provided are ESC, Print Screen, Pause, Insert, Delete and Scroll lock.

❑ **Check Your Progress – 1 :**

1. How many Function Keys are available on the keyboard ?  
[A] 9                    [B] 12                    [C] 22                    [D] 11
2. Identify the Identifier Keys from the given below :  
[A] CTRL                [B] ALT                    [C] SHIFT                [D] All of these
3. In \_\_\_\_\_ keyboard keys are made from three-layer plastic or rubber.  
[A] Hall Effect    [B] Capacitive    [C] Mechanical    [D] Membrane

**7.3 Pointing Devices :**

Pointing devices provide an interface with the system unit by accepting point gestures and converting them into machine readable input. There are wide variety of different pointing devices including mouse, joystick, touch screen and light pen. While the most frequent pointing device by far is the mouse, and many more devices have been developed.

**7.3.1 Mouse :**

In early 1980s, when the Personal Computer was introduced, it was having only keyboard as the main input device. The pointing device was not much required in those days. However, the requirement of mouse was realized as new software's came in. Today, mouse has become an integral part of the computer system.



**Fig. 7.3 : Mouse**

The various events performed on mouse are click, double click, right click, drag and drop.

**The main components of mouse are as follows :**

1. **Left Button :** It involves two events – single click and double click. Single click on item on monitor to select it. Double click to perform an action.
2. **Right Button :** Single right clicking on the object displays a short cut menu of options.
3. **Mouse Cable :** It connects and sends electronic signals from mouse to system unit.
4. **Roller Ball :** It converts movement of mouse into electronic signals.

You can configure mouse properties. For example, you can change the shape of a mouse pointer. Select start > settings > control panel > mouse. The dialog box "mouse properties" will appear on the screen. The various options are buttons, pointers, pointer options, Hardware, activities and wheel. Select the required option for configuration.

- A. **Mechanical Mouse :** Is the most common type of point device. It contains a small rubber ball that protrudes through a hole in the bottom of mouse body. A ball rotates inside the case as you move the mouse around on flat surface. Inside the mouse, rollers, sensors send or deliver signals to the computer telling it the distance, direction and speed of the ball's motion. The computer uses this data to point the mouse pointer on the screen.
- B. **Optical Mouse :** This mouse is a non-mechanical type of mouse. This type of mouse uses a light-emitting diode and photodiodes to detect movement relative to the underlying surface, rather than internal moving parts as other mechanical mouse does. It emits a beam of light from its underside; it uses



light's reflection to judge the distance, direction and speed of travel. The optical mouse offers two benefits :

1. Without using cursor movement keys, the mouse lets you position the cursor anywhere on the screen quickly. Then you move the pointer to the on-screen position you want and press the mouse button, the cursor display at that location.
2. Instead of forcing to type or issue commands from keyboard, the mouse-based operating system allows you to use menus and dialog boxes.
3. Compared to mechanical mouse, the optical mouse is maintenance free. It does not require periodic cleaning.
4. The optical mouse is more precise as compared to the mechanical mouse.

**C. Wheel Mouse :** This type of mouse has a small wheel among its buttons. This wheel can be used for scrolling through a long document. Not all applications and operating systems support the use of wheel.

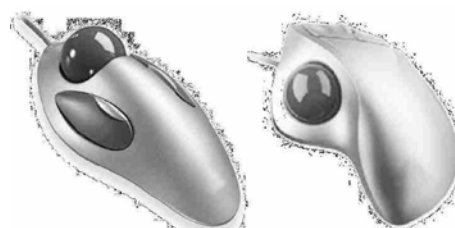
Cordless or wireless mouse is a battery powered device that uses radio waves or infrared light waves to communicate with the system unit. This type of mouse eliminates mouse cord and free up desk space. A cordless mouse frees you from cord problems. It connects to your computer with a radio (rather than an infrared) signal, powered by two AAA batteries.

**□ Check Your Progress – 2 :**

1. \_\_\_\_\_ is a pointing device.  
[A] Keyboard [B] Monitor [C] Printer [D] Mouse
2. To change the mouse setting, you need to open \_\_\_\_\_ of the system.  
[A] Device Manager [B] Disk Manager  
[C] Control Panel [D] Programs
3. A \_\_\_\_\_ mouse has a small rubber ball that protrudes through a hole in the bottom of mouse body.  
[A] Mechanical [B] Optical [C] Wireless [D] All of the above

**7.3.2 Track Balls :**

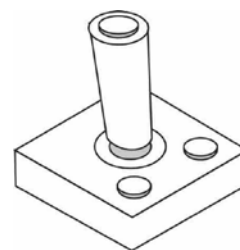
This is a pointing device similar to mouse are trackballs, touch surfaces and pointing sticks. It is a pointing device which looks like an upside-down mouse with an exposed protruding ball. The user rolls the ball with the thumb, fingers, or the palm of the hand to move a cursor. You can use trackball (also called roller ball) to control pointer by rotating ball with your thumb. A touch surface (track pad) is a pointing device consisting of specialized surface that can translate the motion and position of a user's fingers to a relative position on screen. You can also use touch surfaces to control the pointer by moving and tapping you finger on surface of a pad. You can use pointing stick located in the middle of a keyboard to control the pointer by directing the stick with your finger.



**Fig. 7.4 : Track ball**

### 7.3.3 Joy Stick :

Joystick is the most commonly used input device for computer games. The game actions are controlled by varying pressure, speed and direction of Joystick. Additional controls such as buttons and triggers are used to specify commands or initiate specific actions. The joystick has been the principal flight control in the cockpit of many aircraft, particularly military fast jets.



**Fig. 7.5 : Track ball**

### 7.3.4 Touch Screen :

It is a particular kind of monitor screen covered with a plastic layer. Behind this layer are crisscrossed invisible beams of infrared light. This arrangement enables someone to select actions or commands by touching the screen with finger.

Touch screens are easy to use, especially when people need information quickly. These types of displays can be attached to computers or to networks as terminals. These are commonly used at restaurants, automated teller machines (ATMs) and information centres.

### 7.3.5 Light Pen :

Light pen is light sensitive pen like device. A light pen is a computer input device in the form of a light-sensitive wand used in conjunction with a computer's CRT TV set or monitor. It allows the user to point to displayed objects, or draw on the screen. The light pen is placed against the monitor. This closes photoelectric circuit and identifies the spot for entering or modifying data. Light pens can be used to do graphical representations on a computer. For example, light pens are used to edit digital images.

#### ❑ Check Your Progress – 3 :

- \_\_\_\_\_ is the most commonly used input device for computer games.  
[A] Mouse [B] Track ball  
[C] Joystick [D] None of the above
- \_\_\_\_\_ input device is similar to mouse, having a ball to point the object on the screen.  
[A] Mouse [B] Track ball [C] Joystick [D] Touch screen
- In a mobile or tablet, \_\_\_\_\_ is used as an input device.  
[A] Mouse [B] Track ball [C] Joystick [D] Touch screen
- \_\_\_\_\_ is optics sensitive, input pointing device.  
[A] Mouse [B] Light pen [C] Joy stick [D] Touch screen

### 7.4 Scanning Devices :

Scanners read data or information from source and which can be a written document, inventory card, price tag, photograph or picture. A scanning device reads data or information and converts it into a form that the computer can process. There are three types of scanning devices : Optical scanners, bar code readers and character and mark recognition devices.

### 7.4.1 Optical Scanners :

The optical scanner copies or reproduces text as well as images. These devices record light as well as dark areas and also colour of the scanned document. After scanning the image, it can be displayed, printed on paper and stored in memory. There are two categories of optical scanners – Flatbed and portable.

Flatbed scanner is similar to a copying machine. The image which is to be scanned is placed on the glass surface above the scanner which records image from below.

Portable scanner is a type of hand-held device that slides across the image making a direct contact.

The optical scanners are used widely in the world. These are the powerful tools for a wide variety of end users. This includes advertising and graphic professionals who scan images and combine with text. Lawyers and students use portable scanners as a valuable research tool to record information.

### 7.4.2 Bar-Code Readers :

As we all have seen bar code readers at different stores. Wand readers or platform scanners are photoelectric scanners that read the bar codes or vertical zebra-stripped marks, printed on product containers. The electronic cash registers are used in supermarkets. There the bar code system is called Universal Product Code (UPC). The bar code identifies product to the supermarket's computer which has a description and least price for the product. The computer automatically tells electronic cash register, the price of the product. These devices are easy to operate and user friendly.



*Fig. 7.6 : Bar-Code Reader*

### Character and Mark Recognition Devices :

These are the scanners that are able to recognize special characters and marks. They are the special devices that are essential tools for certain applications. There are following three types of Character and Mark Recognition Devices :

1. **Magnetic Ink Character Recognition (MICR) :** It is used in banks to automatically read the MICR Number printed at the bottom of the cheque. It is read by special purpose machine known as reader / sorter which reads characters. These characters are made by ink containing magnetized particles.
2. **Optical Character Recognition (OCR) :** The pre-printed characters can be read by the light source and can be converted into a machine-readable code. The common OCR device is a hand-held wand reader. These are used in the departmental stores to read retail price tags by reflecting light on the printed characters.
3. **Optical Mark Recognition (OMR) :** It is also called mark sensing. An OMR device senses whether the mark as pencil mark is present or absent. The OMR technique is used in evaluation of competitive examination performance. This technique is used for evaluating marks in examinations such as Graduate Record Examination (GRE), Scholastic Aptitude Test (SAT) etc.



**Fig. 7.7 : Optical Mark Recognition**

**□ Check Your Progress – 4 :**

1. OMR Stands for \_\_\_\_\_.  
[A] Object Machine Reader [B] Optical Machine Reader  
[C] Optical Mark Recognition [D] Optical Mark Resolution
2. To process the cheques, \_\_\_\_\_ is used.  
[A] OMR [B] OCR  
[C] MICR [D] None of the above
3. \_\_\_\_\_ is used to read UPC.  
[A] Bar-code reader [B] MICR reader  
[C] Flatbed scanner [D] OMR reader

**7.5 Cameras :**

**7.5.1 Digital Camera :**

Optical scanners, like traditional copying machines, can make a copy from an original object. For example, we can copy a photograph by using optical scanner. Digital camera is an image capturing device which creates or captures original images. Digital camera is similar to traditional camera except that the images are recorded digitally. The images are stored in the memory of the camera or on the disk and not on the film itself. We can take a picture, view it instantly, store it in a memory and place it on web page. This can be done immediately.



**Fig. 7.8 : Digital Camera**

Digital cameras are now available at low cost. Using digital camera and special software, you can edit photographs on computer. The digital cameras work much like a regular camera with a value addition of capturing and digital storage of images internally. Typically, photographs are transferred to the computer through USB port. These photographs are read through PC software. This software can further be used to edit, print, e-mail and archive the photographs.

**7.5.2 Web Camera :**

Web camera is the Digital video camera. It is the other kind of image capturing device. Unlike traditional video cameras the web camera record motion digitally in the memory of the camera or on the disk. The Webcams capture images which can be sent to a computer across the globe using the internet.



**Fig. 7.9 : Web Camera**

**Graphic tablets and digital notebooks :**

Graphic tablets and digital notebooks are digitizing devices. Using digitizing devices, the diagram can be converted into the form that is process-able by the computer. These devices are provided with a flat surface and writing device. As the user moves writing device across the surface, the digitization device records the movement as a series of points and sends this information to the computer. The Graphic tablets comprise of the special graphics surface or tablet and special stylus or a pen like device. The user draws a diagram directly on the tablet or traces images that are placed on the tablet. These devices are widely used by artists, draftsman and engineers. Artists create pictures, draftsman creates maps and engineers digitally save the mechanical drawings.

**Digital notebooks :** The digital notepad is positioned on the top of the tablet. Using a regular pen, the user takes notes and creates drawings on the notepad. The underlying electronic pad records the movements. Later, the notes taken by the user can be processed, edited and used with a word processing program.

**7.6 Voice Recognition Systems :**

The Voice Recognition Systems are the audio input devices which convert sound into the form that can be read and processed by the computer. The most commonly used audio input device is the microphone. Microphone is the main part of Voice Recognition Systems. Other components are sound card and special software. Using this system, the document with voice command can be created. It is an input system that uses a microphone (or a telephone) as an input device and converts a person's speech into digital signals by comparing the electrical patterns produced by the speaker's voice with a set of pre-recorded patterns stored in the computer. Voice-recognition technology is useful in situations where people are unable to use their hands to input data or need their hands free for other purposes. Some Voice Recognition Systems can translate dictation taken from language to other language. For example, it is possible to translate from English to Japanese.

**□ Check Your Progress – 5 :**

1. \_\_\_\_\_ is similar to traditional camera except that the images are recorded digitally.
 

[A] Web camera	[B] Digital camera
[C] Scanner	[D] Telescope
  
2. \_\_\_\_\_ is use for dictation.
 

[A] OMR	[B] OCR
[C] VRS	[D] None of the above

3. \_\_\_\_\_ hardware is essential for Voice Recognition System.  
[A] Microphone [B] Speaker [C] Web camera [D] Digital camera

### 7.7 Let Us Sum Up :

#### In this unit :

- We have learnt about various Input devices.
  - We have discussed different types of key boards.
  - We have also seen different types of pointing devices like Mouse, Trackball, Light-pen etc.
  - We have learnt how a hard-copy is converted into the soft-copy using scanners. We have discussed type of scanners.
  - We have seen special type of scanners like MICR, OCR and OMR type of devices.
  - We have also seen how different types of Cameras can be used for taking input to the computer.
  - Finally, we have ended our discussion with Voice Recognition System.
- Input Devices

### 7.8 Suggested Answers For Check Your Progress :

#### ❑ Check Your Progress 1 :

1. [B]                      2. [D]                      3. [D]

#### ❑ Check Your Progress 2 :

1. [D]                      2. [C]                      3. [A]

#### ❑ Check Your Progress 3 :

1. [C]                      2. [B]                      3. [D]                      4. [B]

#### ❑ Check Your Progress 4 :

1. [C]                      2. [C]                      3. [A]

#### ❑ Check Your Progress 5 :

1. [B]                      2. [C]                      3. [A]

### 7.9 Glossary :

**OMR** : Optical Mark Recognition. It is a technology used to evaluate answer script of objective type of examination.

**MICR** : Magnetic Ink Character Recognition. It is a technology used in the banks to process checks.

**OCR** : Optical Character Recognition. It is a technology to identify character from the image of character.

**UPC** : Universal Product Code

### 7.10 Assignment :

1. Discuss the working of keyboard with functional block diagram. What do you mean by IBM enhanced key board ?
2. What are Character and Mark Recognition Devices ? Discuss their various types

❖ **Short Notes :**

- a. Working of mouse
- b. Various types of mouse
- c. Various types of scanning devices
- d. Light pen
- e. Joystick

**7.11 Activity :**

Explain in brief any five input devices along with their uses.

**7.12 Case Study :**

- Find how Google assistant is working on the Internet and write short description on it.

**7.13 Further Reading :**

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.

**UNIT STRUCTURE**

- 8.0 Learning Objectives
- 8.1 Introduction
- 8.2 Monitors
  - 8.2.1 Other Display Devices
- 8.3 Printers
  - 8.4.1 Dot–Matrix Printer
  - 8.4.2 Ink–Jet Printer
  - 8.4.3 Laser Printer
- 8.4 Let us sum up
- 8.5 Suggested Answer for Check Your Progress
- 8.6 Glossary
- 8.7 Assignment
- 8.8 Activities
- 8.9 Case Studies
- 8.10 Further Readings

**8.0 Learning Objectives :**

After working through this unit, you should be able to :

- Specify the principle of working of monitor
- Enlist various types of output devices
- State the types of printers
- Explain the working of dot matrix printer, ink jet printer, laser printer and LED printer
- Discuss the concept of e–book reader, data projector and HDTV
- Identify the role of output devices in computer systems

**8.1 Introduction :**

Output is defined as a processed data from computer. Output is available to us in the form of hard copy or soft copy of text, graphics, audio, video modes.

The hardware used to provide output processed by the computer is known as output device. Monitors, printers, plotters are the commonly used output devices. For example, let us suppose that you have prepared PowerPoint presentation on some topic. You would practice the presentation on Monitor, take printouts from printer and listen to presentation using audio systems. These output devices translate the information processed by computer into the form that people can understand and use.



**8.2 Monitors :**

A monitor or display (also called a visual display unit) is a piece of electrical equipment which displays images generated by devices such as computers, without producing a permanent record. The monitor comprises the actual display device, circuitry and an enclosure. The display device in modern monitors is typically a thin film transistor liquid crystal display (TFT–LCD), while older monitors use a cathode ray tube (CRT).

Monitor is the most frequently used output device. The main features of monitor are size and clarity. The size of a display is typically given as the distance between two opposite screen corners. The size of monitor is specified as 15", 17", 19" etc. Larger monitors have the advantage of displaying more information on screen. However, these are more expensive.

Resolution of monitor indicates clarity. The unit of resolution is pixels. Pixels are individual dots or "picture elements" that form images on monitor. For a given size monitor, greater the resolution (i.e. more pixels), better the clarity of image. For a higher level of clarity, larger monitors require higher resolution (i.e. more pixels).

To indicate resolution capabilities of a monitor, several standards are available. The most common standards are SVGA, XGA, SXGA and UXGA.

**The resolution standards of monitor are furnished in the Table.**

Standard	Expanded name	Pixels	Monitor Size
SVGA	Super Video Graphics Array	800 X 600	15"
XGA	Extended Graphics Array	1024 X 768	17" and 19"
SXGA	Super Extended Graphics Array	1280 X 1024	19" and 21"
UXGA	Ultra–Extended Graphics Array	1600 X 1200	21"

As seen from the above table, the minimum resolution is provided by SVGA and maximum by UXGA. UXGA is the newest and highest standard. The UXGA monitors are primarily used for high end engineering design and graphic arts.

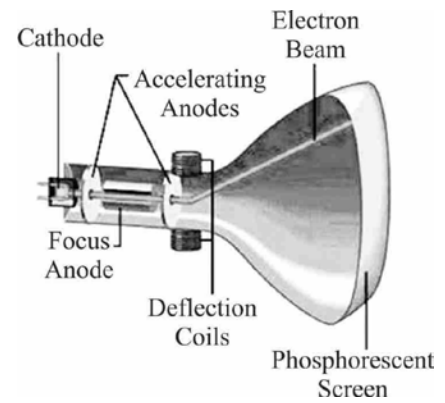
**There are two main types of monitors :**

[1] The CRT monitor, which is big and heavy. It is the oldest technology used by monitors. It looks like a television, but has a bigger display resolution and often a higher frequency. CRT stands for cathode–ray tube. The advantages of CRT monitor are low cost and high resolution. The disadvantage is larger size.

**☐ Check Your Progress – 1 :**

- To view the output in soft–copy form \_\_\_\_\_ output device is used.  
[A] Printer [B] Speaker [C] Monitor [D] Scanner
- The resolution supported by SVGA is \_\_\_\_\_ pixels.  
[A] 800 \* 600 [B] 1024 \* 768 [C] 1280 X 1024 [D] 1600 \* 1200
- The type of large size monitor is \_\_\_\_\_.  
[A] LED [B] CRT [C] LCD [D] Plasma

- [2] The LCD monitor (also called Flat Panel Monitor) is thin, flat and lightweight type of monitor. It is a newer technology item than CRT type. The quality can be the same or even better than a CRT, but this type of monitor costs more than a CRT monitor. There are two types of LCD Monitors – passive matrix and active matrix. Passive matrix (also called dual scan monitors) creates images by scanning entire screen.



**Fig. 8.1 : Working of Monitor**

This type of monitor requires a little power but clarity is not much sharp. Active matrix or thin film transistor (TFT) monitors do not scan down the screen. Instead, each pixel is activated independently. More colours with better clarity can be displayed. These types of monitors are expensive and require more power

### 8.2.1 Other Display Devices :

There are some other types of monitors used for specialized applications. Let us understand the working of these monitors.

1. The hand-held book size devices called is E-book which displays text and graphics. Using contents which are downloaded from the web, these devices are used to read newspapers, magazines and entire books. These readers are very economical. The cost of producing and distributing e-book content is less than publishing. And delivering traditional print media. The other benefit is the time required to create and distribute content is less. Therefore, it is predicted that the e-books will be popular soon
2. Data projectors are specialized devices like slide projectors. These types of devices however connect to computer like microcomputers and project computer output just as it would appear on a traditional monitor. Salesmen, demonstrators, students make and deliver power point presentations on data projectors. The data projectors are mostly used for presentation at any place like classroom and boardroom.
3. High Definition Television (HDTV) is the recent development in the integration of computer and television. The High Definition Television (HDTV) views much clearer and more detailed wide screen picture than a regular television. Because, the output is digital, users can easily freeze video sequences to create high quality still images. The video and still images can then be digitized, edited and stored on disk for later use. This technology is very useful to graphic artists, designers and publishers.

#### ☐ Check Your Progress – 2 :

1. From the given below, \_\_\_\_\_ is not a type of monitor.  
[A] CRT            [B] LCD            [C] TFT            [D] Data Projector
2. LCD stands for \_\_\_\_\_.  
[A] Large Computer Display            [B] Local Crystal Design  
[C] Liquide Crystal Display            [D] Liquide Crystal Design

3. Identify small hand-held display output device from the given below devices.
- |                    |                 |
|--------------------|-----------------|
| [A] E-book Reader  | [B] CRT Monitor |
| [C] Data projector | [D] TFT Monitor |

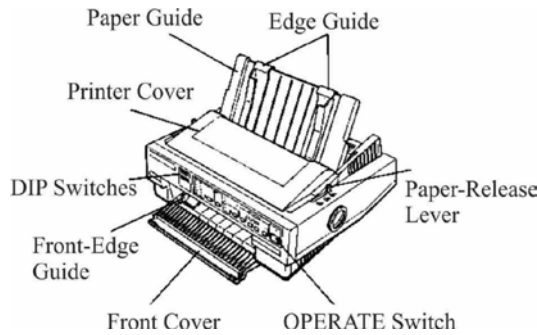
**8.3 Printers :**

The output view on monitor is referred as a soft copy. The output printed on paper through a printer or plotter is called a hard copy. Printer is an important output device for maintaining a hard copy of documents. The commonly used printers are dot matrix, Ink-jet, laser, LED printers. Let us study these types of printers.

**8.3.1 Dot-Matrix Printers :**

A dot matrix printer/impact matrix printer is a commonly used printer. It is use in situations where printed content is more important than quality.

The printer mechanism comprises of a print head that runs back and forth, or in an up and down motion, on the page and prints by impact, striking an ink-soaked cloth ribbon against the paper, much like a typewriter. Because the printing involves mechanical pressure, these printers can create carbon copies and carbonless copies.



**Fig. 8.2 : Dot-Matrix Printer**

Typical output from a dot matrix printer operating in draft mode. This image represents an area of printer output approximately 4.5 cm × 1.5cm (1.75 × 0.6 inches) in size.

Each dot is produced by a tiny metal rod, known as a "wire" or "pin", which is driven forward by the power of a tiny electromagnet or solenoid, either directly or through small levers (pawls). Facing the ribbon and the paper is a small guide plate pierced which contains holes to serve as guides for the pins.

**Advantages :**

1. These machines are highly durable.
2. The cost of these printers is less as compared to other printers.
3. Dot matrix printers such as impact printer, which can make carbon-copies or print on multi-part stationery.
4. Printers like Impact printers which have the lowest printing costs for one page.

**Disadvantages :**

1. Impact printers can only print low resolution graphics, with limited color performance, limited quality and comparatively low speed.
2. These are noisy printers, to the extent that sound dampening enclosures are available for use in quiet environments.

❑ **Check Your Progress – 3 :**

- To view the output in hard-copy form \_\_\_\_\_ output device is used.  
[A] Printer [B] Speaker [C] Light pen [D] Scanner
- The \_\_\_\_\_ printer is less-costly, prints like a typewriter.  
[A] Ink-Jet [B] Ink-Tank [C] Dot-matrix [D] Laser
- \_\_\_\_\_ printer is noisy, low-resolution, low-speed impact printer.  
[A] Laser [B] Dot-matrix  
[C] Ink-Jet [D] None of the above

**8.3.2 Ink-Jet Printers :**

Ink-Jet printer is a non-impact printer that build a character or graphics shapes on the paper by sprinkling of liquid ink in the shape of tiny dots. The quality of print is far better than the print taken by a dot-matrix printer. Ink-jet printer has two cartridges, one of black ink and another of color ink. These cartridges have ink in liquid form.



**Fig. 8.3 : Ink-Jet Printer**

There is a small head is there on the bottom part of the cartridge, which consists of tiny dots and a circuit. Circuit will open or close the dots depending upon the shape of the character to be printed on the paper. Ink-jet printers can be used to print greetings cards, business cards, letterheads and so on.

Compare to dot-matrix printer, ink-jet printer is costly and can produce better quality of printout. The speed of an ink-jet printer is measured in ppm (pages per minutes). Ink-jet printer is faster than dot-matrix printers.

❑ **Check Your Progress – 4 :**

- \_\_\_\_\_ printer use liquid ink to print the paper.  
[A] Laser [B] Ink-Jet  
[C] Dot-matrix [D] None of the above
- Ink-jet printer used \_\_\_\_\_ to print the characters or graphics on the page.  
[A] Toner [B] Carbon Ribbon  
[C] Cartridge [D] None of the above
- \_\_\_\_\_ printer is non-impact printer, produces high quality printout from tiny dots.  
[A] Laser [B] Dot-matrix  
[C] Both [A] and [B] [D] Ink-Jet

**8.3.3 Laser Printers :**

Laser printer is a high-speed, produces high-quality printouts. It is a kind of non-impact printer. Black & White and Color are two models of a laser printer. Color laser printers are very costly printer. It is similar to a copier machine.

A laser printer has special component called tonner, which is filled with carbon powder. The laser beam used in the laser printer produces an image on the drum within printer. The laser light alters the electrical charge on the drum whenever it hits. The toner then sticks the carbon particles on the paper by

applying proper heat and pressure. When the toner becomes empty (without carbon powder), you can refill or replace the toner. Generally, one toner can print 3000 or more pages.

So, the sum of  $(47) : 0010\ 1111$  and  $(29) : 0001\ 1101 = 0100\ 1100$ . Now try to convert binary  $0100\ 1100$  into decimal you will get  $0 + 64 + 0 + 0 + 8 + 4 + 0 + 0 = 76$ .



**Fig. 8.4 : Laser Printer**

**❑ Check Your Progress – 5 :**

1. \_\_\_\_\_ printer is faster, producing high quality of printouts.  
 [A] Dot–matrix                          [B] Ink–jet  
 [C] Laser    [D] None of the above
2. \_\_\_\_\_ printer use toner to print the pages.  
 [A] Ink–jet              [B] Laser              [C] Dot–matrix      [D] Impact

**8.4 Let Us Sum Up :**

The hardware used to provide output processed by the computer is known as output device. Monitors, printers, plotters are the commonly used output devices. A monitor or display (also called a visual display unit) is a piece of electrical equipment which displays images generated by devices such as computers, without producing a permanent record. To indicate resolution capabilities of a monitor, several standards are available. The most common standards are SVGA, XGA, SXGA and UXGA.

**The TWO main types of monitors are :**

- The CRT monitors, which are big and heavy. This is the oldest technology used by monitors. It looks like a television, but has a bigger display resolution and often a higher frequency. CRT stands for cathode–ray tube. The advantages of CRT monitor are low cost and high resolution. Its main disadvantage is its large size.
- The LCD monitor (also called Flat Panel Monitor) is thin, flat and lightweight type of monitor. It is a newer technology item than CRT type.

E–books are hand held book size devices which displays text and graphics. Using contents downloaded from the web, these devices are used to read newspapers, magazines and entire books.

Data projectors are specialized devices similar to slide projectors. These devices however connect to microcomputers and project computer output just as it would appear on a traditional monitor.

High Definition Television (HDTV) it is the recent development in the integration of computer and television. The HDTV delivers much clearer and more detailed wide screen picture than a regular television.

Printer is an important output device for maintaining a hard copy of documents. The commonly used printers are dot matrix, Ink–jet, laser, LCD printers. Let us study these types of printers.

A dot matrix printer or impact matrix printer is a commonly used type of printer. It is ideal for use in situations where printed content is more important than quality.

Inkjet printers are the most common type of computer printer for the general consumer due to benefits such as low cost, high quality of output, capability of printing in different colors and ease of use.

A laser printer is mostly used printer that rapidly produces high quality text and graphics on plain paper.

In the print head LED technology uses a light-emitting diode array as a light source. The LED bar pulse-flashes across the page width and creates the image on the print drum or belt as it moves past.

### 8.5 Suggested Answers For Check Your Progress :

- ❑ **Check Your Progress 1 :**  
1. [C]                      2. [A]                      3. [B]
- ❑ **Check Your Progress 2 :**  
1. [D]                      2. [C]                      3. [A]
- ❑ **Check Your Progress 3 :**  
1. [A]                      2. [C]                      3. [B]
- ❑ **Check Your Progress 4 :**  
1. [B]                      2. [C]                      3. [D]
- ❑ **Check Your Progress 5 :**  
1. [C]                      2. [B]

### 8.6 Glossary :

**CRT :** Cathode Ray Tube. It is a technology used in monitor or television.

**LCD :** Liquid Crystal Display. It is also a type of monitor.

**LED :** Light Emitting Diode. It is a type of monitor or television.

**HDTV :** High-Definition Television

**TFT :** Thin Film Transistor. A type of monitor.

**SVGA :** Super Video Graphics Array. It a type of display resolution.

### 8.7 Assignment :

- ❖ **Broad Questions :**
  1. What do you mean by Dot Matrix Printer ? State its advantages and disadvantages.
  2. Discuss the principle of working of output devices in computer systems.
- ❖ **Short Notes :**
  - a. Ink Jet Printers
  - b. LED Printers
  - c. HDTV
  - d. Data Projector
  - e. E-book reader

### 8.8 Activity :

Explain in brief any five output devices along with their use.

**8.9 Case Study :**

- Gather the information of other types of printers given below and write a short note on it :
  - o Plotters
  - o Multi-Function Printers

**8.10 Further Readings :**

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.
4. Computer Essentials, Timothy J. O'Leary, Linda O'Leary, MKCL Publishing
5. Fundamentals of Computers, V. Rajaraman, Prentice Hall of India
6. Introduction to Computers, Peter Norton, McGraw Hill Publishing Technology Edition

**BLOCK SUMMARY :**

- Computer takes Input (Data) from the user process it and produces Output (Information).
- To process the data, computer need store data, information and instructions into the computer's memory.
- Memories of the computer can be divided into two categories [1] Primary Memory and [2] Secondary Memory.
- Primary memories are faster compared to the secondary memory. They are made from the circuits and they are costlier than secondary memories.
- Primary memories are divided into two categories [1] RAM and [2] ROM.
- RAM stands for Random Access Memory which is based on IC (Integrated Circuits). It is also known as main memory of the system. It is a costly memory available in two types S-RAM and D-RAM.
- CPU directly interact with the RAM as it is fast memory. RAM is volatile memory and loose its content when we turn off the machine.
- ROM stand for Read Only Memory. BIOS is an example of ROM which is responsible to boot the operating system for any computer.
- Improved versions of ROM are PROM, EPROM, EEPROM, and Flash memory.
- Secondary memories are slower compared to the primary memory, they are cheaper and non-volatile memory.
- CPU cannot directly interact with the secondary memory directly. Secondary memory is used to store the data permanently.
- HDDs (Hard Disk Drives) and SSD (Solid State Drives) are popular examples of secondary memories. SSDs are faster than HDDs.
- Optical memories like CD-ROM, DVD and Blu-Ray discs are also secondary memories.
- Portable memories like Pen-drive, Memory card which are made from Flash memories are also an example of secondary memory.
- Cache memory is a high-speed memory placed between CPU and Main memory to reduce speed mismatch problem between CPU and Main memory.
- To input the data to the computer system we need to use Input devices.
- Keyboard and Mouse are popular examples of the Input devices.
- Mouse is pointing input device. Other pointing input devices are trackball and light pen.
- Other input devices which we are using in our daily lives are magnetic strip cards, smart card, barcode reader and RFID tags.
- Cameras like Digital cameras and web cameras are also example of input devices.
- To get the information from the computer system we need to use output devices.
- Monitors and Printers are examples of output devices.



- CRT, LCD, LED, TFT are the different types of monitors. Monitors are used to view soft-copy of the information produces by the computer system.
- do the presentation to a group of people data projector is used, which also an output device.
- Dot-matrix, Ink-jet and Laser printers are popular printers. Dot-matrix is cost effective printer, produces low quality of printout. It is a very slow printer.
- Ink-jet have cartridge, which contain ink in liquid form. Ink-jet printers prints high quality of printout with tiny dots and liquid ink.
- Laser printer produces high quality of printouts. They are much reliable. It is costly printer which can print information faster than dot-matrix and ink-jet printer.

**BLOCK ASSIGNMENT :****❖ Short Answer Questions :**

- (1) List the categories of memory
- (2) Differentiate primary memories and secondary memories
- (3) What is cache memory ? How it is useful in the computer system
- (4) What is flash memory ?
- (5) What is smart card ?
- (6) List all pointing devices
- (7) What is OMR ? What is the use of it ?

**❖ Long Questions :**

- (1) Explain characteristics of memory devices
- (2) Explain Random Access Memory in brief
- (3) Explain characteristics of secondary memory devices
- (4) What are hard drives ? Explain its types in brief
- (5) Write a short note on optical memories
- (6) List and explain different types of printers

**Fundamentals of  
Computer and  
Information  
Technology**

❖ **Enrolment No. :**

1. How many hours did you need for studying the units ?

Unit No.	5	6	7	8
No. of Hrs.				

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

3. Any other Comments

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Dr. Babasaheb Ambedkar  
Open University Ahmedabad

BCAR-101/  
DCAR-101

# **Fundamentals of Computer and Information Technology**

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## **BLOCK 3 : INFORMATION TECHNOLOGIES**

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UNIT 9 INTRODUCTION TO NETWORK

UNIT 10 THE INTERNET

UNIT 11 DIGITAL SECURITY

# **INFORMATION TECHNOLOGIES**

## **Block Introduction :**

In this current 21<sup>st</sup> century, lots of work we are doing by a computer using Internet Technology. We can shop any goods or services using Internet. We can book railway tickets, flight reservation, or hotel book using Internet. We pay our Mobile, Electricity, Gas, Water, Tax etc bills online with the help of Internet. In this unit we will what is Internet, how it emerged and how it works in details.

Internet is a network of networks. Therefore, in the Unit : 9 we have given a brief idea about the network. We have discussed different types of networks, and different topologies of the network. We will see how the network can be classify into different categories, merits and demerits of the network.

In the Unit : 10 we will focus on the Internet. We will see how the Internet has been evolved, how can we access the Internet into our computer or mobile device. We will discuss the role of ISPs. In this unit we will see what is IP-address and how the machines are communication with each other using IP-address and Domain names. Then we will see different terminologies related to the Web.

In unit : 11 we will discuss about how can we secure our system from the Hacker. What are the security measures, we need to take so that we can protect our system and data ? We will see different types of security attacks and their solutions.

I hope students will learn lots of things from this block about Network, Internet and Digital Security.

## **Block Objectives :**

Main objective of this block is to aware students, about different types of computer networks, Advantages and disadvantages of computer networks, what different types of networks are used and what types topologies are available.

The objective of the block is to aware students, about the basics of the Internet Technologies, IP-Address and Domain names. This block will give a brief idea of how 'Internet' comes into existence. We will also discuss the web and related terminologies of the Internet.

Finally, the block will clear the concept of different types of digital attacks, cybercrimes and all fundamentals that you should know to protect the computer system or mobile devices from attacker. Students will learn, how to secure the system and data.

## **Block Structure :**

**Unit 9 : Introduction to Networks**

**Unit 10 : The Internet**

**Unit 11 : Digital Securities**

**UNIT STRUCTURE**

- 9.0 Learning Objectives**
- 9.1 Introduction**
- 9.2 What is Network ?**
  - 9.2.1 Advantages of Network**
  - 9.4.2 Limitation of Network**
- 9.3 Classification of Network**
  - 9.3.1 LAN : Local Area Network**
  - 9.3.2 MAN : Metropolitan Area Network**
  - 9.3.3 WAN : Wide Area Network**
- 9.4 Types of Network**
  - 9.4.1 Point-to-Point Network**
  - 9.4.2 Broadcast Network**
- 9.5 Topologies**
  - 9.4.1 Star Topology**
  - 9.4.2 Bus Topology**
  - 9.4.3 Ring Topology**
  - 9.4.4 Mesh Topology**
  - 9.4.5 Hybrid Topology**
- 9.6 Let Us Sum Up**
- 9.7 Glossary**
- 9.8 Suggested Answer for Check Your Progress**
- 9.9 Assignment**
- 9.10 Activities**
- 9.11 Case Study**
- 9.12 Further Readings**

**9.0 Learning Objectives :**

**In this unit, we will discuss about the computer networks :**

- Learn What is network ? And advantages and disadvantages of networks.
- Understand how the computer networks can be classified.
- Know about types of networks.
- Understand various topologies of network.

**9.1 Introduction :**

Initially, when the computers were invented, they were used as standalone machines. Different computers were used for gathering of information, data

processing and obtaining information. Due to change in technology, and rapid growth in the area of information gathering and distribution, connection between computer devices become an essential need. In this unit we will define the term called 'network'. We will also discuss the advantages and disadvantages of it. We will see different types of network.

## **9.2 What is a Network ?**

Two or more devices connected to each other using some media, to share the information (data transfer purpose) or to share resources (the hardware devices) is called network. Networking can be done of any devices. You may have observed that our telephones or mobiles are connected in the network called telephonic or mobile network. Our television sets are connected with the network so that we can view different channels in it. The connection(s) between two or more computing devices to share data or resources is called computer networks.

In order to meet various requirements and needs, different types of applications, different protocols, media and layout plans are used in the networking. Networks can be classified on the basis of its geographic coverage.

### **9.2.1 Advantages of Computer Networks :**

We have defined the term computer networks as – Two or more computing devices are connected to each other to share data or resources is called computer network. But one question will come into your mind that why should we have to connect computing device ? What benefits are getting after connecting two or more computing devices ? So, here we have given a list of advantages to have a computer network.

- 1. Data Sharing :** Computer networks are useful to share data or information from one machine to another. We can transfer the data whether it is an image, audio, video, text message or any type of files like document, PDF, spread sheet or presentation from one computer to another computer, if the machines are connected to each other in the network.
- 2. Resource Sharing :** You can share the hardware resource like CD-ROM, Printer or hard disk drive of a one computer to another computer if both computers are in the network. You can give a printout from one terminal to the printer attached with another terminal if both terminals are connected with each other, and printer is shared in the network.
- 3. Sharing Internet Connection :** With the help of network, you can also share an Internet connection of one machine to another machines.
- 4. Increase Storage :** If the machines are connected with each other in the network, you can store your data on the hard drive of any machine.
- 5. Reliability of Storage :** If the computers are connected in the network, it allows you to take back of the data of one system to any other system. So, if hard-drive of one machine goes out of order you can recover your data from another machine.
- 6. Communication :** If the machines are connected in the network then users can communicate with each other by exchanging text messages (chat) or Email.

❑ **Check Your Progress – 1 :**

1. \_\_\_\_\_ is/are essential for computer networks.  
[A] Applications [B] Protocols [C] Media [D] All of the above
2. From the given below, which not advantage of computer network ?  
[A] Data sharing [B] Communication  
[C] Privacy [D] Resource sharing

**9.2.2 Limitation of Computer Networks :**

Even though, computer network serves many advantages, there are some limitations are also there. The limitations of computer network are described below :

1. **Cost :** To create a computer network, we need to buy UTP (Unshielded Twisted Pair) cables, connectors, network adapters, Hub/Switches etc. Cost is involved in the purchase of all these essential networking devices.
2. **Privacy :** When computers are connected in the network, then Privacy of the user is the biggest issue. If the proper security is not maintained then someone can access your personal data without your permission.
3. **Needs Trained Employees :** Managing a large network is complicated. To manage such network and networking equipment trained staff is required.
4. **Viruses and Other Threats :** If the machines are connected in the network then it is essential to implement proper security. If security concerns are implemented properly then hacker can hack the system and damage the system or data. If any one machine of the network is virus infected, then it may infect other machines of the network.

**9.3 Classification of Networks :**

As we have seen, two or more computing devices are connected with each other will make computer network. Depending up its geographic coverage network can be divided into three main categories.

- [1] LAN : Local Area Network
- [2] MAN : Metropolitan Area Network
- [3] WAN : Wide Area Network

**9.3.1 LAN : Local Area Network :**

A Local area network is privately owned, relatively smaller network. The span of the Local Area Network is maximum 10 km. It is used to provide local connectivity within premises or building in a small geographic area. Local Area Network connects two or more computing devices using Ethernet or Wi-Fi technologies. Computers connected within a building or premises or nearby buildings are examples of LAN.

**9.3.2 MAN : Metropolitan Area Network :**

A MAN is defined for the geographic area which is lesser than 50km. It provides regional connectivity typically within a city or between two cities. Cable TV is an example which connects television sets of a city is a good example of Metropolitan Area Network. MAN covers more geographic area compare to LAN. Companies may create MAN to connect, various LANs of different departments.

### 9.3.3 WAN : Wide Area Network :

Wide Area Network does not restrict to any geographic boundaries. A WAN provides transmission of data, voice, image and video information at a very long distance. Internet is an example of Wide Area Network which cover entire globe. WANs may utilize public, leased or private communication devices usually in combination and span unlimited number of miles.

Now a days another term called PAN becomes popular. PAN stands of Personal Area Network. In a Local Area Network Wi-Fi (Wireless Fidelity) technology may be used, which is based on Radio transmission. But if you connect two devices with the help of Bluetooth technology to transfer data from one computing device to another, then is called Personal Area Network. Bluetooth produces very short-range signals, which may used to connect your wireless ear buds, wireless neck band, wireless headphones or fitness band with your mobile devices. Using PAN, you can connect your mobile phone with your friend's mobile phone to transfer any file using Bluetooth technology.

#### ❑ Check Your Progress – 2 :

- \_\_\_\_\_ is a smallest network, uses Bluetooth technology to transfer data.  
[A] LAN            [B] MAN            [C] WAN            [D] PAN
- A \_\_\_\_\_ is a small network, connect all computing devices of a building or premises.  
[A] LAN            [B] MAN            [C] WAN            [D] PAN
- Internet is an application of \_\_\_\_\_.  
[A] LAN            [B] MAN            [C] WAN            [D] PAN

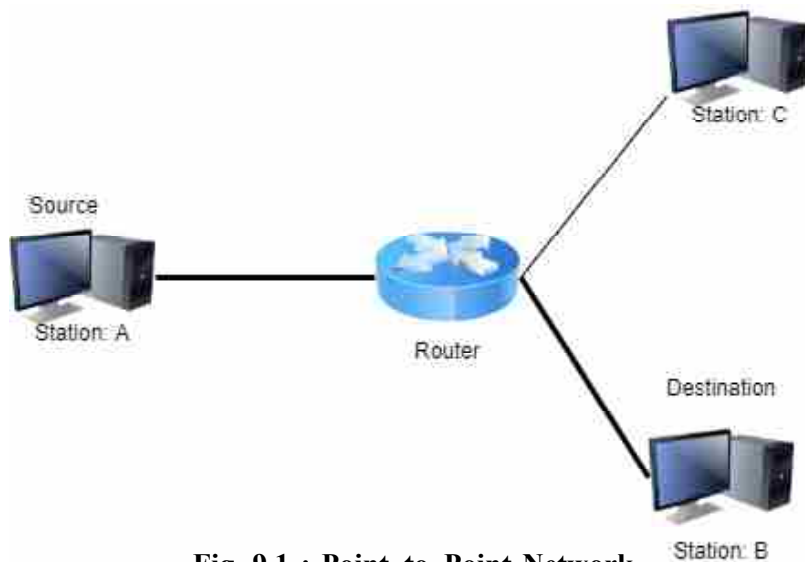
### 9.4 Types of Networks :

There are mainly two types of networks based on that network contains any switching elements or not. These types are : [1] Point-to-Point network and [2] Broadcast network.

#### 9.4.1 Point-to-Point Network :

Point-to-Point is a simplest type of network where two computers or two routers or computer and routers are directly (without any host or networking device) connected. To send the packets from source machine to destination machine, a packet on point-to-point network must have to first visit one or more intermediate machine or router. When the packet is sent by the source machine to the destination machine, each intermediate router between source and destination machine stores the packet. Intermediate routers keep packets into their local memory till the outgoing line towards the destination doesn't becomes free. When the outgoing line towards the destination becomes free, router transmits the packets stored in the memory on a proper outgoing line. In a point-to-point network router transmit the packet on single optimal outgoing line towards the destination and not forward the packets on all outgoing lines. A subnet using this principle is called point-to-point or packet switched network.





**Fig. 9.1 : Point-to-Point Network**

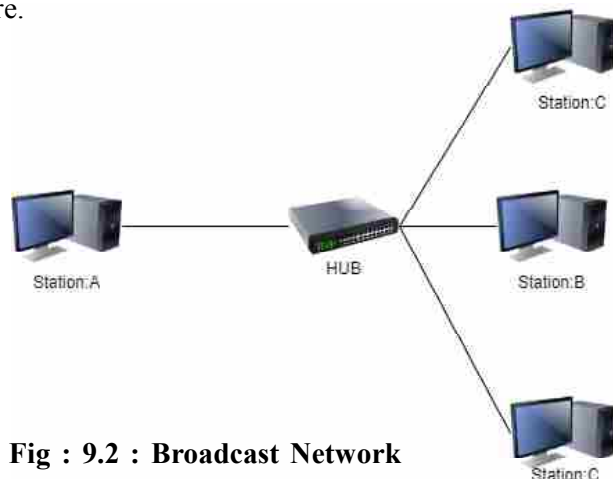
In the Figure 9.1 suppose Station : A is a source and it want to transmit the data to Station : B (Destination). When packet arrives from Source : A to the Router, Router will redirect the packet on particular outgoing line which is connected with Station : B. Here, Station : C will not receive any packet, but packets will be propagated from Station : A to Router, and then Router to Station : B in point-to-point manner.

**9.4.2 Broadcast Networks :**

In a broadcast network a single channel is shared by all the stations (machines) of the network. Packets are sent by any station are sent to all other stations. Destination machine when receive the packet it will accept it and rest of the machines are also receiving the same packets but they will simply ignore it as the packet is not intended to them.

There will be address fields are there in the packet. Before transmitting the data, source machine specifies the addresses of source and destination machine. When the packet is broadcasted, then it will all other stations will receive the broadcasted packet. Every station then matches their addresses with the destination address placed by a sender node. Destination machine will accept the packet as its address match with destination address field of packet. Other machines will simply ignore the packet.

Usually when the networking device HUB is used, it broadcast the packet arrived from a source machine, to all the ports. Compare to point-to-point, Broadcast is less secure.



**Fig : 9.2 : Broadcast Network**

As shown in the Fig. 9.2 if station : A transmits the data for station : B, HUB will accept the packets from station : A. HUB then now forward the data to all the stations. Station : B, will accept the data and other stations will ignore the data packets.

❑ **Check Your Progress – 3 :**

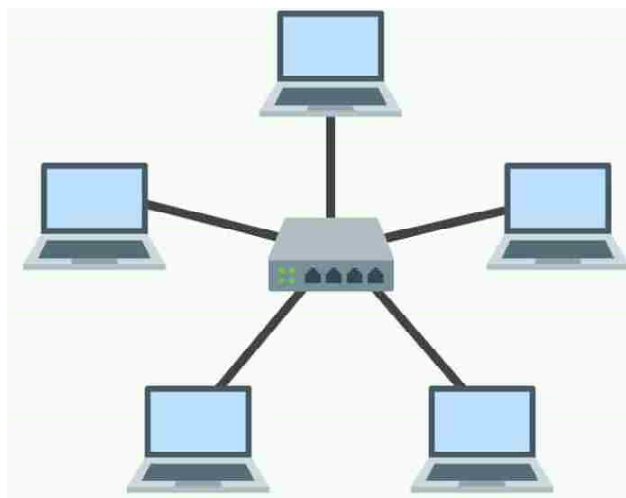
1. Networking device HUB use, \_\_\_\_\_ data transmission method.  
[A] Unicast [B] Broadcast  
[C] Point-to-Point [D] None of the above
2. In a Point-to-Point network, data packets transmitted by source machine, will be forwarded to all the machines of the Network [True / False].
3. \_\_\_\_\_ networking device is used for Point-to-Point data transmission.  
[A] Router [B] HUB  
[C] Both [A] and [B] [D] None of the above

**9.5 Topologies :**

Network topology is a method of arranging networking devices physically or logically into the network. Topology defines how the network devices are arranged into the network, or we can say it is a physical layout of the network. Different topologies are suggested for the network. In this section we will discuss each topology in detail.

**9.5.1 Star Topology :**

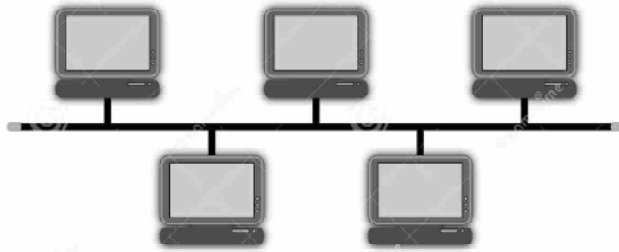
In a start topology each device has a dedicated point-to-point link, with the central controller. The central controller can be either HUB or Switch. In star topology if one machine transmits the data to the other machine, then the data must pass through HUB or switch placed between them. If one or two machines are out of order, it doesn't make any change in the network. Other machines can function in the network in a natural way. If the central controller goes out of order then, obvious entire network will stop functioning. More cabling is needed in the star topology, as there is dedicated cable has to be installed from each machine to central controller. Start topology you can find in the computer laboratories.



**Fig. 9.3 : Star Topology**

### 9.5.2 Bus Topology :

Bus topology is multipoint configuration-based topology. One long, thick cable will act as a backbone of the entire network. All other devices are connected with this backbone cable directly using special connectors. The main advantage of this topology is, it uses less cabling and hence it is cost effective. The problem with this topology is : It is less reliable. If the problem occurs with the backbone cable then entire network goes out of order. Another drawback of this topology is that, data will be transmitted from source to destination only through backbone cable, therefore the speed will be reduced as in heavily loaded network much congestion will occur in the backbone cable. Bus topology is less secure as data transmitted by one machine will be broadcasted to all other machines of the network.



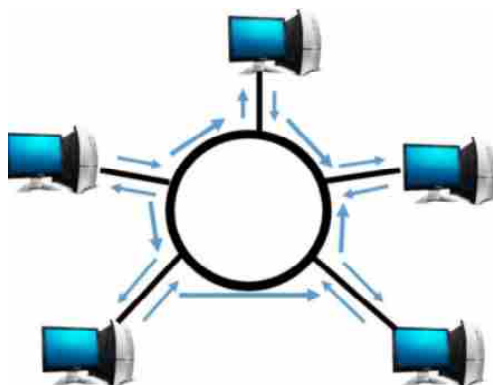
**Fig. 9.4 : Bus Topology**

#### ❑ Check Your Progress – 4 :

1. \_\_\_\_\_ topology is used in the computer laboratory of your study centre.  
[A] Star            [B] Ring            [C] Mesh            [D] Bus
2. In \_\_\_\_\_ topology minimum cable is used.  
[A] Star            [B] Ring            [C] Mesh            [D] Bus
3. In \_\_\_\_\_ topology hub or switch is used.  
[A] Star            [B] Ring            [C] Mesh            [D] Bus

### 9.5.3 Ring Topology :

Ring topology is similar to the bus topology, in which each device has a dedicated point-to-point connection. A signal is passed in the ring (a ring-shaped backbone cable) in one direction from machine to machine, until it reaches to its destination machine. Each machine in the ring also works as a repeater (which is strengthen the weaker signal). When a receiver machine finds that the packet is for some another machine, they will regenerate the same fresh and strong signals and passes to its neighbour. A ring topology is easy to install and reconfigure. Each machine is linked to its immediate neighbours.

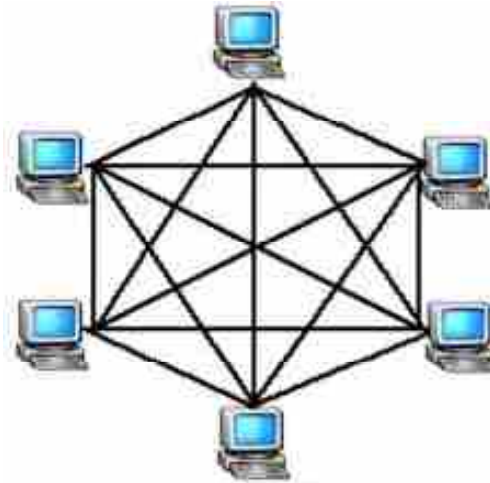


**Fig. 9.5 : Ring Topology**

IBM (International Business Machines) company has proposed ring topology. Token passing mechanism is used in the ring topology to transmit the data. The advantages of ring topology are, it is cost effective and use less cabling. The disadvantages are, the traffic will move only in one direction through a backbone cable. It is less secure as all the intermediate machines between sender and receiver can access the transmitted data.

#### **9.5.4 Mesh Topology :**

In Mesh topology each machine is connected with all other machines via dedicated point-to-point line. Therefore, huge amount of cabling is needed in the mesh topology. Each machine needs  $n-1$  ports, if the network has  $n$  number of machines. For example, in a mesh topology network, if 6 machines are there, then in each machine 5 network IO ports are needed. It is very costly as more hardware are needed to implement mesh topology. There is no central controller is available in the mesh topology. In fact, it is not possible to implement mesh topology because of high cost and hardware required in its implementation, it has many advantages. It is faster as each pair of machines are communicating with their dedicated link. It is more reliable as one or two links goes down; the machines can communicate via some other intermediate machines. It is highly secure as the data of source machine is directly transmitted to the recipient machine, without any intermediate machine.



**Fig. 9.6 : Mesh Topology**

#### **9.5.5 Hybrid Topology :**

Hybrid topology is actually a mixture of any two or three topology discussed above. Suppose, in a building separate LANs are there in a star topology in each floor. Now if all star topology network we connect with a single backbone cable, then it will be a mixture of bus topology and star topology. Such type of topology in which we have used two or more different topologies is called Hybrid topology.

#### **☐ Check Your Progress – 5 :**

- \_\_\_\_\_ topology has been proposed by IBM.  
[A] Star            [B] Ring            [C] Mesh            [D] Bus
- \_\_\_\_\_ topology is costly but more reliable, faster, highly secure.  
[A] Star            [B] Ring            [C] Mesh            [D] Bus

3. In \_\_\_\_\_ topology data is transmitted using token passing mechanism.  
[A] Star [B] Ring [C] Hybrid [D] Mesh
4. \_\_\_\_\_ topology is a combination of two or more topologies.  
[A] Star [B] Ring [C] Bus [D] Hybrid

### 9.6 Let Us Sum Up :

In this chapter we have discussed the term 'Network' and 'Computer Network'. We have seen the advantages and disadvantages of network. We have learnt how networks are classified into PAN, LAN, MAN and WAN. Then we have seen, that network can be of type : [1] Point-to-Point and [2] Broadcast. After discussing different types of networks, we have seen various topologies of the network. Topologies represents physical and logical layout of network. We have discussed Star, Bus, Ring, Mesh and Hybrid topologies with their advantages and disadvantages.

### 9.7 Glossary :

**PAN** : Personal Area Network. It a smallest network in which computing devices are connecting with each other using Bluetooth wireless technology.

**LAN** : Local Area Network. It is a small network spread within campus, or building or two nearby buildings. It uses either Ether or Wi-Fi technology.

**MAN** : Metropolitan Area Network. It can cover city or nearby two cities.

**WAN** : Wide Area Network. It can cover a county, region or entire world. Internet is an application of WAN.

**Wi-Fi** : Wireless Fidelity. It is a wireless data transfer technology of network, which uses high frequency of Radio signals to transmit the data.

### 9.8 Suggested Answers For Check Your Progress :

**Check Your Progress 1 :**

1. [D]                      2. [C]

**Check Your Progress 2 :**

1. [D]                      2. [A]                      3. [C]

**Check Your Progress 3 :**

1. [B]                      2. False                      3. [A]

**Check Your Progress 4 :**

1. [A]                      2. [D]                      3. [A]

**Check Your Progress 5 :**

1. [B]                      2. [C]                      3. [B]                      4. [D]

### 9.9 Assignment :

1. Write a short note on Network Classification.
2. What is topology ? Explain following topologies in brief.
- Bus topology
  - Star topology
  - Ring topology

- Mesh topology
  - Hybrid topology
3. Explain Point-to-Point network and Broadcast network in detail.

**9.10 Activity :**

1. Define the following terms :
  - Sender
  - Recipient
  - Message
  - Media
  - Protocol

**9.11 Case Study :**

Make a small note OSI layer mode of computer networks. Make a list of all 7 layers and write the functionality performed by each OSI layer in details.

**9.12 Further Reading :**

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.
4. Computer Networks by Tanenbaum, Prentice-Hall India Publications.

**UNIT STRUCTURE**

- 10.0 Learning Objectives**
- 10.1 Introduction**
- 10.2 Evolution of the Internet**
- 10.3 Connecting to the Internet**
  - 10.3.1 Internet Service Provider**
- 10.4 IP-Addresses**
- 10.5 Domain Names**
- 10.6 The Web**
  - 10.6.1 Navigating The Web**
  - 10.6.2 Browsers**
  - 10.6.3 Web-Page Design**
- 10.7 Let Us Sum Up**
- 10.8 Suggested Answer for Check Your Progress**
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- 10.10 Assignment**
- 10.11 Activity**
- 10.12 Further Readings**

**10.0 Learning Objectives :**

In this unit, we will discuss about the basics of computer organization and Data processing :

**After working through this unit, you should be able to :**

- Understand, what is Internet ? And How it works ?
- Know, IP-Addresses and Domain Name System
- Understand the Web technologies.
- Know about Browsers, Web-page design and Internet Communications

**10.1 Introduction :**

In the previous unit we have discussed that Internet is an example of Wide Area Network (WAN). Today lots of services, which are provided by the Internet we are accessing. One main reason to buy a computer by businesses, home and other-user is Internet. Internet provides its services almost in all sectors like businesses, governments, educational institutions and individuals. The internet is a worldwide collection of networks that connects millions of machines. Internet carries lots of information worldwide (it is information super highway). Internet is a main component of Information Technology. In this unit we will learn about Internet.

## **10.2 Evolution of The Internet :**

In 1960, the Government of USA has given a project to Department of Defence (DOD) USA, to conduct research on nuclear weapons. Department of Defence, USA has observed that to conduct the research on nuclear weapons, they need lots of computing power. At that time the computer machines were larger in size and situated in different universities at different geographic locations. Department of Defence, USA has decided to create a network to connect various computing devices available in the different departments of different universities under the project called ARPANET (Advanced Research Project Agency Network) with the goal : [1] Allowed scientists and researchers of different geographical locations to share their information and research work together on military and scientific projects, and [2] Network could function even if part of the network were destroyed by any disaster such as nuclear attack. In 1969, the network called ARPANET becomes functional.

During the research work many students and developers has developed different applications like chat, Email online game etc. Many commercial companies had made request to the DOD to be a part of ARPANET, which refused by DOD.

In 1981, after DOD has given the responsibility of this network to National Science Foundation (NSF) who funded for the project, access to ARPANET was expanded by NSF and ARPANET became NSFNET. Later on, NSF has put the entire project open for public. The original ARPANET consisted of four main computers located at University of California at Los Angeles (UCLA), the University of California at Santa Barbara (UCSB), the Stanford Research Institute and the University of Utah. By 1984, this network had 1000 individual computers were linked as a host. Today millions of computers connect to this network, which now known as Internet.

### **❑ Check Your Progress – 1 :**

- \_\_\_\_\_ is a network of network, super highway of information.  
[A] Intranet [B] Internet  
[C] Network [D] None of the above
- ARPANET stands for \_\_\_\_\_.  
[A] Advanced Research Project Agency Network  
[B] Advanced Research Programmed Auto Network  
[C] Advanced Research Project Automatic Network  
[D] Advanced Research Project Authorized Network
- Internet is \_\_\_\_\_ own network. [Publicly, Privately]

## **10.3 Connecting to The Internet :**

Internet is a publicly own network, but still you need to pay for the services. User can connect their mobile devices or computers to the Internet through wired or wireless technology and then access its services. With wired connections, computer physically attach via cable (transmission media) and devices like modem, which transmit the data on the Internet. For wireless connection some devices have built-in technology to transmit the data wirelessly. Other devices can access the internet wirelessly using Wireless modem which also known as dongle and Wi-Fi Router. Today, most user uses Internet connection via



*broadband* technology, which provides fast data transfer speed and always on connectivity. Through the broadband technology user can download any webpage directly, play online games, communicate in real time using chat and more.

Many public places, such as shopping malls, shops, hotels, restaurants, airports, and railway stations have *Wi-Fi Hotspots*. Wi-Fi Hotspots provides wireless network to the computers and many other devices.

Mobile users can share their Internet connection with other by creating Wi-Fi Hotspot in their mobile devices.

**10.3.1 Internet Service Provider :**

An Internet Service provider is also called Internet access provider, is an organization that provides individuals and organizations, access to the Internet. To provide the services the ISPs are charging fees from the customer. ISPs often charged a fixed amount to provide Internet services, or offering various plans to their customer, which are based on speed, download or time duration. Sometimes, ISPs also offer additional services like email, online storage etc.

*Bandwidth* means the amount of data travels on the network in designated time period. A higher bandwidth means more data transmit per second. Bandwidth can be in Kbps (Kilo Bits per second), MBPS (Mega Bits per second) or in Gbps (Giga Bits per second).

**□ Check Your Progress – 2 :**

1. You can share the Internet from your mobile to your friend's mobile by creating \_\_\_\_\_ in your mobile.  
 [A] Wi-Fi Router  
 [B] Wi-Fi Hot spots  
 [C] By choosing Internet share option  
 [D] None of the above
2. ISP stands for \_\_\_\_\_.  
 [A] International Service Provider [B] Internet Server Provider  
 [C] Internet Service Provider [D] International Server Provider
3. \_\_\_\_\_ means the amount of data travels on the network in designated time period.  
 [A] ISP [B] Wi-Fi [C] Bluetooth [D] Bandwidth

**10.4 IP Addresses :**

The internet relies on the addressing system same as our postal services to transmit the data from source machine to destination machine. Each machine on an Internet has unique address which is known as IP (Internet Protocol) address. IP address is a sequence of numbers that uniquely identify the location of the machine or device connected with the Internet.

There are two IP addressing schemes are available on the Internet : IPv4 (IP version 4) and IPv6 (IP version 6). In IPv4 total 32 bits are used to address any machine on the Internet. These 32 bits are divided into the group of four 8-bits long number. Therefore, all four numbers of the IPv4 has to be smaller than 255 (as  $2^8 = 256$ ) and it is separated by '.' (dot). For example, 192.168.111.1 is a valid IP address but 192.768.56.3 is not valid IP address as  $768 > 255$ .

To overcome shortage of IP addresses, as a greater number of devices are connecting to the Internet new addressing scheme IPv6 is used. In IPv6, each machine is assigned 128-bit long IP address. Which divided into eight numbers. Therefore, each number of the IPv6 is a 16-bit long, which is further divided into four hexa-decimal digits (as we know to represent 1 hexa-decimal digit, we need 4-bits). All eight numbers are separated by ':'(colon). For example, fe80:2b97:3095:10c8:58a7:3ce9:12af:2c45 can be a valid address.

❑ **Check Your Progress – 3 :**

1. Identify the Invalid IP address from the given below.  
[A] 192.168.111.1 [B] 259.37.21.1  
[C] 8.8.8.8 [D] 170.16.0.1
2. In IPv4 addressing, \_\_\_\_\_ bits are used to address any device.  
[A] 16 [B] 32 [C] 64 [D] 128
3. The length of the IPv6 is of \_\_\_\_\_ bits.  
[A] 16 [B] 32 [C] 64 [D] 128

**10.5 Domain Names :**

We know that, each machine on the Internet has unique IP address. Machines are communicating with each other using IP addresses. But it is difficult to memorise the IP address of each server on the Internet for human. We always memorise facrbook.com, baou.edu.in, amazon.in and so on, and not the IP address of the servers on which these sites are hosted. Domain name converts these names into the IP addresses.

A domain name is a text-based name that corresponds to the IP address of a server that hosts a website. Usually, to open any website we type the domain name in the URL (Uniform Resource Locator) field in the browser. The suffix of the domain is called TLD (Top-Level Domain), which identifies the type of the organization associated with the domain. The list of the TLDs and its purpose is described in the table given below :

TLD	Intended Purpose
.com	Commercial organization, companies and businesses
.edu	Educational Institutes
.gov	Government Agencies
.mil	Military organizations
.net	Network provider, commercial companies
.org	Non-profitable organizations

❑ **Check Your Progress – 4 :**

1. \_\_\_\_\_ will convert the names of website into the IP address of the server on which the website is hosted.  
[A] DHCP [B] FTP [C] TCP [D] DNS
2. \_\_\_\_\_ is the TLD of your university web site's URL.  
[A] .com [B] .edu.in [C] .edu [D] .org
3. TLD for the agencies working for government is \_\_\_\_\_.  
[A] .agc [B] .edu [C] .gov [D] org

## 10.6 The Web :

The Internet is developed in the late 1960, the Web or World Wide Web (WWW) emerged in early 1990. It is an easier method to access the information available on the server, using a browser online. *The web* is a collection of world-wide websites. The Website is a collection of related Webpages, and associated items such as documents, audio, video, image etc. *Webpages* are electronic documents which provides information and are stored on special computer called *Websserver*.

### 10.6.1 Navigating the Web :

The computer or device from which we access the web page is called *client computer*. To access the website, we need to use specialized software called Browser. Browser has specialized field called URL (Uniform Resource Locator). We need to type domain name like 'www.baou.edu.in' in the URL field. Browser now send a request to the webserver on which the website is hosted. Webserver then accept the request, process the requested web page and provides response (information) to the requested browser. Client and Webserver machines are communicating with each other using special, stateless protocol called *HTTP* (Hypertext Transfer Protocol).

Web technologies matured in the middle of the year 2000. Industry experts introduced the new version of the web called Web 2.0 to refer the websites that provides a mean for users to share personal information (social networks), allow user to modify the content of the website, and provide dynamic and interactive web applications through browser.

### 10.6.2 Browsers :

As we have discussed, a client software used to access the content of the webpages of a website is called browser. Different types of browsers are available from different companies. In fact, browser also comes up with operating systems too. Different browsers which are available today are listed below :

1. **Chrome** : Chrome is a newer browser introduces by Google in 2008. The browser is available for Windows, Mac OS, Android and many other operating systems. Chrome provides independent tabbed browsing.
2. **Firefox** : Firefox browser is developed by Mozilla Corporation. It is available for Windows, Mac OS, Linux, Android and many other operating systems. Firefox is well known for its extensive array of plug-ins. It was first released in 2004. It doesn't come with the operating system, but you have to download and install it into the device.
3. **Internet Explorer** : Internet Explorer is also popular browser introduced by Microsoft Corporation in 1995. It comes with Microsoft's Windows operating system. In Windows-10 you can get the upgraded version of it, that is Microsoft Edge.
4. **Opera** : The second oldest browser is opera browser. It is small in size, fast and free. Opera browser is also available for Windows and Android operating system. To enjoy Opera browser, you need to download and install it.
5. **Safari** : Safari browser comes as preinstall browser in Apples computers. Safari is a default browser for Mac OS and IOS (operating system of Apple's iPhone). It was first released in 2003. The browser becomes well

known for its sleek design, built-in sharing feature for social networks, parent control and fast performance.

### **10.6.3 Webpage Design :**

As we know, website is a collection of related webpages and contents like documents, images, audios, videos etc. The webpages are interlinked with other. A link on the web which, refers to the other web page is called hyperlink. Hyperlink is a built-in connection to other documents, graphics, audio files, videos, web pages, or websites.

To design the web pages a special language is used called HTML (Hypertext Mark-up Language). It is not a programming language like C, C++, Java etc. HTML has some predefined tags to design the web pages. <HTML>, <HEAD>, <TITLE>, <BODY> etc. are predefined tags. Each tag of HTML has its specific meaning, for example <B> tag is used to make the text bold and so on.

HTML is used just to design the web pages. Using HTML, we can build informatic static website only. To build dynamic and interactive web pages, other languages like JavaScript, VB.NET, C#.NET, PHP etc. are also used with HTML. The compiler for JavaScript is available in the most browsers, therefore it is called a client-side scripting language. VB.NET, C#.NET and PHP code will be processed by the server, so it is called server-side languages.

### **10.6.4 Internet Communications :**

Web is one of the services on the Internet. Other services on the Internet facilitate communication among the users, including the following :

1. Email allows us to send messages to and receive messages and files from other users via a computer network.
2. With messaging services, we can have real-time typed conversation with another connected user.
3. VoIP (Voice over Internet Protocol) enables users to speak to other users over the Internet.
4. With FTP (File Transfer Protocol), users can transfer files to and from other computers on the Internet.

#### **❑ Check Your Progress – 5 :**

1. \_\_\_\_\_ is a browser.  
[A] Word            [B] Opera            [C] Chrome            [D] Firefox
2. The protocol used between browser and web server is \_\_\_\_\_.  
[A] TCP            [B] FTP            [C] HTTP            [D] DHCP
3. \_\_\_\_\_ is a client-side scripting language.  
[A] VB.NET            [B] JavaScript            [C] C#.NET            [D] PHP

### **10.7 Let Us Sum Up :**

**In this unit, we have :**

- Discussed what is Internet and How it evolved.
- Elaborated Internet connections and role of ISPs.
- Described importance of IP-Addresses and Domain Names.

- Talked about The Web Technologies.
- Discussed Web page design and Internet Communications.

### 10.8 Suggested Answers For Check Your Progress :

- ❑ **Check Your Progress 1 :**
  1. [B]                      2. [A]                      3. Publicly
- ❑ **Check Your Progress 2 :**
  1. [B]                      2. [C]                      3. [D]
- ❑ **Check Your Progress 3 :**
  1. [B]                      2. [C]                      3. [D]
- ❑ **Check Your Progress 4 :**
  1. [D]                      2. [B]                      3. [C]
- ❑ **Check Your Progress 5 :**
  1. [A]                      2. [C]                      3. [B]

### 10.9 Glossary :

**PHP** : Hypertext Pre-Processor. It is a server-side technology.

**HTML** : Hypertext Mark-up Language. It is language of predefined tags, used to design the static and informative web pages.

**HTTP** : Hypertext Transfer Protocol. It is a protocol used by client (Browser) and web-server to communicate with each other. It is a stateless protocol.

**TLD** : Top-Level Domain. It is a prefix of website URL. For example .com, .edu, .gov, .mil etc are TLDs of the website URL.

### 10.10 Assignment :

1. Write a short note on IP-Addresses.
2. List and explain different types of browsers.
3. Explain the term 'ISP'.

### 10.11 Activity :

Find out the name of different ISPs providing their services into your area, also write the name of your ISP, your Internet connection plan details and bandwidth you are getting into your mobile or computer.

### 10.12 Further Reading :

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.

**UNIT STRUCTURE**

- 11.0 Learning Objectives**
- 11.1 Introduction**
- 11.2 Digital Security Risks**
  - 11.2.1 Cybercrime**
- 11.3 Internet Attacks**
  - 11.3.1 Malware**
  - 11.3.2 Botnets**
  - 11.3.3 Denial of Service Attack**
  - 11.3.4 Back Doors**
  - 11.3.5 Spoofing**
- 11.4 Securing System From Attacks**
- 11.5 Firewalls**
- 11.6 Prevention From Unauthorized Access**
  - 11.6.1 Authentication**
  - 11.6.2 Authorization**
- 11.7 Let Us Sum Up**
- 11.8 Suggested Answers For Check Your Progress**
- 11.9 Glossary**
- 11.10 Assignment**
- 11.11 Activity**
- 11.12 Case Study**
- 11.13 Further Reading**

**11.0 Learning Objectives :**

**After working through this unit, you should be able to :**

- Understand the importance of Digital security.
- State the different Digital Security Risks and Cybercrime
- Name various types Internet attacks
- Learn the use and importance of Firewall
- Learn to protect the system and network from unauthorised access.

**11.1 Introduction :**

Internet plays a vital role to our today's life. Lots of activities we can perform online. We shop any product and make the payment online using net-banking, mobile-banking, credit or debit cards and save time and fuel to find the product. We can pay electricity, gas or water bill online using Internet. We can

book movie tickets, reserve hotel rooms, buy a bus ticket, book a railway or flight reservation online. We can even transfer the fund (money) from one account to another account using Internet. Many people share photos and videos with friends and family members with Internet. Day to day, we are increasing our transaction activities on the Internet.

With the increasing use of Internet, day to day number cases of cybercrimes are also increasing. In this unit we will observe different types of digital security risks and their solutions, so that we can take maximum benefits of the Internet without any kind of fear or with very limited risk.

## **11.2 Digital Security Risks :**

With the increasing use of Internet, it is crucial that users take measures to safeguard or protect their computers, mobile devices and data from damage, loss or misused by someone else. Individual must ensure that their net-banking credentials or credit card numbers are secure while doing online payment.

Digital security risks are an event or action that could cause a trouble to its users like loss of data, damage of hardware and software of the computers or mobile devices, theft of your financial credentials etc. The more common digital security risks include Internet or network attack, use of your system or financial credentials by unauthorised person, hardware or software theft, or system failure.

Security breaches to the digital security may be accidental or intentional.

Some intruders do not disturb any functionality of your computer system, they simply access data and information stored in the system or mobile device before signing out. While other intruders indicate some evidence of their presence either by leaving a message or by intentionally damaging or altering the data.

### **11.2.1 Cybercrime :**

Any illegal act in which computer or its related devices are used is generally referred to as computer crime. Basically, the term 'cybercrime' refers to online illegal act using Internet such as sharing or distributing malicious software or doing identity theft. Cybercrime can be categories as hacker, cracker, script kiddie, unethical employee or cyberterrorists.

- The term **hacker**, is used for a computer enthusiast who also wants to test the various security areas of the application. Hackers test their hacking skills to find out security breaches in the software. The intention is not to perform any malicious activity, but to find out security breaches in the software so that it can be improved.
- The term **cracker**, is used for an unknown user, who illegally access your computer or device through network or Internet to perform destructive actions such as destroying data, stealing information or other malicious activity. Both hacker and cracker have advanced knowledge and skill of using computer, network and Internet technologies.
- The term **script kiddie**, is used for a user who has same intent as cracker but does not have technical skills and proper knowledge. Script kiddies often use prewritten hacking or cracking programs to break into computer and networks.
- The term **Unethical employee**, is used for a user who may break into their employers' computer for different reasons. Some employees are doing this

to exploit a security weakness, and some other employees are doing this for financial gains by selling confidential information of the organization.

- The term **cyberterrorist** is used for the user who uses the Internet to destroy or damage computers for political reasons. The cyberterrorists may target air traffic control of the nation, electricity control system, telecommunication infrastructures and more.

**❑ Check Your Progress – 1 :**

1. \_\_\_\_\_ test their hacking skills to find out security breaches in the software, but not for destructive purpose.  
 [A] Hacker [B] Cracker  
 [C] Cyberterrorist [D] Unethical Employee
2. \_\_\_\_\_ refers to online illegal act using Internet such as sharing or distributing malicious software or doing identity theft.  
 [A] Computer crime [B] Cybercrime  
 [C] Civil crime [D] None of the above
3. If someone create a profile with your name, photos and other personal information without your permission is called \_\_\_\_\_.  
 [A] Financial theft [B] Data corruption  
 [C] Unethical employee [D] Identity theft

**11.3 Internet Attacks :**

When the information is transmitted using Internet, has higher risk then the information transmitted withing the network of an organization. Within the organization network administrators usually takes all measures to take care or protect your data from the possible security risks. Internet on the other hand, is a public network. Anyone can pay for the services and access Internet. There is no central administrator is present on the Internet to take care of your data. While accessing, you need to protect your system and data from malware, botnets, denial of service attack, backdoor and spoofing types of attacks.

**11.3.1 Malware :**

Malwares are malicious software or programs that runs in your computer without your knowledge. Malwares sometimes deliver destructive action or simply pranks to your computer system or mobile device. A common way that gets infect your system or mobile device from viruses or other malware is opening any infected attachment receive in the Email. The following table gives you an idea about different types of Malware and its actions.

Type	Description
Virus	Viruses can damage the programs that affects, or infects. It can alter the settings of system or device, corrupt any software without user's permission or knowledge.
Worm	Worm is program that replicate itself without user's knowledge or permission. It can possibly shut down the system, device or network which you are using from the network.
Trojan horse	Trojan horse does not replicate itself like viruses and worm. It is a program that look like a genuine program or software.



Rootkit	Rootkits are the program which hides itself into the user's machine without user's knowledge and permission. It provides remote access of the system or device without use's knowledge.
Spyware	Spyware hide itself into the user's machine, without user's permission and collect secret information of the system and device and provide it to some outsider or creator of that spyware.
Adware	Adware is a program which displays various online advertisements in the form of banner or pop-up windows.

**☐ Check Your Progress – 2 :**

- Identify the malwares from the given below :  
 [A] Virus            [B] Worm            [C] Spyware            [D] All of the above
- \_\_\_\_\_ malware does not replicate itself, but it looks like a genuine software.  
 [A] Virus            [B] Trojan horse [C] Rootkit            [D] Spyware
- \_\_\_\_\_ malware collect the secret information of your device and give it to the creator of that malware.  
 [A] Adware            [B] Trojan horse [C] Spyware            [D] Rootkit

**11.3.2 Botnets :**

A botnet is also known as zombie army or simply zombies. It infects any device which is connected with the network or Internet. The infected device is known as zombie, whose owner is not aware that the device is infected and it is being remotely controlled by some outsider. A bot is a program that performs repetitive tasks on a network. Cybercriminals install malicious bots on the device which is not protected and create botnet. The criminal the uses the botnet to send spam mails, spread viruses and other malware.

**11.3.3 Denial of Service Attack :**

Denial of service attack is an attack whose main purpose is to disturb device access to an Internet services. The infected device can not access the web or Email services.

**11.3.4 Back Doors :**

Back door is a program that allows use to bypass security checks while accessing network or Internet. Once attacker gain access to such unsecure device, they install a back-door program into the machine can access that device remotely without user's knowledge or permission. A root kit can be a back-door. Some worm installs back-door, which can be used to spread other worms to disturb device activity and performance.

**11.3.5 Spoofing :**

Spoofing is a technique; which attacker use to make their Internet transmission appear genuine to a victim device. Two common spoofing techniques are : [1] IP-spoofing and [2] Email spoofing.

- IP-spoofing :** In an IP-spoofing, attacker making fool to the user, and shows that the IP address used by the attacker is of some genuine source.
- Email spoofing :** Email spoofing occurs when the address of an Email sender or other information of Email is altered in such a way that recipient

will understand, that the Email is originated by different sender. Email spoofing is mainly used in phishing scams and spams.

❑ **Check Your Progress – 3 :**

1. In \_\_\_\_\_ attack security checks of the system are bypassed so that attacker can access that system in future.  
[A] Spoofing [B] Denial of Service  
[C] Back door [D] Botnet
2. In \_\_\_\_\_ attack, device becomes zombie and provide remote access to outsider.  
[A] Spoofing [B] Denial of Service  
[C] Back door [D] Botnet
3. Phishing can be done by \_\_\_\_\_.  
[A] Email spoofing [B] Trojan horse  
[C] Spyware [D] Rootkit

**11.4 Securing System From Attacks :**

To protect the system or device from the attacks which are explained earlier we need to follow the steps given below :

- Use virus protection software and update it regularly.
- Use Firewall software.
- Be suspicious of all unsolicited Email and text messages.
- Disconnect your computer from the Internet if you are not using any services of Internet.
- Download software with caution. Before downloading the software check the authenticity of the website.
- Close spyware windows, if it opens in your computer. Active window runs spyware program into the memory and continues its destructive actions.
- Before using any removable media, scan it for malware and viruses by antivirus software.
- Keep current. Use the updated versions of software. Older version may have security breaches.
- Back up regularly. Take a back up of data into another system or on the cloud storage.

❑ **Check Your Progress – 4 :**

1. To use the removable media into the computer, what will you do after plugging removing media ?  
[A] Update antivirus [B] Scan the media  
[C] Backup the data [D] Open the firewall
2. How to protect the system from outsiders ?  
[A] Installing Antivirus [B] Taking backup  
[C] Implementing Firewall [D] None of the above

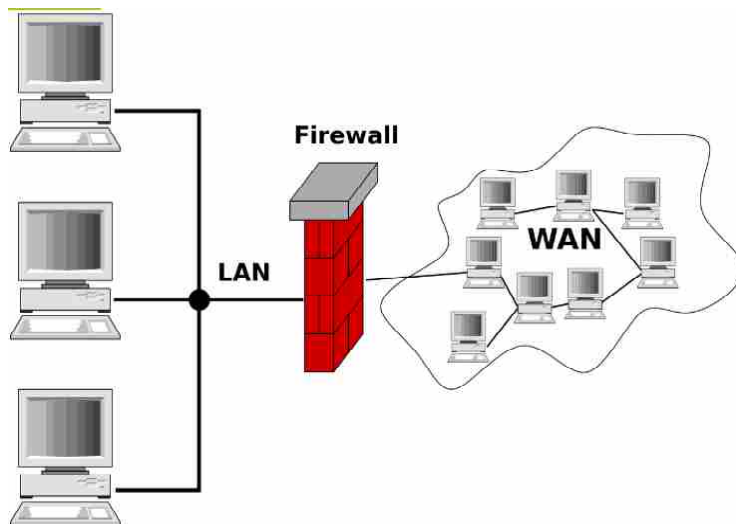
3. How to protect yourself from phishing ?
  - [A] Be suspicious of all unsolicited Email and text messages.
  - [B] Using the latest version of the software.
  - [C] Taking backup of the system regularly.
  - [D] Updating antivirus software regularly.

**11.5 Firewalls :**

A Firewall is available in the form of Hardware or Software, that protect the user's network resources from another (outsider) networks of the Internet. To protect the systems of the LAN from the different types of attacker on the Internet Firewall is a key solution.

Organizations are implementing Firewall to protect the network resource of an organization from the outsider as well as to restrict the Employees of the organization to access some sensitive data like personal data records of the Employees or Payroll records.

Firewall is usually implemented into the system which actually act as gateway system. It is implemented at the point where LAN connects to the WAN. Firewall will block all the ports of gateway machine except those which are in used by the personal or organization. If all unnecessary ports are blocked, it is difficult for the attacker to cross the firewall and access any sensitive data of the organization. Firewall, thus act as a protective layer between LAN of the organization and the Internet.



**Fig. 11.1 : Firewall**

Home and small office user in which system is directly connected to the Internet, can use personal Firewall. It will be installed in the systems which directly interact to the Internet. Windows and Mac operating system, provides Firewall software built-in to the operating system itself. Now, a day some antivirus software products are providing the Firewall software as a bundled with their antivirus product.

**11.6 Prevention From Unauthorized Access :**

Unauthorized access means any user access the computer or network resource without permission or without the knowledge of actual user of the system or network. Unauthorized use is the use of a computer or its data for unapproved or possibly illegal activities.

To prevent the system from unauthorized access Firewall is obviously one solution, apart from Firewall and use of Antivirus software, you can also implement [1] Authentication and [2] Authorization.

### **11.6.1 Authentication :**

Authentication is the process of identifying user. Various mechanisms can be used to do authentication. Username and Password is the simplest method to identify the user (Authentication). Operating system or any software, when start they ask to enter username and password. If user enters correct username and password then system grant the resources to that user. The person who has given valid login credential is called authenticated user. Some website allows user to access some areas of the website without login, for example you can view the products on Amazon or Flipkart without login. A user who access some part of the software without providing their login credential is called Anonymous user or visitor.

Keeping strong password is a skill. Some users don't understand the seriousness of authentication, and choose weak password. Those users become an easy target to the attackers. Here, we have given some tips to keep strong password.

1. Try to avoid personal information in the password. Some user set their mobile number, name or vehicle number as a password. Such type of password is easily guessable and system can be accessed by unauthorized user.
2. Maintain minimum length of the password. Password should be more than 8 characters. Small passwords can be easily tracked by the person standing nearer to you while entering the password or by some software.
3. Password must be difficult. It should have combination of uppercase letters, lowercase letters, digits and special symbols.
4. Change your password on regular time interval basis.
5. Use variations in the password. Do not keep same password for all the websites.
6. Use passphrase in the password. Do not keep a password which spell correctly as per dictionary. If you keep a password which available in the English dictionary, it can be easy recovered by unauthorised person by applying dictionary attack.
7. Avoid common sequence in the password. Your password should not be like '1234' or 'abcd' etc.
8. Manage the password properly. Make sure you need to remember your password. You do not have to write the password which can be easily accessible to someone. Many users are wrongly writing their ATM access password on the ATM card itself.

Apart from the text-based username and password, the other methods are also there to authenticate the user. Some application allow user to enter PIN number to authenticate the user. PIN (Personal Identification Number) is either 4-digit or 6-digit number to authenticate the user. Where some applications do the authentication by taking finger prints of the user by using finger print scanner or by face recognition using front camera module.

**11.6.2 Authorization :**

Authorization is process that has to be performed after authentication. It is a security mechanism that determines user privileges or access levels related to the resource of a system including data, files, services or applications installed in the system. Once the username and password are verified and user is identified by the system then system will grant only those resources to the user, which are granted to that user by network administrator. To implement authorization, network administrator can implement ACL (Access Control List).

**☐ Check Your Progress – 5 :**

1. \_\_\_\_\_ is the process of identifying user.  

[A] Authorization	[B] Access Control List
[C] Authentication	[D] Firewall
  
2. \_\_\_\_\_ can be installed between LAN and WAN to protect the resource of LAN from outsiders.  

[A] Antivirus	[B] Firewall
[C] ACL	[D] None of the above
  
3. Identify the method of Authentication from the given options :  

[A] By accepting text-based Username and Password.
[B] By taking PIN from the user.
[C] Using biometric devices.
[D] All of the above.

**11.7 Let Us Sum Up :**

**In this unit :**

- We have discussed about digital security risks and cybercrimes.
- We gain awareness about different types digital threats.
- We have seen, how secure the computer system and network.
- We have understood the importance of Firewall
- Finally, we have ended our discussion with how to protect the system from unauthorised access, Authentication and Authorization.

**11.8 Suggested Answers For Check Your Progress :**

**☐ Check Your Progress 1 :**

- |        |        |        |
|--------|--------|--------|
| 1. [A] | 2. [B] | 3. [D] |
|--------|--------|--------|

**☐ Check Your Progress 2 :**

- |        |        |        |
|--------|--------|--------|
| 1. [D] | 2. [B] | 3. [C] |
|--------|--------|--------|

**☐ Check Your Progress 3 :**

- |        |        |        |
|--------|--------|--------|
| 1. [C] | 2. [D] | 3. [A] |
|--------|--------|--------|

**☐ Check Your Progress 4 :**

- |        |        |        |
|--------|--------|--------|
| 1. [B] | 2. [C] | 3. [A] |
|--------|--------|--------|

**☐ Check Your Progress 5 :**

- |        |        |        |
|--------|--------|--------|
| 1. [C] | 2. [B] | 3. [D] |
|--------|--------|--------|

### **11.9 Glossary :**

**ATM :** Automated Teller Machine. It is a machine managed by banks so that its customer can withdraw the money.

**ACL :** Access Control List. It can be made by the network administrator to grant the various resources to different network users.

**PIN :** Personal Identification Number. It is an authentication method to identify user.

### **11.10 Assignment :**

1. List and explain different types of Digital Treats in detail.
2. Write a short-note on Authentication process.
3. Explain the term : 'Firewall'.

### **11.11 Activity :**

Make a list of different types of authentication methods which you have observed.

### **11.12 Case Study :**

- Find "What is Encryption ?" and different types of Encryption techniques on the Internet.

### **11.13 Further Reading :**

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.

**BLOCK SUMMARY :**

- Two or more devices are connected with each other to share data or resource is called network.
- If the devices are computing devices, then two or more computing devices are connected to each other is called computer networks.
- With the help of network, we communicate with each other, we can transfer the data from one machine to another as well data and resource sharing are main advantages of computer network.
- Computer network can be classified as LAN, MAN, and WAN.
- LAN is a smaller network, geographically located into one campus, one building or two nearby building, MAN is wider than LAN can be spreader withing city or connects two nearby cities.
- WAN is a wide arear network, can be spreader into the country, region or in the world.
- PAN is a Personal Area Network, can be made by any individual by connecting two or more computing devices with help of Bluetooth technology.
- Network can be of two types : Point-to-Point or Broadcast.
- Physical layout or arrangement of the computing devices is called Topology. Star, Bus, Ring, Mesh and Hybrid are the names of different topologies.
- Internet is the network of networks; it is also known as information superhighway.
- Internet has been evolved by Department of Defence of the USA, during their research on nuclear weapons.
- The name given to the first network by Department of Defence, USA was ARPANET : Advanced Research Project Agency Network.
- To access the benefits served by Internet we need to connect our device with Internet. To get the Internet we need to take connection from ISP : Internet Service Provider.
- Machine on the Internet are communicating with each other by a unique address called IP-address. There are two versions are there of the IP addresses : IPv4 and IPv6.
- Browser is the software by using it we can surf any website. The field name in which we are writing name of the site is called URL : Uniform Resource Locator.
- Website is a collection of webpages. Webpages are electronic document, can be linked with each other. The link, which connects two web pages are called Hyperlink.
- To design a webpage a special language is used called HTML : Hypertext Mark-up Language.
- When the device is connected to the Internet, chances are there that someone outsider can damage the machine, data, information or software.
- Crime committed using Internet is called Cybercrime.

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- Malware, Botnet, Denial of service attack, Back door, Spoofing are different types of attack, which attacker might use to for their profit or to harass you.
- Cybercrime can be categories as hacker, cracker, script kiddie, unethical employee or cyberterrorists.
- Firewall is the software or hardware system, can be implement between LAN and WAN, to protect the LAN resources from the outsiders.
- Authentication is the process of identifying user.
- Authentication can be done by text-based username and password, PIN-based, or using any Biometric device, like figure print scanner of face recognition.
- Authorization is the process of distributing resource to the user after authentication, so that user can access only those resources which are granted by network administrators.
- ACL : Access Control List can be used to implement Authorization.

<b>BLOCK ASSIGNMENT :</b>
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❖ **Short Answer Questions :**

- (1) List the limitations of networks
- (2) List different topologies
- (3) What is PAN ? Explain it with an example
- (4) What is ISP ?
- (5) List different steps to secure your system from the different types of Internet attacks
- (6) What is authentication ?
- (7) What is authorization ?

❖ **Long Questions :**

- (1) List and explain advantages of computer networks
- (2) Explain classification of networks in brief
- (3) Explain Point-to-Point and Broadcast network in detail
- (4) What is IP ? Explain it in brief
- (5) Explain different types of Internet attacks in detail
- (6) Explain the function of Firewall in detail



❖ **Enrolment No. :**

1. How many hours did you need for studying the units ?

Unit No.	9	10	11
No. of Hrs.			

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

3. Any other Comments

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# **Fundamentals of Computer and Information Technology**

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## **BLOCK 4 : COMPUTER APPLICATIONS**

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UNIT 12 SYSTEM SOFTWARE

UNIT 13 APPLICATION SOFTWARE

UNIT 14 INTRODUCTION TO DATABASES

# **COMPUTER APPLICATIONS**

## **Block Introduction :**

In unit 12, we had an introduction to the basic concepts of system software and application software. Now, in this unit, we'll discuss about these concepts in detail. System software is the program that controls computer hardware. It also maintains computer operation efficiently. The main components of system software are operating system, network operating system and utility. Similarly, the application software is used to provide applications to the users. Examples include enterprise software, accounting software, and office suites and graphics software and media players.

In unit 13, we will be discussed different types of Application software. After learning this chapter students will learn different types of application software such as word processing, Spreadsheet, Presentations, DBMS, Graphics software and so on.

In unit 14, we will focus on databases. After learning this chapter student will understand what is database, what are the advantages and disadvantages are there of database products. You will also learn about DBMS and types of databases.

## **Block Objectives :**

Main objective of this block is to aware students, about different types of software. Software are categorized in System software and application software. The objective of this block is to explain what is system software, and what type of system software we are using. Not only that in this unit we have also discussed variety of application software so that you will extends your knowledge about the availability of the variety of software products. Finally, through this block, students will learn the importance of databases into application, and extend their knowledge about different types of database products.

## **Block Structure :**

**Unit 12 : System Softwares**

**Unit 13 : Application Softwares**

**Unit 14 : Introduction To Database**

**UNIT STRUCTURE****12.0 Learning Objectives****12.1 Introduction****12.2 Network Operating Systems**

**12.2.1 The commonly used Network Operating Systems are discussed below**

**12.2.2 The network operating systems perform the following functions**

**12.2.3 Network operating system features may include :**

**12.3 Utilities****12.4 Let Us Sum Up****12.5 Glossary****12.6 Check Your Progress : Possible Answers****12.7 Assignment****12.8 Activity****12.9 Case Study****12.10 Further Readings****12.0 Learning Objectives :**

**After working through this unit, you should be able to :**

- Explain the basic concept and role of system software in computer systems
- State the concept and functions performed by Operating Systems in computers
- Define Microsoft Operating System, Unix Operating system, Linux Operating system and Network Operating Systems (NOS)
- Mention the significant features and functions performed by NOS
- Specify various types of NOS

**12.1 Introduction :****❖ Operating Systems :**

As we know that, the Operating system (OS) is software, having various programs and data that runs on computers which controls the computer hardware and provides common services for efficient execution of various application software.

For hardware functions such as input and output and memory allocation, the operating system work as an intermediary between computer hardware and application programs, although the application code is usually executed by the hardware, but will regularly call the operating system (OS) or be interrupted by it. Operating systems (OS) are found on almost any device that contains a

computer – from video game consoles and cellular phones to super computers and web servers.

Examples of popular modern operating systems (OS) for personal computers are Microsoft Windows, Mac OS X and GNU/Linux.

The components of an operating system (OS) all exist in order to make the different parts of a computer work together. All software—from financial databases to film editors—needs to go through the operating system in order to use any of the hardware, whether it is as simple as keyboard or mouse or complex as an Internet connection.

With the aid of the firmware and device drivers, the operating system extends the most basic level of control over all of the computer's hardware devices. It manages memory access for programs in the RAM, it determines which programs get access to which hardware resources, it sets up or resets the CPU's operating states for optimal operation at all times and it organizes the data for long-term non-volatile storage with file systems on such media as disks, tapes, flash memory, etc.

The operating system acts as an interface between an application and the hardware. The user interacts with the hardware from the other side. The operating system is a set of services which simplifies development of applications. Executing a program involves the creation of a process by the operating system. The kernel generates a process by assigning memory and other resources, establishing a priority for the process (in multi-tasking systems), loading program code into memory and executing the program. The program then interacts with the user and/or other devices and performs its intended function.

Common contemporary operating system (OS) families include Darwin (Mac OS X), BSD, Linux, SunOS (Solaris/Open Solaris) and Windows NT (XP/Vista/7). While servers basically run embedded system Unix or some Unix-like operating system, markets are divided amongst several

Operating systems (OS). Operating system (OS) tells computer how to use its components. Operating System (OS) work as an interpreter between the hardware, application program and the user. When the program wants hardware to do something, it conveys through the operating system (OS). Similarly, when the user wants computer to do something (e.g. printing, copying), the user request is handled by the operating system (OS). The examples of operating system (OS) are UNIX, Microsoft Windows, Macintosh and LINUX.

**☐ Check Your Progress – 1 :**

1. Operating systems are, \_\_\_\_\_ software.  
 [A] Application [B] System  
 [C] Media [D] None of the above
2. Identify operating system from the given options.  
 [A] Windows [B] UNIX [C] Linux [D] All of the above

**The operating system performs following functions–**

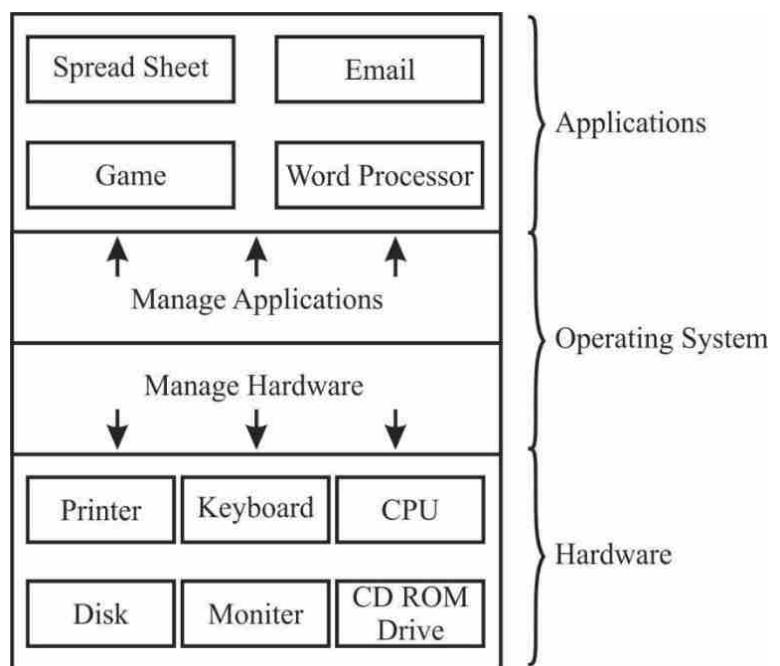
From the user's point of view, the purpose of an operating system (OS) is to assist him in the mechanics of solving problems. Specifically, the following functions are performed by the system :

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1. Job sequencing, scheduling and traffic controller operation
2. Input/ output programming
3. Protecting itself from the user; protecting the user from other users
4. Secondary storage management
5. Error handling

Action	OS Does This
You turn on the computer	Hardware management
You execute an application	Process management
Application reads a tape	Hardware management
Application waits for data	Process management
Process waits while other process runs	Process management
Process displays data on screen	Hardware management
Process writes data to tape	Hardware management
You quit; the process terminates	Process management
You turn off the computer	Hardware management

You can view a computer system as being built from 3 general components : the applications, the hardware and the operating system a (Ref. Figure 1.1.). The hardware includes pieces such as a keyboard, central processing unit (CPU), a printer and hard drive. You can think of these as the parts. You can touch it physically also. Applications are why you use computers; they use the rest of the system to perform the particular task (for ex., send electronic mail, play a game, edit a memo). The operating system (OS) is the component that on one side controls and manages the hardware and on the other manages the applications.



**Fig. 12.1 : Computer System Components**

❑ **Check Your Progress – 2 :**

1. The devices which you see and touch are called \_\_\_\_\_.  
 [A] Hardware [B] Software  
 [C] Both [A] and [B] [D] None of the above
2. Operating system is \_\_\_\_\_.  
 [A] Hardware [B] Software [C] Utility [D] Database
3. The role of the operating system is \_\_\_\_\_.  
 [A] Manage Hardware [B] Manage Process  
 [C] Both [A] and [B] [D] Developing programs

**12.2 Network Operating Systems :**

A Networking Operating System is also Operating System (OS) that contains large number of programs and components that allow a computer running network operating system to serve requests from other computer for web sites, data and provide access to other resources such as file systems and printer.

The network operating systems allow computers to communicate and share data across the network while overseeing the network's security and controlling network operations.

**12.2.1 The commonly used Network Operating Systems are discussed below :**

- **Novell :** As the market leader, Novell set the stage for a long line of PC LAN innovations that extend well beyond simple file and print services. Novell designed the NetWare Load Module (NLM) to enable third-party companies to write server-side NetWare applications and enterprise-oriented features, such as data recovery and fault tolerance.
- In terms of scalability, Novell extended the power and performance of NetWare by allowing other companies to port NetWare from its Intel-only origin to high-end RISC systems, such as the HP9000. At the network level, the routing capabilities and simple client configuration of Novell's IPX protocol suite enables NetWare customers to easily construct networks of any size. Novell has further reinforced the ease-of-installation and ease-of-maintenance of NetWare with the release of NetWare Directory Services (NDS), a global directory structure for all NetWare resources.
- **Banyan Systems :** Banyan Systems' VINES (Virtual Network Software) provides file and print serving services similar to NetWare, but VINES run with existing network protocols, such as TCP/IP, SNA and others. More significantly, VINES was the first PC LAN product to support a network directory service, which Banyan named StreetTalk. StreetTalk presents a single directory that encompasses multiple servers and allows users to login only once to access multiple servers. Of course, Novell later added its own network directory service in version 4.1 of NetWare and other network operating systems vendors are following suit. Banyan is, however, unbundling StreetTalk and offering it for other platforms, such as Windows NT.
- **IBM :** IBM's original PC LAN product was the LAN Server, a dedicated server product that shares the same protocol suite (NetBIOS/NetBEUI) and same overall architecture as Microsoft's LAN Manager Product. This

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Technology**

should not be a big surprise because IBM was one of the core developers of the NetBIOS/ NetBEUI protocol suite and the Server Message Block (SMB) architecture used by IBM, Microsoft and others. IBM's DOS-based LAN Server technology was then integrated into its OS/2 server product. OS/2-based file and print servers have achieved a reputation for stability and reliability; however, OS/2 servers tend to be implemented in sites that have other IBM equipment—AS/400 and mainframes in particular.

- **Microsoft :** Microsoft acquired most of its networking technology from 3Com Corporation. Microsoft incorporated the 3Com technology in its main product lines, starting with LAN Manager, a dedicated file and print server similar to IBM's LAN Server offering. Microsoft then went on to extend its networking technology into workgroup environments with the release of Windows for Workgroups and Windows 95. None of these Microsoft products offered the stability or performance of a dedicated Novell NetWare server—but this changed with the advent of Windows NT Server.
- Windows NT Server is an enterprise-oriented product that can compete head-to-head with NetWare. Windows NT Server also offers additional features and value—most notably, the capability to run on a wide range of platforms, fully integrated support for TCP/IP and support for a range of software products that enable an NT Server to function as a full-blown application server.

**Check Your Progress – 3 :**

1. AS400 is a system of \_\_\_\_\_.  
[A] IBM [B] Microsoft  
[C] Banyan [D] None of the above
2. \_\_\_\_\_ network-based operating system is developed by Banyan Systems.  
[A] NetWare [B] Windows-NT  
[C] DOS [D] VINES
3. DOS stands for \_\_\_\_\_.  
[A] Distributed Operating System [B] Distributed Open System  
[C] Disk Operating System [D] Disk Open Source System

**12.2.2 The network operating systems perform the following functions :**

- Add, manage and remove users who wish to use resources on the network.
- Allow users to access data on the network. This data resides on the server.
- Allow users to access data found on another network such as the internet.
- Allow users to access hardware connected to the network.
- Protect data and services located on the network.

**12.2.3 Network operating system features may include :**

- Support for hardware ports
- Security features such as authentication, authorization, login restrictions and access control directory services and Name services
- Print, file, data storage, replication and backup services



- Remote access
- System management
- Auditing tools and Network administration with graphic interfaces
- Clustering capabilities
- High availability and Fault tolerance.

**❑ Check Your Progress – 4 :**

1. Identify the feature of a Network Operating Systems from the given options :
 

[A] Remote access	[B] System management
[C] Support for Hardware ports	[D] All of the above
2. Identify the which is not a feature of Network OS.
 

[A] Manage users	[B] Sharing of hardware
[C] Provides GUI	[D] Data protection

<b>12.3 Utilities :</b>
-------------------------

Utility is the program that makes computer system easy to use or perform highly specialized functions. Utilities are used to manage disks, troubleshoot hardware problems and perform other tasks that the operating systems are not able to do.

Utility software is a kind of system software designed to help analyse, configure, optimize and maintain the computer. A single piece of utility software is usually called a utility or tool. Utility software should be contrasted with application software, which allows users to do things like creating text documents, playing games, listening to music or surfing the web. Rather than providing such kinds of output-oriented or user-oriented functionality, utility software normally concentrates on how the computer infrastructure (including the computer hardware, application software, operating system and data storage) operates.

Due to this, utilities are often rather targeted and technical at people with a higher level of computer knowledge.

Most utilities are highly specialized and designed to perform only a single task or a small range of tasks. However, there are also some utility suites that combine several features in one piece of software. Most major operating systems come with several pre-installed utilities.

**❑ Check Your Progress – 5 :**

1. Identify Utility program from the given options :
 

[A] Word processor	[B] Excel
[C] Disk defragment	[D] Browser
2. WinZip or Win-RAR are \_\_\_\_\_ software.
 

[A] Application	[B] Operating System
[C] Utility	[D] Driver

<b>12.4 Let Us Sum Up :</b>
-----------------------------

System software is the program that controls computer hardware. It also maintains computer operation efficiently. The main components of system software are operating system, network operating system and utility.

An operating system (OS) is an interface between user and hardware; an OS is responsible for the coordination and management of activities and the sharing the resources of the computer.

The operating system (OS) acts as a host for computing applications that are run on the machine. As a host, one of the purposes of an operating system (OS) is to

❖ **Handle the details of the operation of the hardware.**

The operating system performs following functions—From the user's point of view, the purpose of an operating system is to assist him in the mechanics of solving problems. Specifically, the following functions are performed by the system :

1. Job sequencing, scheduling and traffic controller operation
2. Input/ output programming
3. Protecting itself from the user; protecting the user from other users
4. Secondary storage management
5. Error handling

A Networking Operating System is an operating system (OS) that contains programs and components that allow a computer running network operating system to serve requests from other computer for web sites, data provide access to other resources such as printer and file systems. Novell Netware, UNIX and Windows NT are the main NOS.

❖ **The network operating systems perform the following functions :**

- It can add, remove and manage users.
- Allow users to access data which commonly resides on the server.
- It also allows users to access hardware connected to the network.
- It protects data and services located on the network.

❖ **Network operating system features may include :**

- It supports features like security, authentication, authorization, login restrictions and access control
- Using NOS features we can access name services and directory services
- It supports features like exchange of files, print, data storage, backup and replication services
- Remote access is possible.
- Network administration and auditing tools with graphic interfaces
- Using NOS we can support clustering.
- In NOS Fault tolerance and high availability features.

Utility is the program that makes computer system easy to use or perform highly specialized functions. Utilities are used to manage disks, troubleshoot hardware problems and perform other tasks that the operating systems are not able to do.

**12.5 Glossary :**

**OS :** Operating System. It is a system software, which manages processes, memories, storage and IO devices.

**NOS** : Network Operating System. It is a operating system which supports networking.

**TCP/IP** : Transmission Control Protocol and Internet Protocol. These protocols are used in the networking.

**DOS** : Disk Operating System. It is a simple command-oriented operating system developed by Microsoft.

### 12.6 Suggested Answers For Check Your Progress :

- ❑ **Check Your Progress 1 :**
  1. [B]                      2. [D]
- ❑ **Check Your Progress 2 :**
  1. [A]                      2. [B]                      3. [C]
- ❑ **Check Your Progress 3 :**
  1. [A]                      2. [D]                      3. [C]
- ❑ **Check Your Progress 4 :**
  1. [D]                      2. [C]
- ❑ **Check Your Progress 5 :**
  1. [C]                      2. [C]

### 12.7 Assignment :

- ❖ **Broad Questions :**
  1. What do you mean by operating systems ? State the functions performed by operating systems.
  2. What is network operating system ? State the examples of NOS. Discuss the significant features and functions of NOS
- ❖ **Short Notes :**
  1. Utilities
  2. Novell Netware
  3. Windows NT
  4. Unix Operating Systems.
  5. IBM Operating Systems.

### 12.8 Activity :

Explain the importance of System Software in your own words.

### 12.9 Case Study :

Collect the information about UNIX operating. List feature of UNIX operating system and explain each feature in detail.

### 12.10 Further Reading :

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.
4. Computer Networks by Tanenbaum, Prentice-Hall India Publications.

**UNIT STRUCTURE**

- 13.0 Learning Objectives
- 13.1 Introduction
- 13.2 Word Processing Software
  - 13.2.1 The significant features of M.S. Word are as follows
- 13.3 Spreadsheets
  - 13.3.1 Microsoft Excel
- 13.4 Database Management Systems
  - 13.4.1 Functions of DBMs
  - 13.4.2 Examples of various organizations and their databases
- 13.5 Presentation Programs
- 13.6 Graphics Programs
  - 13.6.1 Computer Graphics has following features
- 13.7 Multimedia Authoring Applications
- 13.8 Entertainment and Education Software
  - 13.8.1 Some examples of entertainment software are
- 13.9 Let Us Sum Up
- 13.10 Check Your Progress : Possible Answers
- 13.11 Glossary
- 13.12 Assignment
- 13.13 Activity
- 13.14 Further Reading

**13.0 Learning Objectives :**

**After working through this unit, you should be able to :**

- State the basic concept of application software
- Explain how the word processing software works and features of MS Word
- Describe how the basic SCM model is developed
- Mention the concept of applications of spread sheets and significant features of MS Excel
- Discuss the concept of Database Management Systems and the use of MS Access and oracle in DBMS applications
- Show how MS PowerPoint is used for presentations
- Illustrate Multimedia Authoring Applications and entertainment and education software

### 13.1 Introduction :

We have studied the basic concept of application software in Unit 1. We have seen that the application software tells computer how to accomplish specific tasks such as word processing or drawing for the user. Thousands of applications are available for many purposes and the people of all ages. Some of the categories include :

1. Word Processing Software
2. Spreadsheets
3. Database Management Software
4. Presentation Programs
5. Graphics Programs
6. Multimedia authoring applications
7. Entertainment and education software
8. Web design tools and Web browsers
9. Games

In this unit, we will take a review of main application software being used.

#### ☐ Check Your Progress – 1 :

1. \_\_\_\_\_ is not an application software.  
 [A] Word processing                      [B] Presentation  
 [C] Windows                                [D] Spreadsheets
2. Identify the Application software from give below :  
 [A] Word processing                      [B] Presentation  
 [C] Spreadsheets                         [D] All of the above
3. Web–Browser is \_\_\_\_\_ software. [Application, System]

### 13.2 Word Processing Software :

Word processing software is used for creating documents. Drafts, letters, reports, essays, write ups etc. can be created using word processing software. Earlier, Word Star was being used widely for this purpose. Sidekick, word Prefect are also used for drafting letters. However, the most commonly used word processing package all over the world is Microsoft Word.

Microsoft Word is Microsoft's word processing software. It was first released in 1983 under the name Multi–Tool Word for Xenix systems. Versions were later written for several other platforms including IBM PCs running DOS (1983), the Apple Macintosh (1984), SCO UNIX, OS/2 and Microsoft Windows (1989). It is a component of the Microsoft Office system; however, it is also sold as a standalone product and included in Microsoft Works Suite. Beginning with the 2003 version, the branding was revised to emphasize Word's identity as a component within the Office suite; Microsoft began calling it Microsoft Office Word instead of merely Microsoft Word. The latest releases are Word 2007 for Windows and Word 2008 for Mac OS X. There are commercially available add–ins that expands the functionality of Microsoft Word.

### **13.2.1 The significant features of M.S. Word are as follows :**

1. It is an easy and simple package for a general user.
2. The features such as paragraph, font, symbols, spell check, table, drawing, bullets and numbering, page numbering etc. are provided by this package. This enables a user to develop a document in error free and attractive form.
3. The text file generated by MS Word is .doc. This file can be used in other applications such as MS Excel, MS Visual Studio 6.0, MS Visual Studio.net, Web browser, pdf format etc.

### **13.3 Spreadsheets :**

Spreadsheet is very well known and widely used computer applications that help us to work out a paper worksheet. It displays number of cells that together made a grid consisting of rows and columns, each cell consisting either alphanumeric text or numeric values. A spreadsheet cell defines a formula that how the contents of that cell are to be calculated from the contents of other cell that each time any cell is updated. Spreadsheets are used for financial information because of their ability to re-calculate the entire sheet directly as a change to a single cell is made.

VisiCalc is usually considered the first electronic spreadsheet and it helped to modify the Apple II computer into a success and greatly assisted in their widespread application. Lotus 1-2-3 was the leading spreadsheet when DOS was the dominant operating system (OS). Excel is now considered to have the largest market share on the Windows and Macintosh platforms

#### **13.3.1 Microsoft Excel :**

Microsoft had been developing Excel on the Macintosh platform for several years at this point, where it had developed into a fairly powerful system. A port of Excel to Windows 2.0 resulted in a fully functional Windows spreadsheet. The more robust Windows 3.x platforms of the early 1990s made it possible for Excel to take market share from Lotus. By the time Lotus responded with usable Windows products, Microsoft had started compiling their Office suite. Starting in the mid-1990s continuing through the present, Microsoft Excel has dominated the commercial electronic spreadsheet market.

#### **❑ Check Your Progress – 2 :**

1. \_\_\_\_\_ is an example of spreadsheet application.  
[A] MS-Word [B] MS-Excel  
[C] MS-PowerPoint [D] None of the above
2. To prepare your resume, you will use \_\_\_\_\_.  
[A] MS-Word [B] MS-Excel  
[C] MS-PowerPoint [D] None of the above
3. \_\_\_\_\_ application is not a part of MS-Office package.  
[A] Microsoft Word [B] Microsoft Excel  
[C] Microsoft Visual Studio [D] Microsoft PowerPoint

### **13.4 Database Management Systems :**

A database Management system is a tool to collect, organize and manage large amount of data in systematic manner that can be retrieved and used as per the need of the organization.

**13.4.1 Most DBMSs perform the following functions :**

- To create and maintain data structures
- It allows concurrent access to many users
- Enforce security and privacy
- Allow extraction and manipulation of stored data
- It enables data entry and data loading
- Provide an efficient indexing mechanism for fast extraction of selected data
- Provide consistency among different records
- Protect stored data from loss by backup and recovery process

**13.4.2 Examples of various organizations and their databases are as follows :**

- Manufacturing Company : stores product data.
- Bank : stores transactions data.
- Hospital : stores patient data.
- University : stores student data.

The commonly used DBMS packages are Microsoft Access and Oracle.

Microsoft Office Access is a relational database management system from Microsoft that combines the relational Microsoft Jet Database Engine with a graphical user interface and software development tools. It is a member of the

Microsoft Office suite of applications and is included in the Professional and higher versions for Windows.

Access stores data in its own format based on the Access Jet Database Engine. It can also import or link directly to data stored in other Access databases,

Excel SharePoint lists, text, XML, Outlook, HTML, dBase, Paradox, Lotus 1–2–3 or any ODBC–compliant data container including Microsoft SQL Server, Oracle, MySQL and PostgreSQL. Software developers and data architects can use it to develop application software and non–programmer ?power users ? can use it to build simple applications.

**☐ Check Your Progress – 3 :**

1. SQL stands for \_\_\_\_\_  
 [A] System Query Language      [B] System Quality Language  
 [C] Structured Query Language    [D] Structured Quality Language
2. \_\_\_\_\_ language is used to operate database products.  
 [A] SQL            [B] C–Language    [C] Java            [D] C#
3. \_\_\_\_\_ is not a DBMS product.  
 [A] Access                              [B] MS SQL Server  
 [C] WordPad                            [D] PostgreSQL

**13.5 Presentation Programs :**

Microsoft PowerPoint is a presentation program developed by Microsoft. It is part of the Microsoft Office suite and runs on Microsoft Windows and Apple's Mac OS X computer operating systems.

PowerPoint is widely used for making presentation slides consisting of various types of information in text form, picture form by business people, educators, students and trainers and among the most prevalent forms of persuasive technology. Beginning with Microsoft Office 2003, Microsoft revised the branding to emphasize PowerPoint's place within the office suite, calling it Microsoft Office PowerPoint instead of just Microsoft PowerPoint. The current versions are Microsoft Office PowerPoint 2007 for Windows and 2008 for Mac.

### **13.6 Graphics Programs :**

Computer graphics are graphics created by using computers and their presentation and manipulation of pictorial data by using various graphic support application software. The development of computer graphics has made computers easier to interact with and better for understanding and interpreting many types of data. Developments in computer graphics had a profound impact on many types of media and have revolutionized the animation and video game industry. All types of computers use some or more graphics and users expect to control their computer through icons and pictures.

#### **13.6.1 Computer Graphics has following features :**

- Representation and manipulation of pictorial data
- Display pictures, films and movies as per the users need
- Digitally synthesizing and manipulating visual content

Today computers and computer-generated images touch many aspects of our daily life. Computer imagery is found in newspapers, on television, during surgical procedures and in weather reports. A well-constructed graph can present complex statistics in a form that is easier to interpret and understand. These graphs are used to illustrate reports, papers, these and other presentation material. A range of tools and facilities are available to enable users to visualize their data and computer graphics are used in many disciplines.

#### **❑ Check Your Progress – 4 :**

1. To make a Presentation \_\_\_\_\_ software is used.  
[A] Corel Draw [B] PowerPoint  
[C] Excel [D] None of the above
2. \_\_\_\_\_ is used to process pictorial data.  
[A] Word processor [B] Spreadsheets  
[C] Graphics programs [D] None of the above

### **13.7 Multimedia Authoring Applications :**

Multimedia is described as a medium having multiple content forms. Multimedia includes a combination of text, audio, images, animation and video in interactivity content forms.

Multimedia is usually recorded and played, displayed or accessed by information content processing devices, such as computerized and electronic devices, but can also be part of a live performance. Multimedia (as an adjective) also describes electronic media devices used to store and experience multimedia is similar to traditional mixed media in fine art, but with a broader scope. The term ? rich media ? is synonymous for interactive multimedia.



**❑ Check Your Progress – 5 :**

1. Multimedia includes \_\_\_\_\_.  
 [A] Text            [B] Audio            [C] Video            [D] All of the above
2. \_\_\_\_\_ is usually recorded and played, displayed or accessed by information content processing devices.  
 [A] Word processor                            [B] Multimedia  
 [C] Graphics programs                        [D] Spreadsheet

**13.8 Entertainment and Education Software :**

The computer application software is widely used for entertainment and education purpose. Thousands of computer games are available for school children. While playing, they learn so many things such as logical reasoning, strategic planning, simulation of various situation and solving the problems and knowledge acquisition etc. The software that imparts education on number of subjects such as mathematics, English, history etc. is also available.

Educational software is computer application software, the primary purpose of such software is to teaching or self-learning processes effectively. The design of educational software programmes for home use has been influenced strongly by computer gaming concepts – in other words, they are designed to be fun as well as educational. A further category of educational software is designed for use in school classrooms. Typically, such software may be projected onto a large whiteboard at the front of the class and/ or run simultaneously on a network of desktop computers in a classroom. This type of software is often called classroom management software.

**13.8.1 Some examples of entertainment software are :**

- Find MP3 is an easy to use and powerful MP3 search tool that allows you to find thousands of free MP3 music files on the Internet. There are many search engines on the Internet that offer free MP3 files and 2 Find MP3 makes it easy to find and download the music you are looking for.
- Play and organize your favourite mp3 and movie files with all-in-one media player. All-in-One Media Player supports all popular audio and video formats including MP3, AVI, MPG and various DVD standards. You will never again lose track of your media collection which often is scattered over different folder locations and disks.

**13.9 Let Us Sum Up :****In this unit, we have :**

- Discussed what is word processing software and spreadsheet software.
- Elaborated Presentation software.
- Described DBMS software.
- Talked about Multimedia software.
- Discussed Educational and Entertainment software.

**13.10 Suggested Answers For Check Your Progress :****❑ Check Your Progress 1 :**

1. [C]
2. [D]
3. Application

- ❑ **Check Your Progress 2 :**  
1. [B]                      2. [A]                      3. [C]
- ❑ **Check Your Progress 3 :**  
1. [C]                      2. [A]                      3. [C]
- ❑ **Check Your Progress 4 :**  
1. [B]                      2. [C]
- ❑ **Check Your Progress 5 :**  
1. [D]                      2. [B]

### **13.11 Glossary :**

**DBMS :** Database Management System. Application to store large amount of data.

**SQL :** Structured Query Language. It is 4th GL language, used to operate databases.

### **13.12 Assignment :**

#### ❖ **Broad Questions :**

1. What do you mean by word processing software ? List various words processing software. Discuss the significant features of Microsoft Word.
2. What do you mean by spread sheet ? What are its utilities ? List the various types of spreadsheets.

#### ❖ **Short Notes :**

- Database management system (DBMS)
- Microsoft PowerPoint
- Computer Graphics
- Multimedia Systems
- Entertainment and education software's

### **13.13 Activity :**

Gather information about "Open Office" product from the Internet and List the features of it.

### **13.14 Further Reading :**

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.

# *INTRODUCTION TO DATABASES*

## **UNIT STRUCTURE**

- 14.0 Learning Objectives
- 14.1 Introduction
- 14.2 Hierarchy of data
- 14.3 Validation of data
- 14.4 Advantages of database
- 14.5 Disadvantages of database
- 14.6 Typed of databases
- 14.7 Let Us Sum Up
- 14.8 Suggested Answers for Check Your Progress
- 14.9 Glossary
- 14.10 Assignment
- 14.11 Activity
- 14.12 Case Study
- 14.13 Further Readings

### **14.0 Learning Objectives :**

After working through this unit, you should be able to :

- Understand the database system.
- State the hierarchy of data into the database
- List the advantages and disadvantages of the database
- Learn validation of data into the database
- List and explain types of databases

### **14.1 Introduction :**

A database is a collection of data organised in a manner that allows user to access, retrieval and use that data. Database can store different types of data such as text, numbers, date, images, audio and video. A database is generally used to store large amount of data pertaining to a particular system for example, School Management System, Payroll System, Library Management System and so on.

Database Management System (DBMS) is a software which allows user to create and manage database. DBMS systems allows user to store the data into database, to retrieve the data, to sort the data. With the help of DBMS system user can add, modify and delete the data into the database. MS–Access, Oracle, MySQL, and MS–SQL Server are examples of DBMS products.

### **14.2 Hierarchy of Data :**

Data is organized in different levels. Each higher level of data consisting of one or more lower level of data.

- **Character** : Character is a collection of 8–bits, which is used to represent any one symbol of a keyboard. It can be alphabets, digits or special symbol.
- **Fields** : A Field is a combination of one or more character. For Example, Roll number of a student, Mobile number or Email address of the customer, ISBN number of a book are example of fields. To maintain integrity, you need to assign a data type when you are defining field. Datatypes include Text, Numbers, Boolean (Yes/No), Date etc. For example, if you have chosen date datatype to the field 'DateOfBirth', then DBMS will not allow any Invalid date in this field at the time of data entry.
- **Records** : A record is a group of related fields. For example : data of (RollName, Name, DateOfBirth, Address) of any one student is a record of that particular student.
- **Data Table / Data File** : Collection of related records is called Data Table or Data File. For example, if the class has 60 students, then Data table should have 60 records.. Each record represents a data of one student that might have (RollName, Name, DateOfBirth, Address) fields.

❑ **Check Your Progress – 1 :**

1. Oracle is an example of \_\_\_\_\_.  
[A] Word processor [B] Presentation tool  
[C] DBMS [D] None of the above
2. Collection of related records are called \_\_\_\_\_.  
[A] Field [B] Character  
[C] Record [D] None of the above
3. Collection of related fields is called \_\_\_\_\_.  
[A] Field [B] Character  
[C] Record [D] None of the above

**14.3 Validation of Data :**

Validation of the data means comparing the data entered by the user with some set of rules or values. The data entered by the user should meet to some specific criteria. If the data fails to validity check, then the DBMS system should not allow to accept such data, and it shows error message to the user. Here, some examples are given for the validation of data.

- **Alphanumeric Check** : Alphabetic check constrain ensures that the data entered by the user has only alphabets into the field. Numeric check constrain ensures that the data inputted into the field contains only digits. For example, in the field of customer's mobile number we don't want to allow any alphabets to be inputted by the user.
- **Range Check** : Range constrain of DBMS system ensures that the data to inputted by the user should follow some range. For example, in the employee table, Age field must take data from 18 to 60.
- **Referential Integrity Check** : Referential Integrity also known as consistency check. Here, DBMS checks that the data inputted by the user is consistent with other related data tables or not. For example, in the 'Salary' table you must not allow to do data entry of the Employee, which does not exist in the 'Employee' table.

- **Required Field Check** : Required field check verifies that user must input the data into some designated field. You can set the rule in the DBMS, such that 'Employee Name' is mandatory and user must have to enter details into this field while entering Employee details.

❑ **Check Your Progress – 2 :**

1. To enforce user to enter Employee name mandatorily, \_\_\_\_\_ check will be used.  
[A] Range [B] Required field  
[C] Referential integrity [D] None of the above
2. \_\_\_\_\_ check is used to validate age filed for the employee.  
[A] Range [B] Required field  
[C] Referential integrity [D] None of the above
3. To check whether the Employee is a valid employed, while entering a salary details of the employee, \_\_\_\_\_ is used to validate data.  
[A] Range [B] Required field  
[C] Referential integrity [D] None of the above

**14.4 Advantages of A Database :**

The concept of Database serves many advantages and disadvantages. Advantages of Database are listed below :

1. **Reduce data redundancy** : Data redundancy means unnecessary duplication of data. If the data is redundant then it causes inconstancy as well as it takes more storage space to store, unnecessarily duplicate data. When we are storing data into the database then we are following some rules called normalization. Normalization is a process of splitting the table into multiple tables to avoid redundancy.
2. **Improve data integrity** : Integrity means validation of the data. When we create a field, we need to specify data type for that field. Not only that DBMS applications allow us to specify validation rules. When user enters a wrong data, which do not match with data types or validation rules, database refuse to take that invalid data from the user.
3. **Sharing of data** : Database allows user to share the data. Online banking, and Railway reservation systems are great examples of data sharing of database.
4. **Ease Access** : It is very easy to access the data from the database. Even if non-technical user can also access the data from the database with minimal effort.
5. **Reduction in development time** : User of database will ease the development process. Application developer can easily access the data from the databases. Many DBMS system provides several tools to assists in developing program, which further reduces the time of development process.

❑ **Check Your Progress – 3 :**

1. Unnecessary duplication of the data is called \_\_\_\_\_.  
[A] Data redundancy [B] Data integrity  
[C] Referential integrity [D] All of the above

2. Validation of the data entered by the user to the database is called \_\_\_\_\_.  
[A] Data redundancy [B] Data integrity  
[C] Referential integrity [D] All of the above
3. Use of database provide \_\_\_\_\_ benefit.  
[A] Reduce data redundancy [B] Improve data integrity  
[C] Reduce development time [D] All of the above

#### **14.5 Limitations of A Database :**

A Database structure is more complex than a File structure. To develop larger database, training has to be provided to the database designer. Database application also needs more storage space, memory and processing power than files. To manage, or maintain database trained database administrator is required. Protection of the database and periodic backup of the database is art and can be done by skilled persons only.

#### **14.6 Types of A Databases :**

Different databases and DBMSs are using specific data model. A data model consists of standards and rules that defines how the database organize the data. A data model is used to define how different users view the organization of data. Depends on which data model is used in the database, databases can be classified into two types.

1. **Relational Database :** A relational database is a database that stores data in tables that has columns and rows. The tables are related to each other by defining relations between tables. A Relation provides link between data stored in the separate tables. Examples of relation databases are Payroll system, Inventory system, Invoicing, Library management system etc.
2. **Object–Oriented Database :** An object–oriented database stores the data in the form of various objects. Each object has its own data and specific methods defined into its structure called class. Examples of object–oriented database are media database which stores pictures, videos, audios etc. with their attributes, groupware database which stores manuals, calendar, memos, reports, schedules etc.

#### **☐ Check Your Progress – 4 :**

1. Inventory is an example of \_\_\_\_\_ database.  
[A] Relational [B] object–oriented  
[C] Multidimensional [D] None of the above
2. Example of object–oriented database is \_\_\_\_\_.  
[A] Inventory system [B] Invoicing system  
[C] Groupware system [D] Payroll system
3. In \_\_\_\_\_ database, objects are stored which has data and methods.  
[A] Relational [B] object–oriented  
[C] Multidimensional [D] None of the above

### **14.7 Let Us Sum Up :**

**In this unit :**

- We have discussed about database system.
- We have learnt hierarchy of data in the database.
- We gain awareness of DBMS software.
- We have seen, advantages and disadvantages of database.
- We have understood different types of databases.

### **14.8 Suggested Answers For Check Your Progress :**

**Check Your Progress 1 :**

1. [A]                      2. [B]                      3. [D]

**Check Your Progress 2 :**

1. [D]                      2. [B]                      3. [C]

**Check Your Progress 3 :**

1. [C]                      2. [D]                      3. [A]

**Check Your Progress 4 :**

1. [B]                      2. [C]                      3. [A]

**Check Your Progress 5 :**

1. [C]                      2. [B]                      3. [D]

### **14.9 Glossary :**

**DBMS :** Database Management System. It is a software used to create and manage databases.

**SQL :** Structured Query Language. It is 4th GL Language used to operate the databases.

### **14.10 Assignment :**

1. List and explain advantages and disadvantages of Database.
2. What is Database ? What is DBMS ? Explain both in brief.
3. List and explain types of DBMS.

### **14.11 Activity :**

Make a list of different types DBMS system. Mention merits and demerits of each DBMS system.

### **14.12 Case Study :**

Find "Normalization of DBMS" on the internet and write different types of it.

### **14.13 Further Reading :**

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.
2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.
3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.

**BLOCK SUMMARY :**

- Set of instructions written in a specific language is called program and set of programs is called software.
- Software can be further classified as System software and Application software.
- That software which are dealing with the hardware devices directly is called system software. Operating systems and Utility programs are example of system software.
- Software which do not deal with the hardware devices directly is called Application software. Word processor, Excel spread sheets, presentation software, graphics software are examples of application software.
- To store huge amount of data in organized way, we need to use database applications rather than files.
- A Software which allows us to create and manage databases are called DBMS (Database Management System).
- SQL (Structured Query Language) is used to operate database; it is a 4th Generation Language.

**BLOCK ASSIGNMENT :**

❖ **Short Answer Questions :**

- (1) List the functions of an operating system
- (2) List all network operating systems
- (3) List all features of network OS
- (4) What is Application software ? List any 4 application software you know
- (5) What is validation ? List all types of data validation in DBMS
- (6) List all advantages of DBMS

❖ **Long Questions :**

- (1) What is operating system ? Explain in brief
- (2) Explain utility programs in brief
- (3) Explain data hierarchy in brief
- (4) List and explain different types of databases.



❖ **Enrolment No. :**

1. How many hours did you need for studying the units ?

Unit No.	12	13	14
No. of Hrs.			

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

3. Any other Comments

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