

PLUS ONE COMPUTER APPLICATIONS



**STUDY
MATERIAL**



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HIGHER SECONDARY NATIONAL SERVICE SCHEME

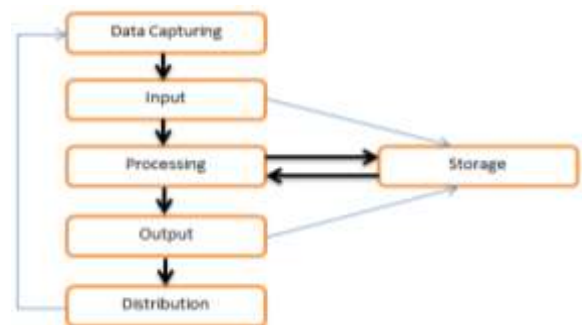
1. Fundamentals of Computers

- **Data**
Denotes raw facts and figures like numbers or words. Eg. Chandran, 37.
- **Information**
Meaningful and processed form of data. Eg. Chandran is 37 years old.
- **Data processing**
Data Processing refers to operations or activities performed on data to generate information.

Data	Information
Collection of raw facts and figures	Processed data
Does not give precise and clear sense	Clear and meaningful
Similar to raw material	Similar to finished product
Cannot be directly used	Adds to knowledge and helps in taking decisions

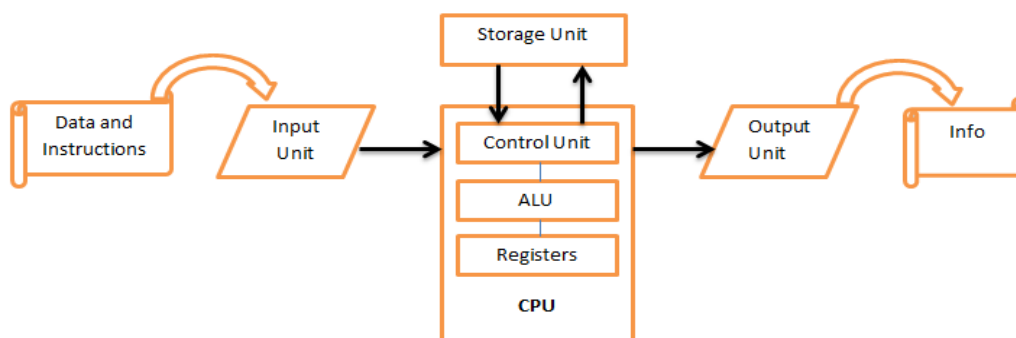
Data Processing stages

1. Capturing data
2. Input of data
3. Storage of data
4. Processing / Manipulating data
5. Output of information
6. Distribution of information



Functional units of a computer

Modern computers are designed based on the model proposed by John Vonn Nuemann. This model consists of different functional units such as Input Unit, Central Processing Unit (CPU), Storage Unit and Output Unit. Following figure organization of basic functional units.



- **Input Unit** - Eg. Keyboard, Mouse, Scanner
 Functions - Accept data & instructions, Convert it into a form acceptable to computer, Supply converted instructions and data to computer for processing.
- **Central Processing Unit (CPU)** - Brain of the computer
 Functions - Perform computations and comparisons, Responsible for activating and controlling operations of other units.
- Components of CPU:
 - Arithmetic Logic Unit (ALU) - Performs calculations and logical operations such as comparisons and decision making
 - Control Unit (CU) – Manages and coordinates all other units of the computer
 - Registers – Temporary storage elements that facilitate functions of CPU
- **Storage Unit**
 - Functions: Store data and instructions, Store intermediate results of processing, Store final results to be sent to output unit
 - Types of storage
 - Primary storage / Main memory
 - RAM holds instructions, data and intermediate results of processing
 - ROM contains instructions for the start-up procedure of computer
 - Adv: CPU can directly access primary memory at very high speed
 - Disadv: Costly, Limited storage capacity
 - Secondary storage / Auxiliary storage - Eg. Hard disk, CD, DVD
 - Data, programs and information are stored in secondary storage
 - Adv: Huge storage capacity, Storage is permanent
- **Output Unit** - Eg. Monitor, Printer
 - Functions: Receive results produced by CPU in coded form, Convert coded results into human readable form, Supply results to outside world
- **Definition of Computer** – Computer is an electronic machine to accept data & instructions, perform arithmetic & logical operations on data according to instructions and output results or information.

- **Characteristics of computers**
 - Advantages of computers – Speed, Accuracy, Diligence, Versatility, Huge memory
 - Limitations of computers - Lack of IQ, Lack of decision making power

Number System

- It is the systematic way to represent numbers
- Number of symbols used in a number system is called **Base** or **Radix**.
- Format: (Number)_{Base}
 - **Positional number systems:** In which the weight of a digit depends on its relative position
 - The digit with most weight (left most digit) is called Most Significant Digit (MSD)
 - The digit with least weight (right most digit) is called Least Significant Digit (LSD)

Number System	Base	Digits	Place Values
Binary	2	0 1	$2^0, 2^1, 2^2, \dots$
Octal	8	0 1 2 3 4 5 6 7	$8^0, 8^1, 8^2, \dots$
Decimal	10	0 1 2 3 4 5 6 7 8 9	$10^0, 10^1, 10^2, \dots$
Hexadecimal	16	0 1 2 3 4 5 6 7 8 9 A B C D E F	$16^0, 16^1, 16^2, \dots$

- Digits in binary number system are called bits (short for Binary Digit)

Number conversions

Conversion	Procedure
Decimal to binary	Repeated division by 2; Group remainders from bottom to top
Decimal fraction to binary	Repeated multiplication by 2; Collect numbers left of decimal point, top to bottom
Decimal to octal	Repeated division by 8; Group remainders from bottom to top
Decimal to hexadecimal	Repeated division by 16; Group remainders from bottom to top
Binary to decimal	Multiply each digit with its place value ($2^0, 2^1, 2^2$) and add
Octal to decimal	Multiply each digit with its place value ($8^0, 8^1, 8^2$) and add

Hexadecimal to decimal	Multiply each digit with its place value ($16^0, 16^1, 16^2$) and add
Octal to binary	Convert each digit to its 3-bit binary equivalent
Hexadecimal to binary	Convert each digit to its 4-bit binary equivalent
Binary to octal	Group into groups of 3(R2L); convert each group into octal
Binary to hexadecimal	Group into groups of 4 (R2L); convert each group into hex
Octal to hexadecimal	Convert octal to binary and then binary to hexadecimal
Hexadecimal to octal	Convert hexadecimal to binary and then binary to octal

Binary Addition	Sum	Carry Over
0+0	0	0
0+1	1	0
1+0	1	0
1+1	0	1
1+1+1	1	1

Data representation

A. Representation of integers

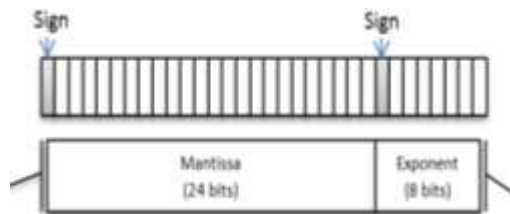
There are three methods for representing an integer number in computer memory.

- i) Sign and magnitude representation
- ii) 1's complement representation

iii) 2's complement representation Data Representation	Positive number	Negative number
Sign and Magnitude	<ol style="list-style-type: none"> 1. Find 7-bit binary equivalent 2. MSB – 0 	<ol style="list-style-type: none"> 1. Find 7-bit binary equivalent 2. MSB – 1
1's complement	<ol style="list-style-type: none"> 1. Find 8-bit binary equivalent 	<ol style="list-style-type: none"> 1. Find 8-bit binary equivalent 2. Replace 0 with 1 and 1 with 0
2's complement	<ol style="list-style-type: none"> 1. Find 8-bit binary equivalent 	<ol style="list-style-type: none"> 1. Find 8-bit binary equivalent 2. Replace 0 with 1 and 1 with 0 3. Add 1

B. Representation of floating point numbers

A floating point number consists of mantissa and exponent. A floating point number / real number consists of an integer part and a fractional part. A real number can be written in a special notation called the floating point notation. Any number in this notation contains two parts, mantissa and exponent



C. Representation of characters

- ASCII (American Standard Code for Information Interchange) - Represents all keyboard characters using 7 bits for each character
 - Assigns a unique number called ASCII code to each character
- EBCDIC (Extended Binary Coded Decimal Interchange Code) - Represents 256 characters
- ISCII (Indian Standard Code for Information Interchange)
- Unicode - Represents characters of all written languages of the world using more than 16 bits.

D. Representation of audio, image and video

- Image file Formats - Joint Picture Experts Group (JPEG), BMP (Bitmap file format), TIFF (Tagged Image File Format), GIF (Graphics Interchange Format), PNG - (Portable (Public) Network Graphic).
- Audio File Formats – WAV, MP3, MIDI(Musical Instrument Digital Interface), AIFF, etc.
- Video File formats -- AVI (Audio Video Interleave), MP3, JPEG-2, WMV etc.

2. Components of the Computer System

Computer system consists of Hardware and Software. **Hardware** is the tangible and visible parts of a computer. Eg. Processor, Mother board etc. **Software** is a set of programs that help us to use the computer system or electronic devices.

Different Hardware Components

- **Processors** - CPU is an Integrated Circuit (IC) package containing millions of transistors in a single silicon chip. Eg. Intel Core i3, AMD Quadcore etc.
 - Registers – Very fast temporary storage locations inside CPU
 - They help to speed up execution of programs
 - Important registers are Accumulator, MAR (Memory Address Register), MBR (Memory Buffer Register), IR (Instruction Register), PC (program Counter)
- **Motherboard** - Large Printed Circuit Board (PCB) to which all major components are fixed
 - Also provides expansion slots for memory, graphics card etc...
- **Peripherals and Ports**
 - Peripherals are devices attached to computer system to enhance its capabilities
 - Includes input, output, external storage & communication devices
- **Ports** on the motherboard are used to connect peripheral devices.
 - Serial port - Transmits data one bit at a time - Used in older computers to connect mouse or keyboard
 - Advantages: Cheaper to make, easier to shield from interference
 - Disadvantages: Speed is too low
 - Parallel port - Transmits several bits of data simultaneously - Used to connect printer or scanner
 - Advantages: Faster than serial port
 - Universal Serial Bus (USB) port - High speed short distance communication
 - Used to connect mouse, keyboard, printer, external hard disk etc...
 - Advantages:
 - Can supply electric power to external devices
 - USB devices can be connected / disconnected even when power is on

- LAN port / Ethernet port / Network port - Allows computers to connect to network using wired connection
- RJ45 is used for connecting cables through LAN ports
- PS/2 port - Slow ports invented by IBM for connecting keyboard and mouse
- Audio ports - Used to connect audio devices like speakers, microphone etc...
- Video Graphics Array (VGA) port - Connects monitor, projector to computer
- High Definition Multimedia Interface (HDMI) - Digital connection for transmitting high-definition video and multi-channel audio over single cable.
- **Memory** - A place to store data, instructions and results temporarily or permanently.
- **Primary memory** - High speed memory for holding data & intermediate results temporarily
 - Three types – RAM, ROM and Cache memory
 - **RAM** – Random Access Memory. It is the main memory that processor can read from and write to.
 - **ROM** – Read Only Memory - Permanent memory that can perform only read operations – Types of ROM:
 - PROM – Programmable ROM
 - EPROM – Erasable Programmable ROM
 - EEPROM – Electrically Erasable Programmable ROM
 - **Cache Memory** – Cache memory is a small and fast memory between the processor and RAM. Frequently accessed data, instructions, intermediate results, etc. are stored in cache memory for quick access. Cache is more expensive than RAM, but speeds up the computer.

RAM	ROM
Random Access Memory	Read Only Memory
Faster than ROM	Slower memory
Stores operating system, application programs and data when computer is working	Stores the boot-up program called BIOS used to boot the computer initially
Allows reading and writing	Usually allows reading only
It is volatile; Contents are lost when device is switched off	It is non-volatile; Contents remain even when the device is switched off

- **Secondary or Auxiliary Memory**

Secondary memory is a Permanent storage. It is Larger than RAM. The major categories of storage devices are magnetic, optical and semiconductor memory.

- Three major categories – magnetic, optical and semiconductor memory.
 - **Magnetic storage devices :-**
 - Magnetic storage devices use plastic tape or metal/plastic disks coated with magnetic materials.
 - Data is recorded magnetically in these devices.
 - Popular magnetic storage devices are magnetic tapes, floppy disks, hard disks, etc.
 - **Optical Storage Devices**
 - Optical disk is a data storage medium which uses low-powered laser beam to read from and write data into it.
 - It consists of an aluminum foil sandwiched between two circular plastic disks.
 - Data is written on a single continuous spiral in the form of pits and lands. The main types of optical disks are CD, DVD and Blu-Ray.
 - **Semiconductor storage (Flash memory)**
 - Contain no moving parts; hence are shock-proof; Faster and durable
 - USB Flash drive (2 GB - 32 GB) - Small external storage device; Portable and rewritable
 - Flash memory cards - Flat memory cards used in cell phones.

- **Input devices** - An input device is used to feed data into a computer

Input Devices	Description
Keyboard (Wired or Wireless)	Most common input device to input alphabets, numbers and characters Keyboard detects the key presses and generates corresponding ASCII code
Mouse (Wired or Wireless)	Pointing device to move cursor on screen by rolling over flat surface

Wireless)	Types of mouse: Ball mouse, Optical mouse (LED), Laser mouse (Laser beam)
Light pen	Pointing device that can draw directly on the screen Used by engineers, artists and designers for Computer Aided Designing (CAD)
Touchpad	Pointing device used in laptops, operated using fingers
Touch screen	Device that allows user to operate by touching the display screen. Ex. ATM
Graphic tablet	Input device for artists consisting of an electronic writing area and a pen
Joystick	Used for playing games, control simulators and robots Consists of a stick that can move in any direction & button on top for selection
Microphone	Accepts sound and converts it to digital format
Scanner	Captures pictures / text and converts into digital format Resolution of image scanned is expressed in DPI (Dots Per Inch) Types of scanners: Flatbed scanner (Not portable, can scan from book), Sheet feed scanner (Scans single page), Hand held scanner (Portable, Not smooth) Optical Character Recognition (OCR) software - Used to recognize printed text from image and convert it into editable form
Optical Mark Reader (OMR)	Reads predefined positions and records where marks made on printed forms Used for objective-type tests Requires good quality paper and correct alignment of printing
Barcode Reader	Barcode - Set of vertical lines with different thickness & spacing

	Used to input data from sets of barcodes
Quick Response (QR) code reader	Two-dimensional codes that allow to store more information than barcodes Can be read using barcode readers or mobile with camera and special software
Magnetic Ink Character Recognition (MICR) Reader	Used in banks for faster electronic clearance of cheques Uses ink containing iron oxide, which is magnetically charged during scanning Reduces errors in data entry and speeds up money transfer
Biometric sensor	Identifies human physical features such as fingerprints, iris patterns...
Smart card reader	Small plastic card containing memory that stores and transacts data Used in banking, healthcare and electronic cash payments
Digital Camera	Takes pictures and videos and converts them to digital format Has internal memory to store pictures, consists of tiny pixels (picture elements) Web camera - Compact, inexpensive digital camera without internal memory for video calling

- **Output devices** – An output device is used to print/display output from a computer
 - Hardcopy - Permanent outputs which can be used when required – Printers, Plotters
 - Softcopy - Electronic outputs viewed on a screen temporarily – VDU

Output Device	Description
Visual Display Unit (VDU)	Displays text, graphics or video on a screen Characteristics of VDU: Size (measured diagonally across screen), Resolution (maximum number of pixels displayed), Dot pitch (Pixel

	<p>spacing on the screen; smaller dot pitch gives sharper image), Response time (Time taken for a pixel to turn from a state of brightness to darkness and back; lesser response time gives better movie viewing experience)</p> <p>Types of VDU: CRT monitor, Flat-panel monitor</p>
Cathode Ray Tube (CRT) monitor	<p>Resembles old televisions; Two types – Monochrome and Color</p> <p>Accurate colors, Fast response</p>
Flat-panel monitor	<p>Adv: Thinner, Lighter in weight, Uses less power, Emits less heat</p> <p>Types: LCD monitor, LED monitor, Plasma monitor, OLED monitor</p>
Liquid Crystal Display (LCD) monitor	<p>Liquid crystals sandwiched between two plastic plates with a light source at the back to make picture visible</p>
Light Emitting Diode (LED) monitor	<p>Use LED behind the LCD to light up the screen</p> <p>Adv: Better color, clarity, wider angle, faster refresh rates, power savings</p> <p>Disadv: Expensive</p>
Plasma monitor	<p>Sandwiches neon/xenon gas between two sealed glass plates with parallel electrodes on the surface; When voltage is passed between electrodes, the gas lights up in colors.</p> <p>Gives high resolution but is expensive</p>
Organic Light Emitting Diode (OLED) monitor	<p>Made up of millions of tiny LEDs with carbon in the light emitting layer</p> <p>Adv: Thinner, Lighter, Better quality, Better angle, Consumes less power</p> <p>Disadv: Very expensive</p>
LCD Projector	<p>Video projector for displaying video, images or data on large screens</p> <p>Beam of high intensity light travels through thousands of shifting pixels</p>

	in LCD display & passes through a lens which projects and focuses image on a surface
Printers	<p>Produce hardcopy output</p> <p>Factors that determine quality of a printer: Resolution (Measured in Dots Per Inch (DPI)), Speed (Measured in characters per second (cps), lines per minute (lpm) or pages per minute (ppm))</p> <p>Impact printers - Hammer strikes paper through inked ribbon</p> <p>Ex. Dot Matrix printers</p> <p>Non-impact printers - Print without touching the paper</p> <p>Eg. Inkjet printers, Laser printers, Thermal printers</p>
Dot Matrix Printer (DMP)	<p>Use small pins in print head and an inked ribbon to produce output</p> <p>Slow, noisy, not commonly used for personal use</p> <p>Widely used at shops because we can get carbon copies and low printing cost</p>
Inkjet printer	<p>Forms image on page by spraying tiny drops of ink from print head</p> <p>Printer is cheap but ink cartridges are costly</p>
Laser printer	<p>Image to be printed is transferred to a drum using a laser beam</p> <p>Toner powder is sprayed on drum which sticks to portions traced on drum</p> <p>Toner is transferred onto paper by rolling paper over drum and heating it to fuse image on paper</p> <p>Expensive but good quality and very fast; Speed is measured in ppm</p>
Thermal printer	<p>Produces image by heating heat-sensitive thermal paper</p> <p>Adv: Quiet, faster than dot matrix printers, smaller, lighter and consume less power; hence ideal as portable printers</p>

Plotters	Output device used to produce hard copies of graphs and designs on paper Used in design of cars, ships... Types of plotters: Drum plotters, Flatbed plotters
Drum / Roller plotter	Consists of drum or roller on which paper is placed; Drum rotates back and forth to produce graph using drawing arm holding colour ink pens or pencils
Flatbed / Table plotter	Paper spread flat on table, Uses 2 drawing arms, each holding colour ink pens Slow to print large, complicated drawing
3D Printer	New generation output device used to print 3D objects Produces different objects in different materials using the same printer
Audio output device	Speakers are connected to computer through audio ports Produces sound by the movement of diaphragm in the speaker

E-waste

- e-Waste refers to electronic products nearing the end of their "useful life".
- Electronic waste contains toxic substances such as mercury, lead, cadmium, brominated flame retardants, etc.
- These toxic materials can cause cancer, reproductive disorders and many other health problems, if not properly managed.
- The Pollution Control Board is the authority that manages and guides the safe disposal of e-Waste

Popular E Waste disposal methods

- **Reuse:** It refers to second-hand use or usage after the equipment has been upgraded or modified.
- **Incineration:** The waste is burned in specially designed incinerators at a high temperature in the range of 900 to 1000 degree Celsius.

- **Recycling:** Recycling is the process of making new products from a product that has originally served its purpose.
- **Land filling:** In this method the e-Waste is buried in soil by taking large pits.

Green computing

- It is the environmentally responsible and eco-friendly use of computers and disposing them with minimal or no impact on the environment (Symbol: Energy Star)
 - Steps to be taken for green computing
 - Turn off computer when not in use
 - Power on printers only when needed
 - Use power saver mode
 - Take printouts only when necessary
 - To make computers green, use *Green design*, *Green manufacturing*, *Green use*, *Green disposal*

Software

- Software is a set of programs that help us to use computer system and other electronic devices efficiently and effectively.
 - There are two types of software – **System software** and **Application software**.
1. **System Software** - Set of one or more programs designed to control operations of computer
 - Functions of system software
 - Supports running of software
 - Communication of software with peripheral devices
 - Helps to manage resources of the computer
 - Components of system software
 - **Operating system** - The most important system software
 - Set of programs that act as interface between user & hardware
 - Makes the computer convenient to use
 - Functions of operating system - Process management, Memory management, File management and Device management
 - Examples of OS – DOS, Windows, Linux

- **Language processors**
 - Low level languages are machine-oriented languages
 - Machine Language – Language which uses binary language; Very difficult to learn and understand
 - Assembly Language - Programming language which is easier than machine language
 - High level languages (HLL) are like English & easy to understand
 - Need for language processors
 - HLL cannot be understood by the computer
 - HLL must be translated into machine language
 - Language processors are system programs that translate programs written in HLL to its equivalent machine language
 - Types of language processors
 - Assembler – converts programs written in assembly language into machine language
 - Interpreter –converts an HLL program into machine language line by line. If error is found, execution stops and continues only after error is corrected., Ex. BASIC
 - Compiler – converts HLL program to machine language in single run. Error list generated after compilation. Eg. C, C++
- **Utility software** - Helps users in system maintenance and routine tasks
 - Examples are compression tools, Disk defragmenter, Backup software and Antivirus software

2. Application Software - Software developed for specific applications

- **General purpose software packages** - Perform operations for a particular application
 - Word processing software, Spreadsheet software, Presentation software, Database software, Multimedia software
- **Specific purpose software** - Highly specialised software to handle particular tasks
 - Payroll system, Inventory Management system, Human Resources Management system.

Free and Open Source software

- Freedom to use, copy, distribute, examine, change and improve the software
 - Advantages: Adaptable, Less cost, Adherence to standards and Security
 - Eg. GNU/Linux, GIMP, Mozilla Firefox, Openoffice.org
 - FSF (Free Software Foundation) defines 4 freedoms:
 - Freedom 0 – Run program for any purpose,
 - Freedom 1 – Study how program works and adapt it,
 - Freedom 2 - Distribute copies of software,
 - Freedom 3 – Improve program and release to public

Freeware	Shareware
Copyrighted software made available for free use for an unlimited period	Commercial software distributed to give users a chance to try software
All features are free	All features may not be available
Can be distributed free of cost	Cannot be distributed freely

- **Proprietary software** - Property of developer, cannot be copied or distributed without license. Eg. Windows Operating System, MS Office etc...

Humanware or Liveware

Humans who use computer - System administrator, systems manager, system analyst, database administrator, computer engineer, computer programmer & computer operator.

3. Principles of Programming and Problem Solving

Software is a collection of programs to solve problems using computers. A sequence of instructions written in a language understood by computers is called a computer program. An instruction is an action-oriented statement.

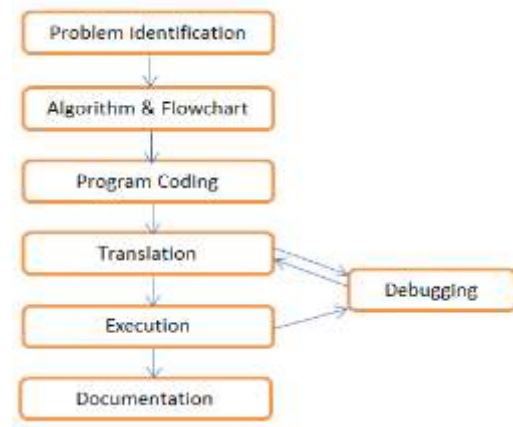
Approaches in problem solving

1. **Top-down design** - A complex problem is solved by breaking it down into smaller tasks & solving each task by performing simpler activities
 - Advantages:
 - Clarifies what is to be done in each part

- Smaller parts are less complicated
 - Parts of the solution can be reused
 - Allows more than one person to work for the solution
2. **Bottom-up design** - Solution for problem is developed after solutions for sub-tasks



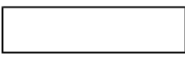

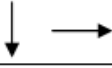

Phases in programming

- Problem identification
- Algorithms and flowcharts
- Program coding
- Translation
- Debugging
- Execution and testing
- Documentation



- **Problem Identification** - Identify data involved in processing, its type and quantity, formula to be used, activities involved and output to be obtained
- **Algorithms and Flowcharts** - Develop a step-by-step procedure to solve the problem
 1. **Algorithm** - A finite sequence of instructions to solve a problem
 - Characteristics of algorithms
 - Should begin with instruction to accept input
 - Use variables to refer data
 - Every instruction should be basic, precise and unambiguous
 - Total time to carry out all the steps must be finite
 - After performing the instructions, the desired output must be obtained
 2. **Flowcharts** - A pictorial representation of an algorithm with specific symbols for instructions and arrows for sequence of operations.
 - Advantages of flowcharts - Better communication, Effective analysis, Effective synthesis & Efficient coding
 - Limitations of flowcharts - Time consuming and difficult to draw, Changes require a completely new flowchart, No standards
 - Flow of control
 - Sequential flow – Instructions are executed one by one sequentially

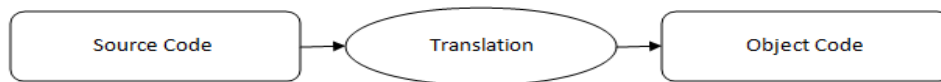
- Branching / Selection – A condition branches flow of control to one or two statement sets based on result of condition
- Looping – A set of statements are executed repeatedly
 - Elements of loop – Condition, Initialization, Updation, Loop body
 - There are two types of loops - Entry controlled loops and Exit controlled loops

Symbol	Name	Function
	Terminal	The ellipse is used to indicate START and STOP
	Input / Output	The parallelogram is used as an input/output symbol
	Process	A rectangle represents the processing step
	Decision	The rhombus is used as a decision symbol
	Flow Lines	Arrows are used to indicate flow of operation
	Connector	If flowchart becomes too complex, connector symbols are used to represent an entry from or an exit to another part of the flowchart

Entry Controlled Loop	Exit Controlled Loop
Condition is checked before execution of body	Condition is checked after execution of body
Body may never be executed	Body will surely be executed at least once
Suitable for skipping body from execution	Suitable to ensure normal execution of body

3. **Coding the program** - The process of writing program instructions to solve a problem
 - Each language has its own character set, vocabulary and grammar called Syntax
 - Programs written in HLL is known as source code and it is stored in a file called source file
4. **Translation** - The process of converting a program written in HLL into equivalent machine code
 - This is done by compiler or interpreter

- Syntax errors will be displayed during this step



5. Debugging -The process of detecting & correcting errors (Programming errors are called bugs)

- There are two types of errors in a program
 - **Syntax errors** - Occurs when rules of programming are not followed
 - It is detected during translation
 - Object program will be generated only if syntax errors are corrected
 - **Logical errors** - Occurs due to improper planning of the program's logic
 - Program will be executed but output will not be correct
 - Can be detected by testing

6. Execution and Testing

- Testing procedure is running program to process test data that will produce known results
- Run time errors occur due to inappropriate data encountered in an operation
- Can be corrected by checking the validity of data before processing

7. Documentation- Ongoing process that starts in problem study phase & continues till implementation

- Internal documentation - Comments written within source code that help in debugging and program modification
- External documentation - System Manual and User Manual

Performance evaluation of algorithms is based on time & space complexity. Algorithms must execute faster with minimum memory space requirements.

Algorithm to check whether given number is even or odd

Step 1: Start

Step 2: Input N

Step 3: If $N\%2 = 0$ Then

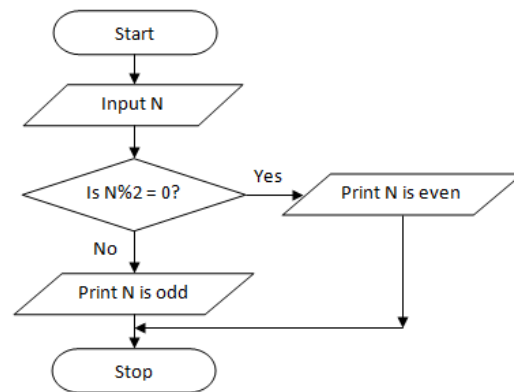
Step 4: Print "N is even"

Step 5: Else

Step 6: Print "N is odd"

Step 7: End of If

Step 8: Stop



Flowchart to check the given number is odd or even

4. Getting started with C++

C++ is a powerful Object Oriented Programming (OOP) language developed by Bjarne Stroustrup.

- **Character Set:** - Character set in C++ is a set of valid symbols. It consists of
 - Letters(A-Z,a-z)
 - Digits (0-9)
 - White spaces(Space bar,Tab,New line)
 - Special characters(+,#,\$,%,&,{,<,?...etc

Tokens

Tokens are the smallest individual units in the program. There are 5 types of tokens in C++.

They are.

1. Keywords
2. Identifiers
3. Literals
4. Punctuators
5. Operator

1. Keywords

Keywords are reserved words that convey special meaning to the language compiler

Eg: `if, switch, for, while, int, float, break` etc.

2. Identifiers

Identifiers are the name given to the programming elements such as variables, arrays, functions etc.

○ **Rules to form an identifier :**

- Identifier is a sequence of letters digits and underscore.
- The first character must be letter or underscore
- Keywords cannot be used as identifiers.
- Special characters or white spaces cannot be used.

3. Literals

Literals or Constants are tokens that do not change their values during program run
Literals are classified into

○ **Integer Literals:-**tokens that constitute only by digits are called integer literals

○ Eg: 567, 8976, -895...etc.

○ **Floating point Literals:-**are numbers having fractional parts

○ Eg:- 8.765 ,3.14,-9.567,.0987...etc

○ **Character Literals:-** are single character enclosed in single quotes . The value of the single character constant is its ASCII value Eg: 'A', 'f', '8'...etc

○ C++ has some non-graphic characters which cannot be typed directly from the keyboard can be represented using **escape sequence** which consist of a backslash(\) followed by one or more characters

○ **String Literals:-** are one or more characters enclosed within a pair of double quotes

4. Punctuators

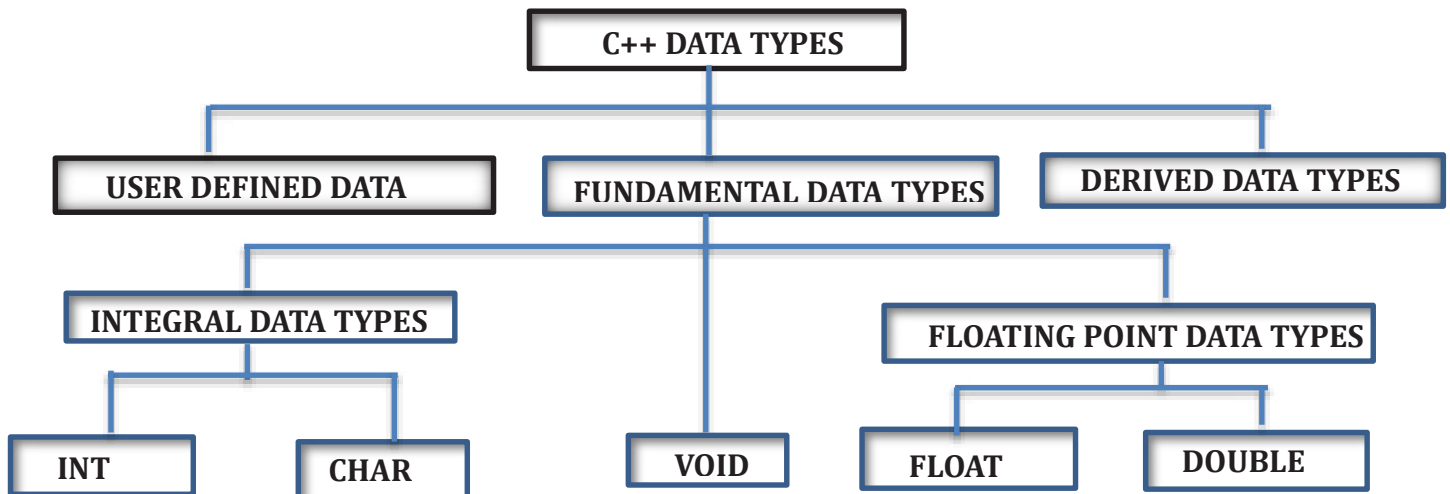
Punctuators are some special symbols that have syntactic or semantic meaning to the language compiler Eg: `; # { } [] “`...etc.

5. Operators

Operators are the tokens that trigger some kind of operations. The operators is applied on a set of data called operand.

5. Data types and Operators

Data types are the means to identify the nature of the data and the set of operations that can be performed on the data.



- **Fundamental data type**

- **int data type:-** are used to represent whole numbers without fractional parts. It consumes 2 bytes of memory.
- **float data type :-** are used to represent numbers with fractional parts. It consumes 4 bytes of memory.
- **char data types: -** are used to represent character literals of C++ and is internally stored as integers. It consumes 1 bytes of memory.
- **double data types: -** are used represent numbers with fractional parts but has more precision than float data types. It consumes 8 bytes of memory.
- **void data type :-** are used to represent empty set of data and hence its size is zero

Variables

Names given to memory locations. A variable has:

- Variable name - Symbolic name given to memory location
- Memory address / L-value - Base address of variable is starting address of allocated memory
- Content / R-value - The value stored in the location

Operators

Operators are the tokens that trigger some kind of operations. The operators is applied on a set of data called operands. Based on the number of operands used operators are classified into

- **Unary operators:** - operates on a single operand. **E.g.:** ! ++ --
- **Binary operators:** - operates on two operands. **Eg :-** * / % > <
- **Ternary operators:** - operates on three operands. **Eg:-** Conditional operator (? :).

Based on the nature of the operation, operators are classified into arithmetic, relational, logical, input/output, assignment, short-hand, increment/decrement, etc.

- **Arithmetic operators**

Used for arithmetic operations such as addition (+), subtraction (-), multiplication (*), division (/) and modulus (%).

Eg: a+b

- **Relational operators**

Used for comparing numeric data resulting in either, true (1) or false (0). The relational operators are less than (<), greater than (>), less than or equal to (<=), greater than or equal to (>=), equal to (==), and not equal to (!=).

- **Logical operators**

Used to combine logical values resulting in true or false .The logical operators are AND(&&),OR(||), NOT(!)

- **Input/ Output operators**

- The get from extraction operator (>>) is used for input. Eg:- cin>>a;
- The put to (insertion) operator is used for output Eg:- cout <<<a;

- **Assignment operator (=)**

- Used to store a value in a variable. Eg:- a=5;

Expressions

An expression is composed of operators and operands to perform an operation. Based on the operators used they are classified into

Arithmetic expressions: - expression which contains only arithmetic operators. It is classified into **Integer expression** and **Real (floating point) expression**.

Relational expressions: - are expression which contains relational operators.

Logical expressions: - combines two or more relational expressions with logical operators.

Statements

Statements are the smallest executable unit of a programming language. C++ uses the symbol semicolon (;) as the delimiter of a statement. Different types of statements in C++ are

- **Declaration statements:** - Declaration statements are used for declaring variables in C++.

Syntax: `data_type <variable1 [, <variable2>, <variable3>...];`

Eg: `int num;`

- **Assignment statements:** - An assignment statement assigns a value to a variable.

Syntax:

```
variable = constant;
variable1 = variable2;
variable = expression;
```

Eg: `a=15; b=a; c=a+b;`

- **Input statements:** - Input statements allows the user to store data in the memory during the execution of the program. The predefined word '**cin**' and the operator 'get from (>>)' together are used to extract data from the keyboard and stored in memory locations identified by the variable.

Eg: `cin>>num;`

- **Output statements:** - Output statements makes the result available to use through any output device. The predefined word '**cout**' and 'put to operator (<<)' together are used to output the result into monitor.

Eg: `cout<<"Welcome to C++;`

6. Introduction to Programming

Structure of a C++Program

```
#include<iostream>    //Preprocessor directive
using namespace std; //Declaration of namespace eg:-std
int main ()
{
    statements;
    return 0;
}
```

- **Preprocessor directive:-**Instructs the compiler to perform an action before actual compilation. Starts with the symbol #.

Eg: - `#include<iostream>` - instruction to link the header file `iostream`

- **Concept of namespace:** - Tells the compiler to use namespace `std`. In this program `std` is the standard namespace in which a lot of objects including `cin` and `cout` are defined.
- **The `main ()` function:** - `main` is the essential function for every C ++ program . A C++ program execution starts and ends within the `main ()` function.
- Sample program to find the sum of two integers

```
#include<iostream>
using namespace std;
int main()
{
    int a,b,c;
    cout<<"Enter two numbers";
```

```

cin>>a>>b;
c=a+b;
cout<<"\n Sum ="<<c;
return 0;
}

```

- **Guidelines for coding**

- Use suitable naming convention for identifiers
- Use clear and simple expressions
- Use comments wherever needed
- Give proper indentation.

Comments

These are notes /statements included in a program to increase the readability of the program. Comments are ignored by the compiler. There are two ways to write comments in C ++.

- Single line comment: // The characters two slashes is used to write single line comments
- Multiline comments: /* */ anything written within these is treated as comment. It can take a number of lines.

- **Variable initialization** - Variable is associated with two values: L-value &R-value

- When a variable is declared, a memory location with address is allocated (L-value)
- Content (R-value) will be any value of permitted data type, initially Garbage Value
- Variable Initialization - Supplying value to variable at declaration using assignment operator (=)

- `data_type variable = value;`
- `data_type variable(value);`
- Eg. `int rollno = 113; float b(9.3);`

- Dynamic Initialization - Variable initialization during execution of program by assigning an expression to the variable

- Eg. `float interest = P*n*r/100.0;`

- **const** – Access modifier

- To create symbolic constants whose value cannot be changed during execution
- Called Access modifier: Read/write accessibility of variable is modified as read-only

- Eg. `const float pi = 3.14;`
- **Type modifiers**
 - Used before data type name in variable declaration to alter size, range or precision
 - Common modifiers are signed, unsigned, long and short
- **More operators**
 - Arithmetic assignment operator (C++ Shorthands)
 - `+=` `-=` `*=` `/=` `%=`
 - Binary operators whose first operand should be a variable
 - Eg. `a=a+10` is equivalent to `a+=10`
 - Increment / Decrement operator
 - Unary operators whose operand should be a variable
 - Increment (`++`) - For incrementing the content of an integer variable by 1
 - `++x` (pre-increment) and `x++` (post-increment): Same as `x=x+1`
 - Decrement (`--`) - For decrementing the content of an integer variable by 1
 - `--x` (pre-decrement) and `x--` (post-decrement): Same as `x=x-1`
 - Prefix form (Change, then use method)
 - Increment/decrement is done first, then new value is used for operation
 - Postfix form (Use, then change method)
 - Current value of variable is used for operation, then increment/decrement is done
- **Precedence of operators**
- The order of evaluation of an expression depends on the priority of the operator. It is called the precedence of operators- Operator priority can be changed by using parenthesis ().

Priority	Operation
1	()
2	++ -- ! Unary+ Unary- sizeof
3	* / %
4	+ -
5	< <= > >=
6	== !=
7	&&
8	
9	?:

10	= *= /= %= += -=
11	,

Type conversion

Data type of one operand is converted to another

- Implicit type conversion (Type promotion) - Done by C++ compiler
 - For expressions involving different data types, all lower sized operands are converted to the data type of highest sized operand
- Explicit type conversion (Type casting)
 - Programmer specifies new data type within parenthesis to left of operand
- Type compatibility in assignment statements
 - Case 1: Size of data type of LHS is higher than that at RHS
 - Data type of value at RHS is promoted to that of variable at LHS (Type Promotion)
 - Case 2: Size of data type of LHS is smaller than that at RHS
 - Higher order bits of result are truncated to fit in variable location of LHS - Programmer must apply Type Casting

7. Control Statements

Control statements are used for altering the normal flow of program execution. Control statements are classified into two **Decision making/selection statements and Iteration statements.**

Decision making statements

- The statements provided by C++ for the selected execution are called decision making statements or selection statements. The decision will be in the form of selecting a particular statement for execution or skipping some statements from being executed. `if` and `switch` are the two types of selection statements in C++.
- **if statement**

The `if` statement is used to select a set of statements for execution based on a condition. In C++, conditions, otherwise known as test expressions are provided by relational or logical expressions. The syntax (general form) of if statement is as follows:

```

    if (test expression)
    {
        statement block;
    }

```

- **if...else statement**

If we want to execute some actions when the condition becomes False, we introduce another form of if statement, `if.. else`. The syntax is:

```

    if (test expression)
    {
        statement block 1;
    }
    else
    {
        statement block 2;
    }

```

- **Nested if:** When we write an if statement inside another if block, it is called nesting.

Nested means one inside another.

Example for nested if

```

    if (test expression 1)
    {
        if (test expression 2)
            statement 1;
        else
            statement 2;
    }
    else
    {
        body of else ;
    }

```

- **else if ladder:** If.. else if statement is used in programs when multiple branching is required. Different conditions will be given and each condition will decide which statement is to be selected for execution.
- **switch statement:** Switch statement successively tests the value of a variable or an expression against a list of integer or character constants.

The syntax of switch statement is given below:

```
switch (expression)
{
    case constant_1: statement block 1;
        break;
    case constant_2 : statement block 2;
        break;
    case constant_3 : statement block 3;
        break;
        :
        :
    case constant_n-1 : statement block n-1;
        break;
    default : statement block n;
}
```

- **Conditional operator (? :)**: It is the conditional operator (? :) consisting of symbols? and: (a question mark and a colon). It requires three operands to operate upon. It can be used as an alternative to `if...else` statement.

Its general form is:

Test expression ? True_case code : False_case code;

switch statement	else if ladder
Permits multiple branching	Permits multiple branching
Evaluates conditions with equality operator only	Evaluates any relational or logical expression
Case constant must be integer or character	Condition may include range of values and floating-point constants
When no match is found, default statement is executed	When no expression evaluates to TRUE, else block is executed
break statement is required for exit from switch statement	Control automatically goes out after completion of a block
More efficient when same variable is compared for equality	More flexible and versatile compared to switch

Iteration statements

While writing programs, we use some specific constructs of the language to perform the repeated execution of a set of one or more statements. Such constructs are called iteration statements or

looping statements. All of them allow a set of instructions to be executed repeatedly when a condition is True.

- Loops work on the basis of conditions, a variable like the counter will be used to construct a loop.
- This variable is generally known as loop control variable because it actually controls the execution of the loop. Four elements of a loop are :
 - **Initialisation:** Before entering a loop, its control variable must be initialised.
 - **Test expression:** It is a relational or logical expression whose value is either True or False.
 - **Update statement:** The update statement modifies the loop control variable by changing its value.
 - **Body of the loop:** The statements that need to be executed repeatedly constitute the body of the loop.
- C++ provides three loop statements: while loop, for loop and do...while loop.

- **while statement**

The while loop is an entry-controlled loop. The condition is checked first and if it is found True the body of the loop will be executed. That is the body will be executed as long as the condition is True. The syntax of while loop is:

```
initialisation of loop control variable;
while(test expression)
{
    body of the loop;
    updation of loop control variable;
}
```

- **for statement**

The for loop is also an entry-controlled loop in C++. All the three loop elements (initialisation, test expression and update statement) are placed together in for statement.

The syntax is:

```
for (initialisation; test expression; update statement)
{
    body-of-the-loop;
}
```

- **do . . .while statement**

The `do ...while` loop is an exit-controlled loop. The condition is checked after the first execution and if it is found `True` the body of the loop will be executed.

Syntax is:

```
initialisation of loop control variable;
do
{
    body of the loop;
    Updation of loop control variable;
} while(test expression);
```

The test expression is evaluated only after executing body of the loop. So `do...while` loop is an exit controlled loop.

8. Computer network

Computer network is a group of computers and other computing hardware devices (such as Printers, Scanners, Modems, CD drives, etc.) connected to each other electronically through a communication medium.

- **Advantages of networks:** Resource sharing, Price-performance ratio, Communication, Reliability, Scalability.
- **Bandwidth** measures the amount of data that can be sent over a specific connection in a given amount of time.
- **Need for network**
- **Resource sharing:** The sharing of available hardware and software resources in a computer network is called resource sharing.
- **Price-performance ratio:** One can easily share the resources available in one computer with other computers.
 - This will least affect the performance of such resources and lead to considerable savings in cost.
- **Communication:** Computer network helps user to communicate with any other user of the network through its services like e-mail, chatting, video conferencing etc.
- **Reliability:** It is possible to replicate or backup data/information in multiple computers using the network.
 - These can be retrieved from other computers in which they are saved in case of disasters.
- **Scalability:** Computing capacity can be increased or decreased easily by adding or removing computers to the network.

Key terms in Network

- **Bandwidth:** Bandwidth measures the amount of data that can be sent over a specific connection in a given amount of time.
 - Bandwidth describes the maximum data-transfer rate between computers in a network. In digital systems, bandwidth is measured in bits per second (bps).
 - If the bandwidth is more, data travels faster.
- **Noise:** Noise is unwanted electrical or electromagnetic energy that lowers the quality of data signals.
- **Node:** Any device (computer, scanner, printer, etc.) which is directly connected to a computer network is called a node.

Data communication system

Data communication is the exchange of digital data between any two devices through a medium of transmission. Components of data communication system are:

- **Message:** It is the information to be communicated. Major forms of information include text, picture, audio, video, etc.
- **Sender:** The computer or device that is used for sending messages is called the sender, source or transmitter.
- **Receiver:** The computer or device that receives the messages is called the receiver.
- **Medium:** It is the physical path through which a message travels from the sender to the receiver. It refers to the way in which nodes are connected.
- **Protocol:** The rules under which message transmission takes place between the sender and the receiver is called a protocol.

Communication medium

The medium for data transmission over a computer network is called communication channel or communication medium. The communication medium are of two types: **guided** and **unguided**. In guided or wired medium, physical wires or cables are used and in unguided or wireless medium radio waves, microwaves or infrared signals are used for data transmission.

- **Guided medium (Wired)**
 - a. **Twisted pair cable (Ethernet cable):** It consists of four twisted pairs which are enclosed in an outer shield. These pairs are colour coded.

Twisted pair cables are of two types:

(i) Unshielded Twisted Pair (UTP) cables: As its name suggests, the individual pairs in UTP cables are not shielded.

- Characteristics of UTP cable
 - Low cost cable available for setting up small networks.
 - Thin and flexible cable.
 - Ease of installation.
 - Carries data up to a length of 100 m at a stretch.

(ii) Shielded Twisted Pair (STP) cables: It is the same cable as the UTP, but with each pair shielded individually.

- Characteristics of STP cable
 - Shielding in STP offers better immunity against noise.
 - It is more expensive than UTP cable.
 - Compared to UTP cable, STP cable is difficult to install.
- An RJ-45 connector is used to connect UTP/STP twisted pair cable to a computer.

b. Coaxial cable: A coaxial cable consists of an inner conductor surrounded by a tubular insulating layer which is further covered by a tubular conducting shield.

- Characteristics of coaxial cable
 - Carries data to longer distances (185 m - 500 m) at a stretch.
 - High bandwidth.
 - Less electromagnetic interference due to the outer shield.
 - Thicker than twisted pair.
 - Less flexible than twisted pair.
 - Difficult to install than twisted pair cable.

c. Optical fibre cable: Optical fibres are long thin glass fibres through which data is transmitted as light signals. Data travels as fast as light and can be transmitted to far off distances.

Optical fibre has the following parts: **Core** - the thin glass rod at the centre through which the light travels. **Cladding** - the outer optical material surrounding the core that reflects the light back into the core. **Coating** - the plastic coating that protects the cable from damage and moisture.

At the source end, the optical transmitter converts electrical signals into optical signals (modulation) using semiconductor devices such as light-emitting diodes (LEDs) or laser

diodes. At the destination end, the optical receiver, consisting of a photo detector, converts light back to electric signals (demodulation) using the photoelectric effect.

- Characteristics of optical fibre cable
 - High bandwidth for voice, video and data applications
 - Carries data over a very long distance at a stretch.
 - Not susceptible to electromagnetic fields, as it uses light for data transmission.
 - The most expensive and the most efficient communication media available for computer networks.
 - Installation and maintenance are difficult and complex.

- **Unguided medium (Wireless)**

Electromagnetic waves are used for wireless communication on computer networks.

Frequencies of waves are measured in Hertz (Hz).

a. Radio waves: Radio waves have a frequency range of 3 KHz to 3 GHz. Radio waves can be used for short and long distance communication.

- Characteristics of radio wave transmission
 - Waves are transmitted in all directions, therefore transmitting and receiving antennas need not be aligned face to face.
 - Relatively inexpensive than wired media.
 - Can penetrate through most objects.
 - Transmission can be affected by motors or other electrical equipment.
 - Less secure mode of transmission.
 - Permissions from authorities concerned are required for the use of radio wave transmission.

b. Micro waves: Micro waves have a frequency range of 300 MHz (0.3 GHz) to 300 GHz.

Microwaves travel in straight lines and cannot penetrate any solid object. Therefore, high towers are

built and microwave antennas are fixed on their top for long distance microwave communication.

- Characteristics of micro wave transmission
 - Relatively inexpensive than wired media.
 - Offers ease of communication over difficult terrain.
 - The transmission is in straight lines. Therefore, the transmitting and receiving antennas need to be properly aligned (line of sight transmission).

c. Infrared waves: Infrared waves have a frequency range of 300 GHz to 400 THz. These waves are used for short range communication (approx. 5 m) in a variety of wireless communications, monitoring and control applications.

- Characteristics of infrared wave transmission
 - A line of sight transmission; hence information passed to one device is not leaked.
 - Only two devices can communicate at a time.
 - The waves cannot cross solid objects. (You may stand between the remote control and your television set and check whether the remote control works.)
 - The longer the distance the weaker the performance.

Wireless communication technologies using radio waves

a. Bluetooth: Bluetooth technology uses radio waves in the frequency range of 2.402 GHz to 2.480 GHz. This technology is used for short range communication (approx. 10 m) in a variety of devices for wireless communication.

- Characteristics of Bluetooth transmission
 - Line of sight between communicating devices is not required.
 - Bluetooth can connect upto eight devices simultaneously.
 - Slow data transfer rate (upto 1 Mbps).

b. Wi-Fi: Wi-Fi network makes use of radio waves to transmit information across a network like cell phones, televisions and radios. The radio waves used in Wi-Fi ranges from a frequency of 2.4 GHz to 5 GHz. Communication across a wireless network is two-way radio communication.

- Characteristics of Wi-Fi transmission
 - Line of sight between communicating devices is not required
 - Data transmission speed is up to 54 Mbps
 - Wi-Fi can connect more number of devices simultaneously
 - Used for communication upto 375 ft (114 m)

c. Wi-MAX: Worldwide Interoperability for Microwave Access (Wi-MAX) combines the benefits of broadband and wireless. Wi-MAX has a the frequency range of 2 GHz to 11 GHz. Wi-MAX can provide high-speed wireless Internet access over very long distances (a whole city).

- Characteristics of Wi-MAX transmission

- Hundreds of users can connect to a single station.
- Provides higher speed connection upto 70 Mbps over an area of 45 Kilometres.
- Line of sight between communicating devices is not required.
- Weather conditions like rain, storm etc. could interrupt the signal.
- Very high power consumption.
- High costs of installation and operation.

Satellite link: Long distance wireless communication systems use satellite links for transmitting signals. Signals can be sent to geostationary satellites in space and then redirected to another satellite or directly to a faraway destination. Transmission of signals from the earth to a satellite is called uplink and from a satellite to the earth is called downlink.

- Characteristics of transmission using satellite link
 - Satellites cover a large area of the earth.
 - This system is expensive.
 - Requires legal permission and authorisation.

Data communication devices

A data communication device provides an interface between computer and the communication channel.

- **Network Interface Card (NIC):** Network Interface Card (NIC) is a device that enables a computer to connect to a network and communicate.
- **Hub:** A hub is a device used in a wired network to connect computers/devices of the same network. Computers/devices are connected to ports of the hub using Ethernet cable. When NIC of one computer sends data packets to hub, the hub transmits the packets to all other computers connected to it.
- **Switch:** A switch is an intelligent device that connects several computers to form a network. Switches are capable of determining the destination and redirect the data only to the intended node.
- **Repeater:** A repeater is a device that regenerates incoming electrical, wireless or optical signals through a communication medium.
- **Bridge:** A bridge is a device used to segmentise a network. An existing network can be split into different segments and can be interconnected using a bridge.

- **Router:** A router is a device that can interconnect two networks of the same type using the same protocol.
- **Gateway:** A gateway is a device that can interconnect two different networks having different protocols.

Data Terminal Equipment

A data terminal equipment (DTE) is a device that controls data flowing to or from a computer.

- **Modem:** A modem is an electronic device used for communication between computers through telephone lines.
 - The name is formed from the first three letters of the two words modulator and demodulator.
 - It converts digital signals received from a computer to analog signals for telephone lines.
 - It also converts the analog signals received back from telephone lines to digital signal for the computer.
- **Multiplexer/ Demultiplexer :** Multiplexing is sending multiple signals on a physical medium at the same time in the form of a single, complex signal and then receiving the separate signals at the receiving end.
 - Multiplexer combines the inputs from different sources, demultiplexer separates the signal and send them to destinations.

Network topologies

The way in which the nodes are physically interconnected to form a network is called a Topology.

- Major topologies are *bus, star, ring and mesh*.
- **Bus Topology:** In bus topology all the nodes are connected to a main cable called bus.
 - If a node has to send data to another node, it sends data to the bus.
 - The process of transmitting data from one node to all other nodes is called broadcasting.
 - Characteristics of bus topology
 - Easy to install.
 - Requires less cable length and hence it is cost effective.
 - Failure of a node does not affect the network.
 - Failure of cable (bus) or terminator leads to a breakdown of the entire network.

- Fault diagnosis is difficult.
- Only one node can transmit data at a time.
- **Star topology:** In star topology each node is directly connected to a hub/switch. If any node has to send some information to any other node, it sends the signal to the hub/switch.
 - Characteristics of star topology
 - More efficient compared to bus topology.
 - Easy to install.
 - Easy to diagnose faults.
 - Easy to expand depending on the specifications of central hub/switch.
 - Failure of hub/switch leads to failure of entire network.
 - Requires more cable length compared to bus topology.
- **Ring topology:** In ring topology, all nodes are connected using a cable that loops in a ring or circle. A ring topology is in the form of a circle that has no start and no end.
 - Characteristics of ring topology
 - No signal amplification is required as each node amplifies the signal.
 - Requires less cable length and hence is cost effective.
 - If one node fails, entire network will fail.
 - Addition of nodes to the network is difficult.
- **Mesh topology:** In mesh topology, every node is connected to other nodes. So there will be more than one path between two nodes
 - Characteristics of mesh topology
 - Network will not fail even if one path between the nodes fails.
 - Expensive because of the extra cables needed.
 - Very complex and difficult to manage.

Types of networks

A computer network may span any amount of geographical area. On the basis of the area covered, computer networks are classified as:

- **PAN** - Personal Area Network: PAN is a network of communicating devices (computer, mobile, tablet, printer, etc.) in the proximity of an individual. It can cover an area of a radius with few meters.

- **LAN - Local Area Network:** LAN is a network of computing and communicating devices in a room, building, or campus. It can cover an area of radius with a few meters to a few Kilometers.
- **MAN - Metropolitan Area Network:** MAN is a network of computing and communicating devices within a city. It can cover an area of a few Kilometers to a few hundred Kilometers radius. MAN is usually formed by interconnecting a number of LANs and individual computers.
- **WAN -Wide Area Network:** WAN is a network of computing and communicating devices crossing the limits of a city, country or continent. It can cover an area of over hundreds of Kilometres in radius.

Logical classification of networks

- **Peer-to-Peer:** A peer-to-peer network has no dedicated servers.
 - All the computers are considered equal.
 - Any computer can act as a client or as a server at any instance.
 - This network is ideal for small networks.
- **Client-Server:** In a network, the client-server architecture consists of high-end computer (called server) serving lower configuration machines called clients.
 - A server provides clients with specific services (responses) upon client's request.
 - The services include sharing of data, software and hardware resources.

Classifications for servers are

- File server* - A computer that stores and manages files for multiple users on a network.
- Web server* - A computer dedicated to responding to requests for web pages.
- Print server* - Redirects print jobs from clients to specific printers.
- Database server* - Allows authorised clients to view, modify and/or delete data in a common database.

Identification of computers over a network

- **Media Access Control (MAC) address:** A Media Access Control (MAC) address is a universally unique address (12 digit hexadecimal number) assigned to each NIC (Network Interface Card) by its manufacturer. This address is known as the MAC address.

- **Internet Protocol (IP) Address:** An IP address is a unique 4 part numeric address assigned to each node on a network, for their unique identification. IP address is assigned to each machine by the network administrator or the Internet Service Provider.
- There are two versions of IP addresses: version 4 (IPv4) and version 6 (IPv6). IPv4 uses 32 bits and IPv6 uses 128 bits for an IP address.

Network protocols

A network protocol is the special set of rules to be followed in a network when devices in the network exchange data with each other. Each protocol specifies its own rules for formatting data, compressing data, error checking, identifying and making connections and making sure that data packets reach its destination.

- **TCP/IP:** TCP/IP, Transmission Control Protocol/Internet Protocol, is a suite of communications protocols used to interconnect network devices on the local networks and the Internet.
- **HTTP:** HTTP stands for Hypertext Transfer Protocol.
 - It is a standard protocol for transferring requests from client-side and to receive responses from the server-side.
 - The two important characteristics of HTTP are HTTP is transmission medium independent. HTTP is stateless.
- **FTP:** FTP stands for File Transfer Protocol.
 - It is a standard for exchanging of data and program files across a network.
- **DNS:** DNS stands for Domain Name System.
 - DNS returns the IP address of the domain name, that we type in our web browser's address bar.
- **Uniform Resource Locator (URL):** URL stands for Uniform Resource Locator.
 - URL is a formatted text string used by web browsers, email clients and other software to identify a network resource on the Internet.
 - URL consists of letters, numbers and punctuations. URL string can be divided into three parts.
 - a) Network protocol (also called the scheme)
 - b) Domain name (Host name or address)
 - c) File name
- **Generic Domain Names**
 - com - Commercial business
 - edu - Educational institutions
 - gov - Government agencies

- .mil - Military
- .net - Network organizations
- .org - Organizations (nonprofit)
- **Country Specific Domain Names**
 - .in - India
 - .au - Australia
 - .ca - Canada
 - .ch - China
 - .jp - Japan
 - .us - United States of America

9. Internet

Internet - Largest computer network in the world

- **Vinton Gray Cerf** was instrumental in the development of Internet and TCP/IP protocol, is considered as the father of Internet.
- Tim Berners Lee a researcher, proposed the idea of World Wide Web (WWW).
- An Intranet is considered as a private computer network similar to Internet that uses TCP/IP protocol to share information, software or services within an organisation.
- When an intranet is made accessible to some computers that are not part of a company's private network it is called an extranet.
- Data transfer rate is the average number of bits transferred between devices in unit time.
- WWW documents are created using Hyper Text Markup Language (HTML) tags and are called web pages.
- The three basic privacy levels in social media are private, friends and public

Connecting the computer to the Internet

The following are the hardware and software requirements for connecting a computer to the Internet:

- A computer with Network Interface Card (wired/wireless) facility and an operating system that supports TCP/IP protocol
- Modem
- Telephone connection
- An Internet account given by an Internet Service Provider (ISP)
- Software like browser, client application for e-mail, chat, etc.

Types of connectivity

- **Dial-up connectivity:** A dial-up connection uses the conventional telephone line and a dial-up modem to dial and connect to the server at the Internet Service Provider (ISP).
 - This connection commonly uses a 56 kbps modem that can transmit data up to a maximum speed of 56 kbps.
- **Wired broadband connectivity:** Wired broadband connections are ‘always on’ connections that do not need to be dialled and connected.
 - Broadband connections use a broadband modem allow us to use the telephone even while using the Internet.
- **Comparison between dial-up and wired broadband connections.**

Dial-up connection	Wired broadband connection
Slow connection, speed upto 56 kbps	High speed connection, speed usually higher than 256 kbps
Requires dialling to connect to ISP	Always on connection
Uses telephone line exclusively	Simultaneous use of voice and Internet
Uses dial-up modem	Uses broadband modem

Popular broadband technologies

- **Integrated Services Digital Network (ISDN):** ISDN is a broadband service capable of transporting voice and digital data.
- **Cable Internet:** Cable Internet access provides Internet access using coaxial cables laid for television signal transmission to our homes. The service provider uses a cable modem at our home to connect our computer to cable network.
- **Digital Subscriber Line (DSL):** DSL is another broadband service that provides connection to the Internet through standard telephone lines. DSL allows the user to use copper telephone lines for both Internet communication and for making voice calls simultaneously.
- **Leased Lines:** Leased lines are dedicated lines used to provide Internet facility to ISPs, business, and other large enterprises.
- **Fiber to the Home (FTTH):** Fibre to the Home (FTTH) uses optical fibres for data transmission.

Wireless broadband connectivity

The popular wireless broadband accesses are

- **Mobile Broadband:** Mobile broadband is wireless Internet access using mobile phone, USB wireless modem, tablet or other mobile devices.
- **Wi-MAX:** Wi-MAX offers a Metropolitan Area Network which can provide wireless Internet upto a distance of 50 Km.
- **Satellite Broadband:** Satellite broadband technology is a method by which Internet connectivity is provided through a satellite. A Very Small Aperture Terminal (VSAT) dish antenna and a transceiver (transmitter and receiver) are required at the user's location.

Internet access sharing methods

An Internet connection can be shared among several computers using a LAN, Wi-Fi network or Li-Fi network.

Services on Internet

- **World Wide Web (WWW):** The World Wide Web (WWW) is a system of interlinked hypertext documents accessed via the Internet.
 - It is a service on the Internet that uses Internet infrastructure.
 - WWW is a huge client-server system consisting of millions of clients and servers connected together.
 - Each server maintains a collection of documents and they can be accessed using a reference called Uniform Resource Locator (URL).
- **Browser** - A web browser is a software that we use to retrieve or present information and to navigate through web pages in the World Wide Web.
 - Some common browsers are Google Chrome, Internet Explorer, Mozilla Firefox, Opera, and Safari.
- **Web browsing** -Traversing through the web pages of World Wide Web is called web browsing.
- **Search engines:** Internet search engine websites are special programs that are designed to help people to find information available in World Wide Web.
 - Search engine programs search documents available on World Wide Web for specified keywords and return a list of the documents/web pages matching the keywords.
 - Some of the most popular web search engine sites are Google, Bing, Yahoo Search, Ask, etc.
- **E-mail:** Electronic mail or e-mail is a method of exchanging digital messages between computers over Internet.

- E-mail has become an extremely popular communication tool. The e-mail will be delivered almost instantly in the recipient's mail box (Inbox).
- The structure of an e-mail address is: `user_name@domain name`.
- An e-mail address consists of two parts separated by @ symbol.
- The first part is the username that identifies the addressee and the second part is the domain name of the e-mail server, i.e., the name of the e-mail service provider.
- **Sections of an e-mail :-** A client software gives provisions to enter the following sections.
 - **To** (Recipient Address) – A box to provide the e-mail addresses of the primary recipients to whom the e-mail has to be sent.
 - **Cc** (Carbon copy) – Write the e-mail addresses of the secondary recipients to whom the message has to be sent.
 - **Bcc** (Blind carbon copy) – Depending on e-mail service used, the tertiary recipients may only see their own e-mail address in Bcc, or they may see the e-mail addresses of all recipients.
 - **Subject** – Provide a meaningful subject for your conversation.
 - **Content** – Type your message here.

Advantages of using e-mail

The benefits of using e-mail facility are listed below.

- **Speed:** An e-mail is delivered instantly to any location across the globe.
- **Easy to use:** We can send and receive e-mails, organise our daily conversations and save them easily on our computer.
- **Provision of attachments:** The attachment feature allows to send pictures, files, documents, etc. along with e-mail.
- **Environment friendly:** E-mails do not use paper and save a lot of trees from being cut down.
- **Reply to an e-mail:** When we need to reply to an e-mail, we can use the provision of attaching previous e-mails as reference.
- **Cost-effective:** When compared to fax or conventional mail, e-mail is less expensive.
- **Available anywhere anytime:** Messages can be read at user's convenience.

Social media

Social media refers to the use of mobile and web-based technologies through which individuals and communities can create, share, discuss and modify content.

- **Classification of social media:**

- **Internet forums:** An Internet forum is an online discussion web site where people can engage in conversations in the form of posted messages. Ubuntu Forum – a community that provides help on Ubuntu is a popular forum.
- **Social blogs:** A blog (web log) is a discussion or informational website consisting of entries or posts displayed in the reverse chronological order i.e., the most recent post appears first. Blogger.com and Wordpress.com are popular sites that offer blogging facility.
- **Microblogs:** Microblogs allow users to exchange short sentences, individual images or video links. Twitter.com is a popular microblogging site.
- **Wikis:** Wikis allow people to add content or edit existing information in a web page, to form a community document. Wiki is a type of content management system. wikipedia.org – the free online encyclopaedia is the most popular wiki on web.
- **Social networks:** Social networking sites allow people to build personal web pages and then connect with friends to communicate and share content. Popular social networking sites are facebook.com and linkedin.com.
- **Content communities:** Content communities are websites that organise and share contents like photos, videos, etc. Youtube.com is a popular video sharing site and flickr.com shares pictures.
- **Advantages of social media**
 - Bring people together: Social networking allows people to find long-lost childhood friends and make new ones.
 - Plan and organise events: These sites help users to organise and participate in events.
 - Business promotion: Social media offers opportunities for businesses to connect with customers, implement marketing campaigns, manage reputation, etc.
 - Social skills: These sites allow people to express their views over a particular issue and become an agent for social change.
- **Limitations in use of social media**
 - Intrusion to privacy: The personal information of users can be used for illegal activities.
 - Addiction: Addiction to these sites wastes our valuable time. It will negatively affect our mental states and may lead to depression and tension.
 - Spread rumours: Social media will spread the news very quickly.

- **Social media interaction – Best practices**
 - Avoid unnecessary uploading of personal data like e-mail address, telephone number, address, pictures and videos.
 - Setting time schedule for using these sites can save wastage of time.
 - Be aware of what you post online. Avoid posting content you may regret later.
 - Set your privacy levels in such a way that you know exactly who can see your posts and who can share them.

Cyber security

Security to computer networks is vital because important data can be lost and privacy can be violated. The common threats that affect a computer network are:

- **Computer virus:** A computer virus is a program that attaches itself to another program or file enabling it to spread from one computer to another without our knowledge and interferes with the normal operation of a computer.
 - A virus might corrupt or delete data on our computer, replicate itself and spread to other computers or even erase everything in the hard disk.
- **Worm:** A computer worm is a standalone malware (malicious software) program that replicates itself in order to spread to other computers.
- **Trojan horse:** A Trojan horse, will appear to be a useful software but will actually do damage once installed or run on the computer.
 - When a Trojan is activated on a computer, they can cause serious damage by deleting files and destroying information on the system.
- **Spams:** Spams or junk mails are unsolicited e-mails sent indiscriminately to persons to promote a product or service.
- **Hacking:** Hacking is performed both by computer security experts and by computer criminals. Computer experts perform hacking to test the security and find the vulnerabilities in computer networks and computer systems.
 - Such computer experts are often called ‘*white hats*’ and such hacking is called ethical hacking.
- Computer criminals break into secure networks to destroy data or make the network unusable for those who are authorised to use the network.
 - They do this with the intent of stealing confidential data or destroying files. Such criminals are called ‘*black hats*’.

- There is another category of hackers called *grey hat hackers*, sometimes act illegally, though with good intentions, to identify the vulnerabilities, who fall between white and black hackers.
- **Phishing:** Phishing is an attempt to acquire information such as usernames, passwords and credit card details by posing as the original website, mostly that of banks and other financial institutions.
- **Denial of Service (DoS) attack:** A Denial of Service (DoS) attack is usually aimed at a web server. Such an attack forces the server/computer to restart.
- **Man-in-the-Middle attacks:** A man-in-the-middle attack refers to an attack in which an attacker secretly intercepts electronic messages between the sender and the receiver and then captures, inserts and modifies messages during message transmission.

Preventing network attacks

- **Firewall:** A firewall is a system of computer hardware and software that provides security to the computer network in an organisation.
 - A firewall controls the incoming and outgoing network traffic by analysing the data and determining whether they should be allowed through or not, based on a rule set.
- **Antivirus scanners :** Antivirus tools are used to detect them and cure the infected system. Antivirus software scans files in the computer system for known viruses and removes them if found.
- **Cookies:** Cookies are small text files that are created when we use a browser to visit a website. Cookies keep track of our movements within the web site – remembers our user name, preferences, e-mail address, etc.

Guidelines for using computers over Internet

Following are the major guidelines for using computers over Internet.

- Most of the computer viruses are spread through e-mail attachments. Do not open any e-mail attachment that you are not sure about the sender.
- Download files only from reputed sources. Do not use/copy software that you cannot confirm the origin.
- Avoid clicking on pop-up advertisements. Close them instead.

- Use USB drives with caution. Plugging someone else's USB storage into your computer or plugging your own USB storage into a computer at an Internet cafe/ unsafe computer, can spread an infection through the USB storage.
- Make sure the firewall is set and turned on.
- Use strong passwords. Change passwords at regular intervals.
- Update the virus definitions of your antivirus program periodically online.
- Keep a regular backup of your important files (on DVD, another hard disk, etc.)

10. IT Applications

Information and Communication Technology (ICT) integrates telecommunication and computers for capturing, storing, processing, interpreting and printing information

- ICT is the term often used as an extended synonym for Information Technology (IT).
Information and Communication Technology (ICT)
- ICT is more specific in integrating telecommunication and computers comprising of many technologies for capturing, storing, processing, interpreting and printing information.
- A system of financial exchange between buyers and sellers in an online environment is called an Electronic Payment System (EPS).

E-Governance

- **Categories of e-Governance**
- **Government to Government (G2G)** - It is the electronic sharing of data and/or information among government agencies, departments or organisations.
- **Government to Business (G2B)** - Here, e-Governance tools are used to aid the business community to interact with the government.
- **Government to Employees (G2E)** - It is the electronic sharing of data and/or information among government to employees, it include salary and various service matters.
- **e-Governance infrastructure**
 - The e-Governance infrastructure mainly consists of State Data Centers (SDC) for providing core infrastructure and storage, State Wide Area Network (SWAN) for connectivity and Common Service Centers (CSC) as service delivery points.

- **Kerala State Wide Area Network (KSWAN):** Kerala State Wide Area Network (KSWAN) has been set up as a backbone of the State Information Infrastructure (SII).
- **Common Service Centre (CSC):** Common Service Centres (CSC) are the front-end delivery points of the government, private and social sector services for the rural citizens of India.
- **Akshaya centres:** Akshaya centres were initially launched in the year 2002 in the Malappuram district in Kerala.
 - Its intention was to impart e-Literacy to the citizens. Akshaya was conceived as a landmark ICT project by the Kerala State Information Technology Mission (KSITM) to bridge the digital divide and to bring the benefits of ICT to the entire population of the State.
 - Akshaya was launched on 18th November 2002 by the former President of India, Dr. A. P. J. Abdul Kalam.
- **Aadhaar** is a 12 digit individual identification number issued as part of e-Governance by the Unique Identification Authority of India (UIDAI) on behalf of the Government of India.
 - This number will serve as a proof of identity and address, anywhere in India.

Benefits of e-Governance

- e-Governance leads to automation of government services, ensuring the information regarding the activities of public welfare is easily available to all citizens.
- e-Governance strengthens the democracy by ensuring greater participation of citizens at all levels of governance.
- It ensures more transparency in the functioning and thus helps eliminate corruption.
- It makes every government department responsible as they know that they are closely observed.
- Proper implementation of e-Governance saves unnecessary visits of the public to offices. It saves time and money.

Challenges to e-Governance

- The existing digital divide is an obstacle in utilising the services of e-Governance. Those who live in remote areas with lower e-Literacy will face difficulty to access the services of e-Governance.
- e-Governance applications being computer/web based, security measures are highly required since there is possibility of cyber-attack.

- Usually a huge initial investment and planning are required for the proper implementation and maintenance of e-Governance services.
- Many people are anxious about the sharing of their personal information, biometry, etc. to the agencies designated for data collection.
- Integrity of various departments is very much essential for the efficiency and effectiveness of e-Governance.

e-Business

e-Business is the sharing of business information, maintaining business relationships and conducting business transactions by means of the ICT application. Companies (business), public institutions (administration), as well as individuals (consumer) engage in e-Business.

e-Banking

e-Banking or electronic banking is defined as the automated delivery of banking services directly to customers through electronic channel.

Advantages of e-Business

- It overcomes geographical limitations
- e-Business reduces the operational cost
- It minimises travel time and cost
- It remains open all the time
- We can locate the product quicker from a wider range of choices

Challenges to e-Business

- A good percentage of the population is unaware of IT applications and its uses.
- Most of the customers, especially to rural population, do not possess plastic money-credit card, debit card and net banking system, which is necessary for e-Business.
- If not used with caution, customers may lose valuable information like their credit card number, passwords, etc.
- Products like apparel, handicrafts, jewellery, etc are often purchased after examining physically. But in online shopping, customers don't have this 'touch and feel' advantage.
- For the success of e-Business of any organisation or company, perfect and efficient shipment service is a necessity.

e-Learning

The use of electronic media and ICT (Information and Communication Technologies) in education is termed e-Learning.

e-Learning tools

- **Electronic books reader (e-Books)** : Portable computer devices that are loaded with digital book content via communication interfaces is called electronic books reader. It can open any book, any page quickly, without much effort.
- **e-Text** : Textual information available in electronic format is called e-Text. This text can be read and interacted with an electronic device like computer, e-Book reader, etc.
- **Online chat** : On line chat is a framework that provides interaction in a social environment. It helps communicating with people at different places.
- **e-Content** : Lot of e-Learning materials are delivered in different multimedia formats like videos, presentations, graphics, animations, etc. are e-content.
- **Educational TV channels**: There are many telecasting/webcasting channels which are dedicated for the e-Learning purpose.

Advantages of e-Learning: - Use of electronic media and ICT in education e-Learning has lot of advantages. They are listed below:

- e-Learning has the ability to offer courses on variety of subjects to large number of students from distant location.
- In e-Learning cost for learning is much less. It saves journey time and money, instructor fees, etc.
- People with limited financial resources are very much supported by the lower cost of e-Learning.
- It provides facility to do online courses from various nationally or internationally reputed institutions.
- Time and place is not a constraint for e-Learning.

Challenges to e-Learning: - Listed below are some of the challenges faced by e-Learning:

- Face to face contact between students and teachers is not possible.
- Proper interaction among teachers and students are often limited due to the lack of infrastructural facilities.

- Equipment and technology (computer and high speed Internet) requirement restrict adoption of e-Learning.
- Learners who require constant motivation may not be serviced adequately.
- Hands-on practical in real laboratory scenario is also a constraint in e-Learning.

ICT applications in health care

- There is an enormous range of opportunities for significant cost reduction and service enhancement through IT applications in health care.

Medical equipments

- Most of the modern medical equipment work with the support of computers. Scanners like CT and MRI depend on computers to process their data into a readable format. Micro-processors are used to control a variety of support devices.
- **Electronic Medical Record (EMR) :** There has been a move to store all patients' records in digital format. This is known as Electronic Medical Record (EMR). An EMR is mostly used by doctors for diagnosis and treatment.
- **Web-based support/diagnosis:** On the Internet you can find a wide variety of medical information, including information about available treatments/alternative therapies, access to medical research/journals, support groups for people suffering from particular conditions, etc .
- **Telemedicine:** Telemedicine has been used to share observations and prescriptions with the experts in the medical field.
- **Research and development:** Over recent years drug discovery has been a concern for many in the pharmaceutical industry. Use of IT may radically alter the cost associated with the discovery of drug over the coming years. Thus IT helps in diagnosis, treatment of patients and better running of hospitals.

ICT enabled services

ICT enabled services, also called web enabled services cover the entire range of operations which make use of ICT for improving services provided by an organisation.

- **Business Process Outsourcing (BPO) :** Business process outsourcing (BPO) is a subset of outsourcing. It involves contracting of the operations and responsibilities of specific business functions to a third-party service provider. Outsourcing sometimes involves transferring employees and asset from one firm to another.

- **Knowledge Process Outsourcing (KPO) :** Knowledge Process Outsourcing (KPO) is a form of outsourcing. Here knowledge and information related work is carried out by a different company or subsidiary within the same organisation.
- **Call centre :** A call centre is a telephone service facility set up to handle a large number of both incoming and outgoing calls for an organisation.
- **Teleconferencing:** Teleconferencing is a meeting or conference held between two or more parties in remote locations, made possible by the use of IT infrastructure and services. Teleconferencing is used to connect several different people from several different locations.
- **Video conferencing:** Video conferencing is a type of teleconferencing wherein we can include the video of the parties involved in the conference. Videoconference allows people at remote locations join in a conference and share information. A video camera and a speakerphone are connected to a computer and the computers are connected to the network or Internet.