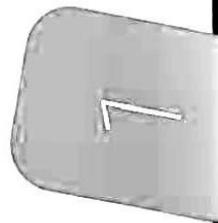


CSE 1101: Introduction to Computer Systems:



Definition:

A computer is a machine or device that performs ~~and~~ process, calculations and operations based on instructions provided by a software or hardware program. It has the ability to accept data (input), process it, and then produce outputs.

Computer can also store data for later uses in appropriate storage devices and retrieve whenever it is necessary.

Modern computers are electronic devices used for a variety of purposes ranging from browsing the web, writing documents, editing videos, creating applications, playing video games etc. They are designed to execute applications and provide a variety of solutions by combining integrated hardware and software components.

Functions of Computer:

The functions of computer are numerous as modern computers are capable of completing simple to complex tasks with ease. Computer technology and related devices are becoming more advanced over time. In this way, it is very difficult to classify the functions.

at a computer. However, some basic functions are performed by every computer system irrespective of its size, power, capability or modernity.

Based on the fundamental working of a computer system, a computer mainly has four basic functions, namely:

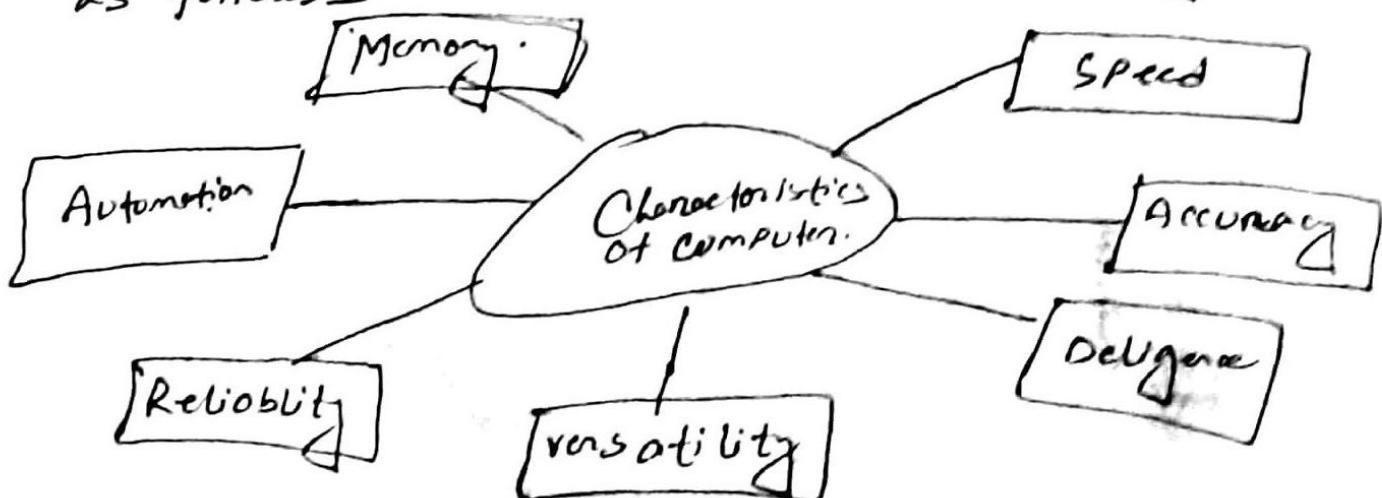
- Data Input.
- Data Processing.
- Information output.
- Data and Information storage.



The above functions of the computer are also known as an input function, process function, output function, and storage function respectively.

④ Characteristics of Computer:

The characteristics of the computer system are as follows—



Speed: A computer works with much higher speed and accuracy compared to humans while performing mathematical calculations. Computer can process millions (1,000,000) of instructions per second. The time taken by computers for their operations is micro seconds and nano seconds.

Accuracy: Computer performs calculations with 100% accuracy. Error may occur due to data inconsistency or inaccuracy.

Diligence: A computer can perform millions of tasks or calculations with the same consistency and accuracy. It does not feel any fatigue or lack of concentration.

Versatility: Versatility refers to the capability of a computer to perform different kinds of works with some accuracy and efficiency.

Reliability: A computer is reliable as it gives consistent result for similar set of data i.e. if we give same set of input any number of times, we will get the same result.

Automation: Computer performs all the tasks automatically i.e. it performs ~~task~~ tasks without manual intervention.

Primary: A computer has built-in memory called primary memory where it stores data. Secondary storage are removable devices such as CDs, Pen drives etc. which are also used to store data.

② Block Diagram of a Computer System:

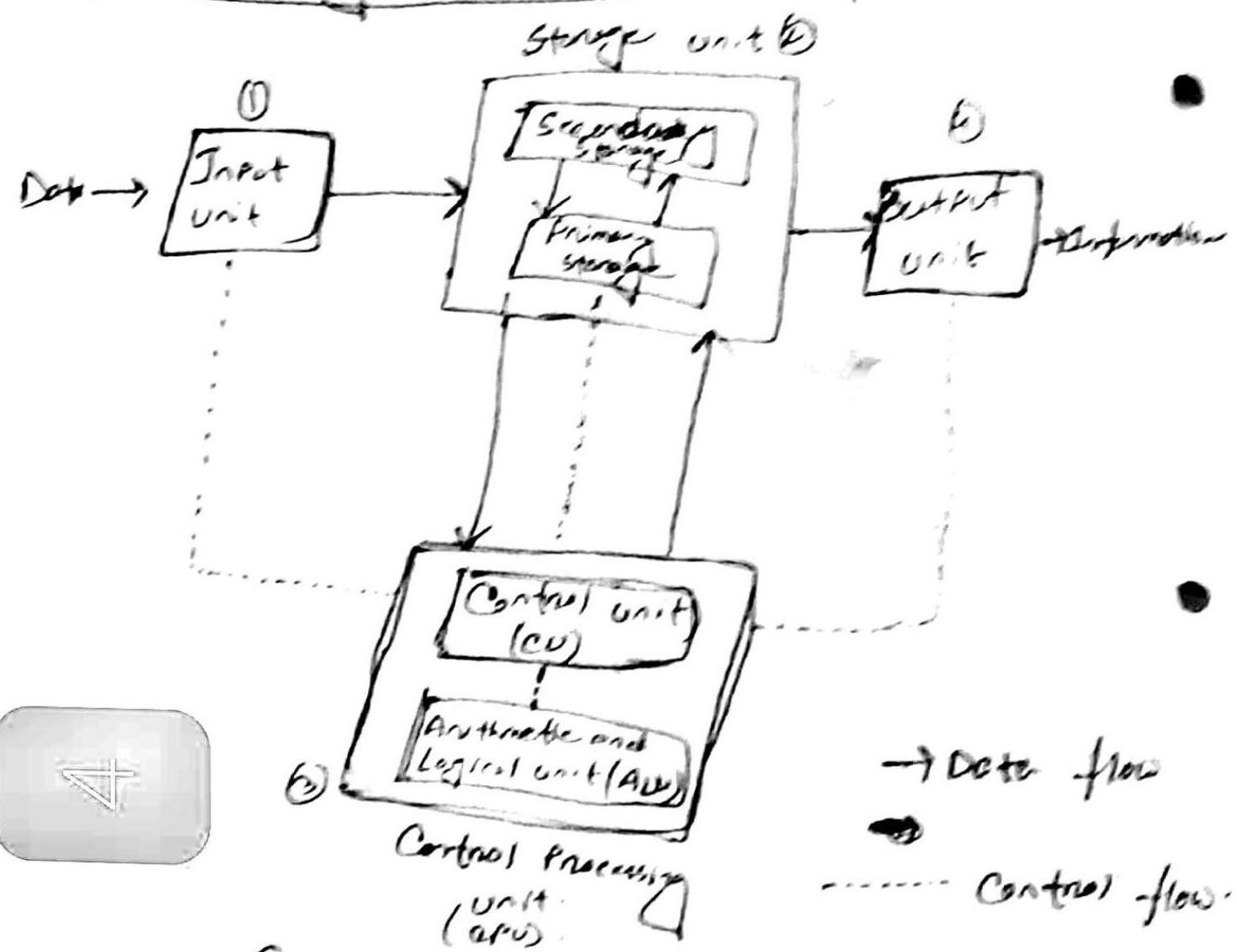


Fig: Block Diagram of a Computer.

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~~Output device~~

Input unit:

- It accepts the data from outside world.
- It converts these data in computer acceptable form. (Binary - 0, 1).
- It supplies the converted data to the computer system for further processing.
- The keyboard and mouse are common examples of input devices.



Storage unit:

- It holds the data and instructions required for processing (received from input devices).
- Intermediate results of processing.
- Final results of processing, before these results are realised to an output device.
- The common output devices are printer or monitor.

Types of storage unit:

- ① Primary storage: It is also known as main memory, is used to hold pieces of program instructions and data, intermediate results of processing and recently produced results of processing.
- ② Secondary storage: we can store the data and programs on a long-term basis in the secondary memory. The hard disks and the optical disks are the common secondary devices. It is slow and cheap memory as compare to primary memory. The memory is not connected to the processor directly.
- ③ Central Processing Unit: The Central Processing Unit is the central processor or main processor of the computer system. The processor carries out the instructions of the computer program with the help of basic arithmetic and logic, input/output operations.



① Parts of CPU:

- ① Arithmetic Logic unit (ALU): The arithmetic and logical unit is, the combinational digital electronic circuit that can perform arithmetic operations on ~~any~~ integer binary number. It performs the arithmetic and logical operations.

Arithmetic → addition, subtraction,
multiplication, division.

Logical → 2 values compare
 $(> = \leq)$ etc.

- ② Control unit (CU): The control unit (CU) controls all the activities or operations which are performed inside the computer system. It receives instructions or information directly from the main memory of the computer.

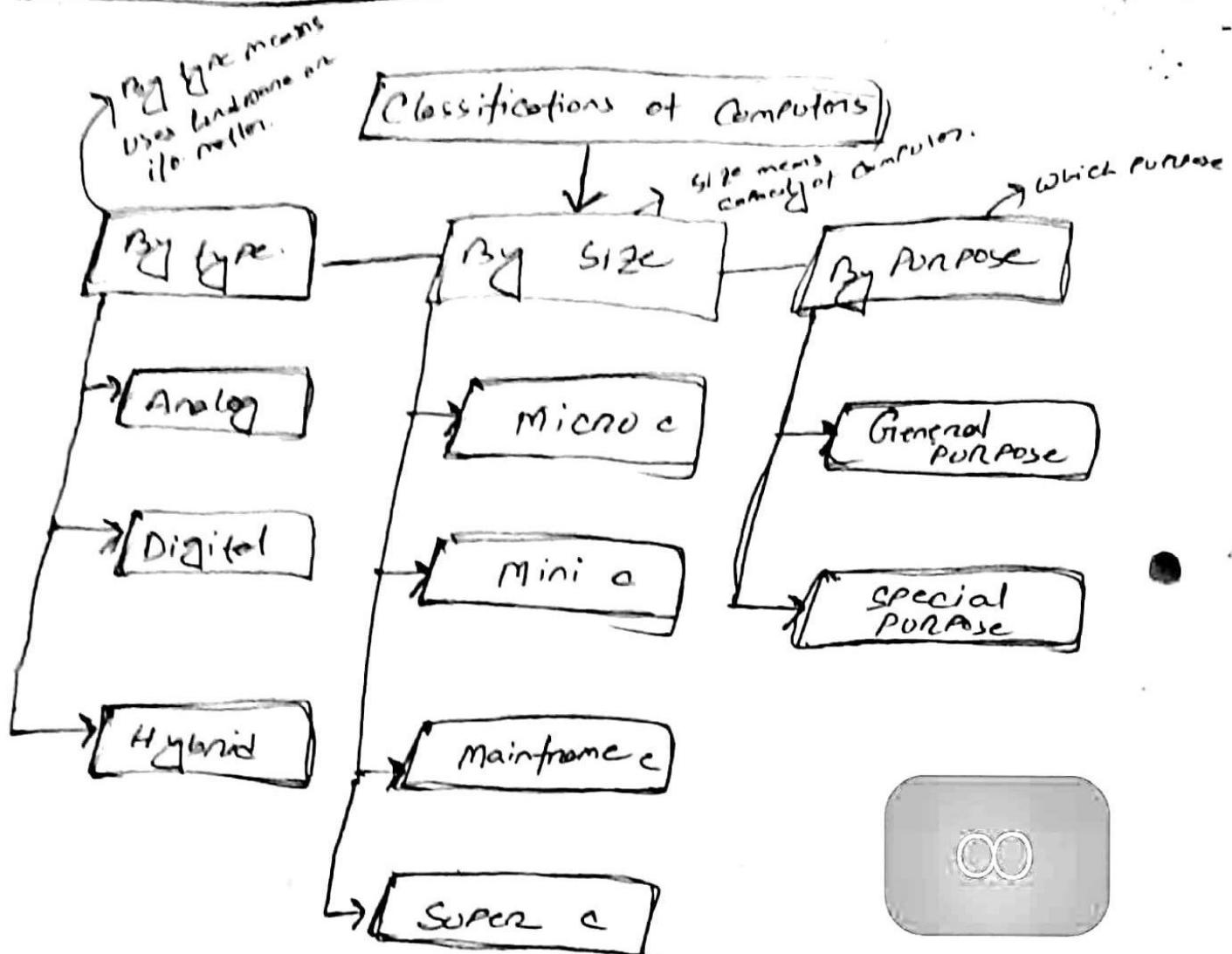


② Output unit:

- ① The devices receives or accept the data in binary form.
- ② The output devices convert the binary code into the human readable form.
- ③ These devices produce the converted result and show to the user.
- ④ The monitor and printer are common example of output devices.

Q Classification of computer:

Boolegues



Q By type:

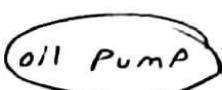
① Analog: An analog computer is a computer which is used process analog data. Analog computers store data in a continuous form of physical quantities and perform calculations with the help of measures. It is quite different from the digital computer, which makes the symbolic numbers to represent results.

Examples of analog computers are ~~temperature~~ temperature, air pressure, speedometer, resistance of computer, frequency of signal and voltage etc.

Q1) Digital Computers The definition of a digital computer is the most commonly used type of computer and is used to process information with quantities using digits, usually using the binary number system. i.e. using only the two digits 0 and 1.

Examples: Smartphones and tablets, calculators, Digital clock etc.

• Hybrid Computers: Hybrid computers are computers that exhibit features of analog computers and digital computers.

Ex: Gasoline machine  oil pump

→ By size:



① Micro Computer: A micro computer is a small, relatively inexpensive computer with a microprocessor as its central processing unit (CPU). It includes a microprocessor, memory and minimal input/output (I/O) circuitry mounted on a single Printed circuit board (PCB).

A micro computer is a complete computer on a small scale, designed for use by one person at a time. A microcomputer is now primarily called a personal computer (PC) or a device based on a single cheap microprocessor. Common micro computers include laptops and desktops.

④ Minicomputer: Mini computers are digital computers, generally used in multi user systems. They have high processing speed and high storage capacity than microcomputers.

Microcomputers can support 4-200 users simultaneously.

The users can access the microcomputer through their PCs/terminals. They are used for real time applications in industries, ~~and~~ research centers etc.

Ex: PDP 11 and IBM (8000 series).

⑤ Mainframe Computer: Mainframe computers are multi-user, multi-programming and high performance computers. They operate at a very high speed, have very large storage capacity and can handle the workload of many users. Mainframe computers are large and powerful systems generally used in centralized databases.

Mainframe computers are used in organizations like banks or companies, where many people access the same data.

Ex: CDC 6600 and IBM ES/90.

Super Computers:

Supercomputers are the fastest and the most expensive machines. They have high processing speed compared to other computers. The speed of a super computer is generally measured in FLOPS. (Floating point operations per second). Some of the supercomputers can perform trillions of calculations per second. Supercomputers are built by interconnecting thousands of processors that can work parallelly.

Supercomputers are used for highly calculation-intensive tasks such as weather forecasting, climate research, biological research, etc

Ex:



By Purpose:

 General Purpose: A general computer is one of that given the appropriate application and required time should be able to perform most common computing tasks.

→ Laptop, Desktop and, smart phones and tablets are General purpose computers.

Purpose

② Special Computer: As the name states, a Special purpose computer are designed to be task specific and most of the times their job is to solve one particular problems. They are also known as dedicated computers, because they are dedicated to perform a single task over and over again.

Ex: Automatic teller machines (ATM) or washing machines.

⇒ Hardware, Software, and firmwares:

③ Hardware: Hardware is the computer's part that is seen and touched by us. These are the physical parts of a computer which make up the body of our computer like; keyboard, mouse, monitor, printer, hard disk, motherboard etc.

④ Software: Software is a set of instructions, data or programs used to operate computers and execute specific tasks.

Ex: Google chrome, Mozilla, MS office.

⇒ The two main categories of software are application software and system software.

⑤ Application Software: An application software is that software which fulfills a specific need or performs tasks. Ex: calculator, facebook, Google chrome etc.



④ System Software: System software is designed to run a computer's hardware and provides a platform for applications to run on top of.

Ex: Windows, Linux, etc. (OS).



⑤ Firmware: Firmware is a type of software that is associated with your hardware. Firmware is software installed at the time of manufacturing any hardware, including hardware such as keyboards, hard drives, BIOS and printers. The firmware contains instructions programs to perform the basic functions of any hardware.

⑥ Comparison between Software and Firmware:

⑦ Comparison Table between Software and Firmware:

<u>Software</u>	<u>Firmware</u>
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① Set of instructions.

① Type of software to control the hardware.

② It includes categories such as Application software, Computer Programming tools.

② It includes no such categories.

③ Updating is straightforward.

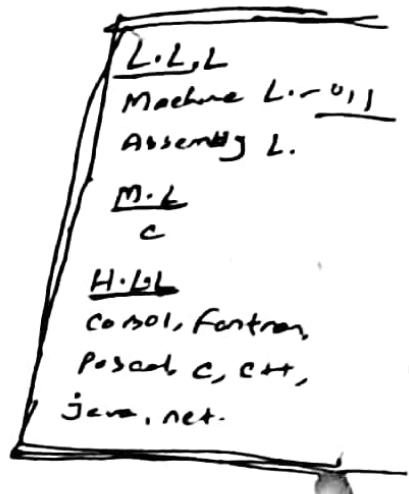
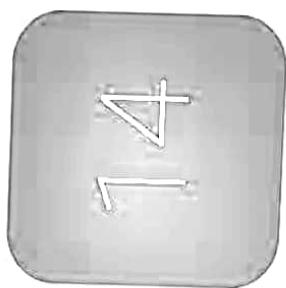
③ Updating is comparatively difficult.

④ It's size massive.

④ It's size is very small.

Both low-level and high level language is used in the developing process.

usually, low-level language is used the developing process.



Impact of Computer:

Positive Impact:

- ① It helps us to automate various tasks that we cannot do manually.
- ② It helps us to organize our data and information in a better way.
- ③ It has much more computing and calculating power than an ordinary human.
- ④ It may be the storage of our important files.
- ⑤ It may help us solve problems faster than an ordinary human being can do.

Negative Impact.

- ① It can potentially destroy our social life and interaction with humans if we do not maintain the balance.
- ② It may effect to destruction of our eye sight due to radiation.
- ③ It may damage our studies and life.
- ④ Too much time in front of monitor may adverse effect our eye sight and can also make you fat.



B Number System:

A number is a way to represent arithmetic value, count or measure of a particular quantity. A number system can be considered as a mathematical notation of numbers using a set of digits or symbols.

[In simpler words the number system is a method of representing numbers] Every number system is identified with the help of its base or radix.

⇒ What is Base or Radix of a number system?

→ The base or radix of a number system is can be defined as the total numbers of different symbols which can be used in a particular number system. Radix means 'Root' in Latin.

⇒ Base=4 implies that there are 4 different symbols in that number system. Similarly, base=2 implies that there are 2 different symbols in that number system.

\Rightarrow Radix / Base:

1. Decimal (Base 10): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
2. Binary (Base 2): 0, 1
3. Octal (Base 8): 0, 1, 2, 3, 4, 5, 6, 7
4. Hexadecimal (Base 16): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
A B C D E F

\Rightarrow Classification of Number System:

The number system can be classified into two types namely:

- ① Positional Number System.
- ② Non-positional number system.



\Rightarrow Positional Number System:

A positional number system is also known as weighted number system. As the name implies there will be a weight associated with each digit.

Ex: Decimal, Binary, octal, Hexadecimal.

(1) Non-positional number system: Non positional

Number system is also known as non weighted number system. Digit value is independent of its position.

Ex: Roman code \rightarrow I II IV X.

Tally code \rightarrow ~~|||||~~ | |||| | | | | | |

(2) Conversion of number system:

In our previous section, we learned different types of number system such as binary, decimal, octal, and hexadecimal. In this part we will know how we can change a number from one number system to another number system.

As we have four types of number system so, each one can be converted into the remaining three systems. There are the following conversions possible in Number system.

- (1) Binary to other number systems.
- (2) Decimal to other number systems.
- (3) Octal to other number systems.
- (4) Hexadecimal to other number systems.



Q] Conversion of Binary Number ~~to~~ to Decimal

Number :

Ex: 1:

$$(1101.101)_2 = (?)_{10}$$

$$\begin{aligned}
 (1101.101)_2 &= 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} \\
 &= 1 \times 8 + 1 \times 4 + 0 \times 2 + 1 \times 1 + 1 \times \frac{1}{2} + 0 \times \frac{1}{2^2} + 1 \times \frac{1}{2^3} \\
 &= 8 + 4 + 0 + 1 + 0.5 + 0 + 0.125 \\
 &= (13.625)_{10}.
 \end{aligned}$$



$$\therefore (1101.101)_2 = (13.625)_{10}.$$

Ex: 2:

$$(1011001)_2 = (?)_{10}$$

$$\begin{aligned}
 (1011001)_2 &= 1 \times 2^6 + 0 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 \\
 &= 64 + 0 + 16 + 8 + 0 + 0 + 1 \\
 &= (89)_{10}.
 \end{aligned}$$

$$\therefore (1011001)_2 = (89)_{10}.$$

Ex: 3:

$$(10111.10)_2 = (?)_{10}.$$

$$\therefore (10111.10)_2 = (13.5)_{10}.$$

Ex: 1:

$$(110010.11)_2 = (?)_{10}$$

$$\therefore (110010.11)_2 = (50.75)_{10}.$$

Q: Conversion of octal Number to Decimal Number;

Ex: 1:

$$(\underline{\quad \quad})_8 = (?)_{10}$$

$$(507.46)_8 = (?)_{10}.$$

$$\therefore (507.46)_8 = 5 \times 8^2 + 0 \times 8^1 + 7 \times 8^0 + 4 \times 8^{-1} + 6 \times 8^{-2}$$

$$= 5 \times 64 + 0 + 7 + 4 \times \frac{1}{8} + 6 \times \frac{1}{64}$$

$$= 320 + 0 + 7 + 4 + 6 \times \frac{1}{64}$$

$$= 327 + 0.09375$$

$$= (327.09375)_{10}.$$

$$\therefore (507.46)_8 = (327.09375)_{10}.$$

Ex: 2:

$$(540)_8 = (?)_{10}.$$

$$\therefore (540)_8 = (352)_{10}.$$



Ex: 3:

$$(425)_8 = (?)_{10}$$

$$\therefore (425)_8 = (277)_{10}.$$

Ex: 4:

$$(575.65)_8 = (?)_{10}$$

$$\therefore (575.65)_8 = (381.828125)_{10}.$$

Q1) Conversion of Hexadecimal to Decimal Number:

Ex: $(4CD)_{16} = (?)_{10}$

$$\begin{aligned}\therefore (4CD)_{16} &= 4 \times 16^2 + C \times 16^1 + D \times 16^0 \\ &= 4 \times 16^2 + 12 \times 16^1 + 13 \times 16^0 \quad [\because C=12, D=13] \\ &= 1024 + 192 + 13 = (1299)_{10}\end{aligned}$$

Ex: $(ABC \cdot 56)_{16} = (?)_{10}$

$$\begin{aligned}\therefore (ABC \cdot 56)_{16} &= A \times 16^3 + B \times 16^2 + C \times 16^1 + 5 \times 16^{-1} + 6 \times 16^{-2} \\ &= 10 \times 256 + 11 \times 16 + 12 \times 1 + 5 \times \frac{1}{16} + 6 \times \frac{1}{16^2} \\ &= 2560 + 176 + 12 + 0.3125 + 0.0234375 \\ &= (2748.3359375)_{10}.\end{aligned}$$

Ex: $(3B)_{16} = (?)_{10} \Rightarrow (59)_{10}$

Ex: $(5DC \cdot AF)_{16} = (?)_{10} \Rightarrow (1500.68359375)_{10}.$

Q2) Conversion of Binary Number to octal Number:

Ex: $(10101.11)_2 = (?)_8$

$$\begin{aligned}\therefore (10101.11)_2 &= \begin{matrix} 0 & 1 & 0 & 1 & 0 & 1 & 1 & 1 \end{matrix} \\ &= 2^5 \cdot 5 \cdot 6 \\ &= (25.6)_8.\end{aligned}$$



Ex: $(1011001)_2 = (?)_5$

$$\begin{aligned}\therefore (1011001)_2 &= \begin{matrix} 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 \\ \downarrow & \downarrow & & \downarrow & & & \\ 1 & 2 & & 1 & & & \end{matrix} \\ &= (121)_5.\end{aligned}$$



Ex: $(1101111.11)_2 = (?)_5$

$$= (157.6)_5.$$

Ex: $(1010111.01)_2 = (?)_5$

$$= (127.2)_5.$$

(b) Conversion of Binary Number to Hexadecimal Number:

Ex: $(1101101.101111)_2 = (?)_{16}$

$$\begin{aligned}\therefore (1101101.101111)_2 &= \underbrace{0}_{6} \underbrace{1}_{10} \underbrace{0}_{12} \cdot \underbrace{1}_{10} \underbrace{0}_{12} \\ &= 6 \quad 10 \quad 10 \quad 12\end{aligned}$$

$$= (6 \ A \ B C)_{16}.$$

Ex: $(1001100.111110)_2 = (?)_{16} \Rightarrow (4C.A8)_{16}$

Ex: $(1001001.100001)_2 = (?)_{16} \Rightarrow (49.84)_{16}$

Ex: $(1011001)_2 = (?)_{16} \Rightarrow (59)_{16}.$

Q) Conversion of Hexadecimal Number to octal Number:

Ex: $(5A.2E)_{16} = (?)_8$

$$\begin{aligned}\therefore (5A.2E)_{16} &= \begin{matrix} 5 & A & 2 & E \\ & \downarrow 10 & & \end{matrix} \\ &= 0101 \quad 1010 \quad 0010 \quad 1100 \\ &= (01011010.00101100)_2 \\ &= \boxed{001} \boxed{011} \boxed{00} \cdot \boxed{001} \boxed{011} \boxed{000} \\ &= 1 \quad 3 \quad 2 \cdot 1 \quad 3 \quad 0 \\ &= (132.13)_8.\end{aligned}$$



Ex: $(ABC)_{16} = (?)_8$

$$\therefore (ABC)_{16} = (5274)_8.$$

Ex: $(2A)_{16} = (?)_8$

$$\therefore (2A)_{16} = (52)_8.$$

Ex: $(DADA)_{16} = (?)_8$

$$\therefore (DADA)_{16} = (155332)_8.$$

[Last]

Q) Conversion octal number to Binary Number: (1)

Ex: $(525.27)_8 = (?)_2$

$$\begin{aligned}\therefore (525.27)_8 &= \begin{matrix} 5 & 2 & 5 & . & 2 & 7 \\ 101 & 010 & 101 & & 010 & 111 \end{matrix}\end{aligned}$$

$$= (101010101.010111)_2$$

Ex: $(457.36)_8 = (?)_2$

$$\therefore (457.36)_8 = (10001111.011110)_2$$

Ex: $(526.14)_8 = (?)_2$

$$\therefore (526.14)_8 = (101010110.001100)_2$$

Ex: $(126.04)_8 = (?)_2$

$$\therefore (126.04)_8 = (010011110.000100)_2$$

Conversion of Hexadecimal to Number to Binary Number:

Ex: $(5A.2C)_{16} = (?)_2$

$$\begin{aligned}\therefore (5A.2C)_{16} &= \begin{matrix} 5 \\ \downarrow \\ 0101 \end{matrix} \cdot \begin{matrix} A \\ \downarrow \\ 1010 \end{matrix} \cdot \begin{matrix} 2 \\ \downarrow \\ 0010 \end{matrix} \begin{matrix} C \\ \downarrow \\ 1100 \end{matrix} \\ &= (01011010.00101100)_2\end{aligned}$$

Ex: $(2A)_{16} = (?)_2 \Rightarrow (00101010)_2$

Ex: $(ABC.DE)_{16} = (?)_2 \Rightarrow (101010111100.11011110)_2$

Ex: $(ABBA)_{16} = (?)_2 \Rightarrow (1010101110111010)_2$

Conversion of octal number to Hexadecimal Number:

Ex: $(525.27)_8 = (?)_{16}$

$$\begin{aligned}\therefore (525.27)_8 &= 5 \quad 2 \quad 5 \quad \cdot \quad 2 \quad 7 \\ &= 101 \quad 010 \quad 101 \quad \quad 010 \quad 111\end{aligned}$$

$$= (10101010 \cdot 010111)_2$$

$$= \boxed{1} \quad \boxed{0} \quad \boxed{1} \quad \cdot \quad \boxed{0} \quad \boxed{1} \quad \boxed{1} \quad \boxed{0} \quad \boxed{0}$$

$$\begin{aligned}&= 1 \quad 0 \quad 5 \quad 5 \quad \quad 5 \quad 122c \\ &= (155.5C)_{16}\end{aligned}$$

24

$$\underline{\text{Ex:}} \quad (407 \cdot 36)_8 = (?)_{16} \Rightarrow (107 \cdot 73)_{16}$$

$$\underline{\text{Ex:}} \quad (113)_8 = (?)_{16} \Rightarrow (4B)_{16}$$

$$\underline{\text{Ex:}} \quad (257)_8 = (?)_{16} \Rightarrow (AF)_{16}$$

Conversion of Decimal Number to Binary Number

$$\underline{\text{Ex:}} \quad (25)_{10} = (?)_2$$

$$\therefore \begin{array}{r} 2 \overline{) 25} \\ 2 \overline{) 12} - 1 \\ 2 \overline{) 6} - 0 \\ 2 \overline{) 3} - 0 \\ 2 \overline{) 1} - 1 \\ 0 - 1 \end{array} \quad \begin{array}{l} \text{Least significant bit} \\ \text{Least significant bit} \\ \text{Most significant bit} \end{array}$$

$$\therefore (25)_{10} = (11001)_2$$

25

$$\underline{\text{Ex:}} \quad (28 \cdot 125)_{10} = (?)_2$$

$$\therefore 28 + 0 \cdot 125$$

$$\begin{array}{r} 2 \overline{) 28} \\ 2 \overline{) 14} - 0 \\ 2 \overline{) 7} - 0 \\ 2 \overline{) 3} - 1 \\ 2 \overline{) 1} - 1 \\ 0 - 1 \end{array}$$

$$\begin{aligned} 0 \cdot 125 \times 2 &= 0 \cdot 250 \rightarrow 0 \\ 0 \cdot 250 \times 2 &= 0 \cdot 50 \rightarrow 0 \\ 0 \cdot 50 \times 2 &= 1 \cdot 00 \rightarrow 1 \end{aligned}$$

$$\therefore (28 \cdot 125)_{10} = (11100 \cdot 001)_2$$

$$\therefore (2xy)_{10} = (3xy)_8$$

$$\sqrt{3} - \frac{\sqrt{3}}{2}$$

$$\overline{E_{\mu\nu}}(x) = \overline{e_\mu}(x) e_\nu$$

Conversion of Dr. Carl Kierkegaard to Christianity

$$Y_{\dots,0110,\cdot} \left(= Y_{12}\right) = \phi(\omega_1) \Big/ \overline{\phi}$$

$\text{H}_2\text{O} + \text{CO}_2 = \text{H}_2\text{CO}_3$

$$\therefore (250 \cdot 20)_{\mu} = (1111000 \cdot 00110 \cdots)_{\mu}$$

250 + 0.20

卷之三