

UNIT-4

Overview of Computer Architecture and Organization

★ Definition of Computer Architecture:-

⇒ Computer Architecture is the designing of computer and its different parts. It deals with the working of different parts of the computer, how they are interconnected in computer, how they perform data communication etc. A computer architecture depends on the type of computer and its working. There are different architectures designed for different types of computers. The architecture of personal computer, work stations and super computers all differs from one another.

★ Definition of Computer Organization:-

⇒ A computer organization is a very very large field. It takes care of all the designing, development, data communication and making rules and regulations for proper working of computer industry. It is an apex body to develop design and control all the issues related with proper working and functioning of computers.

★ Structural Components of Computer System:-

CPU:-

⇒ It stands for Central Processing Unit. The CPU has three main sections -

i) Arithmetic and Logic Unit (ALU)

- ii) Control unit and ALU
 iii) Accumulator and general and special purpose registers.

i) Arithmetic and Logic Unit (ALU):-

⇒ The function of ALU is to perform Arithmetic and logical operation. Arithmetic operation (+, -, *, /) and logic operations (>, <, >=, <=, ==, !=).

ii) Control unit:-

⇒ The Control unit of a CPU controls the entire operation of a computer. This Control unit acts as a brain of computer. It also controls all other devices such as memory, I/O devices etc. It fetches instructions from the memory and decodes those instructions, interprets those instructions and performs suitable tasks. It gives order to ALU what operations are to be performed.

iii) Accumulators and general purpose registers:-

⇒ The CPU contains large no. of registers to store data temporarily during the execution of a program.

The general purpose registers are used to store data and intermediate results during the execution of a program. They are accessible to users through instructions.

Accumulator is the most important general purpose register having multiple functions. It is most efficient in data movement, arithmetic and logic operations.

Its function depends on the design of the Processor.

Main Memory:-

⇒ All computers accept very small computers contain both semiconductor as well as magnetic memory. The semiconductor memory is used as the main memory or, Primary memory of the computer system. The main memory is used to store the programs and data which are currently required by the CPU. The CPU communicates directly with the main memory. The main memory is very costly so, the size of main memory is much smaller as compare to second memory as the CPU uses semiconductor technology and has very high speed therefore its matching memory must be very fast. Thus, the main memory uses semiconductor technology. RAM and ROM IC are used as the main memory of computer. RAM is a volatile memory it means it contains gets erased once the power is switched off and ROM is non-volatile memory it means that its contents will not be erased even if the power is switched off.

I/O:-

⇒ The I/O devices ~~and~~ are Secondary Storage unit of a computer system is called as Peripherals. Input devices are those devices which accept input from the user and convert those data and instructions into binary form which computer

Can understand. There are a large no. of input devices such as Keyboard, mouse, Joystick, Pointing Stick and track ball pad, Scanner, Optical Mark reader (OMR), Optical bar code (OBC), Magnetic int character reader (MCR), voice input system (like Mike), Touch Screen etc.

Those devices which are used to display and give information to the user are known as output devices. These output devices accept input from the computer (CPU) in binary format and convert those input in user understandable format and displays it. Some of the widely used output devices are monitor (CRT, TFT, LCD, PLASMA), Printer, speaker, flatter etc.

★ System Interconnection:-

⇒ It is the connection of wires from one part to another part from which the electricity flows. These interconnective wires are also known as bus or, system bus.

Memory and peripheral devices are connected to the micro processor through a group of lines called as 'Bus'. There are three types of Bus.

i) Address Bus:-

⇒ Address Bus is used to transmit the address of one device to another.

ii) Data Bus:-

⇒ Data Bus is used to transfer data from one device to another.

iii) Control Bus:-

⇒ Control Bus is used to transmit control instructions to the given or specified component of the computer system.

★ Structural Component of CPU (CU, ALU, Registers, CPU interconnection):-

Registers:-

⇒ A CPU contains a number of registers to store data temporarily during the execution of a program. The number of registers differs from processor.

Registers are classified as follows —

i) General register Purpose:-

⇒ These registers store data and intermediate results during the execution of a program. They are accessible to user through instructions of the user is working at assembly language.

ii) Accumulator:-

⇒ It is the most important general purpose register having multiple functions. It is most efficient in data movement, arithmetic and logical operations. Its function depends on the design of the processor.

iii) Special Purpose registers:-

⇒ A CPU contains a number of special purpose registers for different purposes following are the special purpose registers.

- a) Program Counter (PC).
 - b) Stack Pointer (SP).
 - c) Status register (SR).
 - d) Instruction register (IR).
 - e) Index Register (IX).
 - f) Memory address register (MAR).
 - g) Memory Buffer Register (MBR).
- OR
- Data Register (DR).

★ Basic Functions of Computer:-

Data Processing:-

⇒ Data Processing It means the data given to computer is undergoing some operations. These operations can be arithmetic, logical, comparative, trigonometric, etc. Only after processing of the given data the final output is obtained.

Data Storage:-

⇒ Memory is used to store the data and information in a computer system. The stored data can be retrieved later on when required.

Data Movement:-

⇒ A data once taken as an input travels through

different parts before coming out at final result.

Control:

⇒ It means to control the different activities and Programs running on a Computer. It means to control different Hardware components of a Computer System. The control keeps the system properly and makes its function as require.

★ Major components of Computer System:

Hardware:-

⇒ Hardware are those parts of Computer which has its physical existence. Hardware can be seen with our naked eyes, it can be touched and feel. Some of the hardware are - Monitor, keyboard, Mouse, CPU, Speakers - etc.

Software:-

⇒ Software are logical entity we can see and feel but we can't touch it, we can't hold it in our hand. Some of the example of Software are - Adobe Acrobat reader/writer, MS-word, MS-excel, MS-Power Point - etc.

Application Software:-

⇒ Application Software are developed for a particular work to be perform. following are the application Software such as MS-office (MS-word, MS-excel, MS-Powerpoint, MS-access, MS-outlook - etc), C, C++, Java, VB, Oracle - etc.

System Software :-

⇒ System Software are those software which control and govern the overall functioning of computer. It provides support for other applications software. Some of the system softwares are - windows, unix, linux, compiler, interpreter etc.

Compiler :-

⇒ Compiler is a software which is used to read source code of a high level language completely in a single go and convert it into machine level code. If any error occurred it gives suitable message. Compiler is faster than the interpreter and it is more costly also.

The compiler converts high level language written source code into machine level language source code.

Interpreter :-

⇒ An interpreter reads one statement at a time, translates it into machine code; executes it and then goes to the next statement of the program.

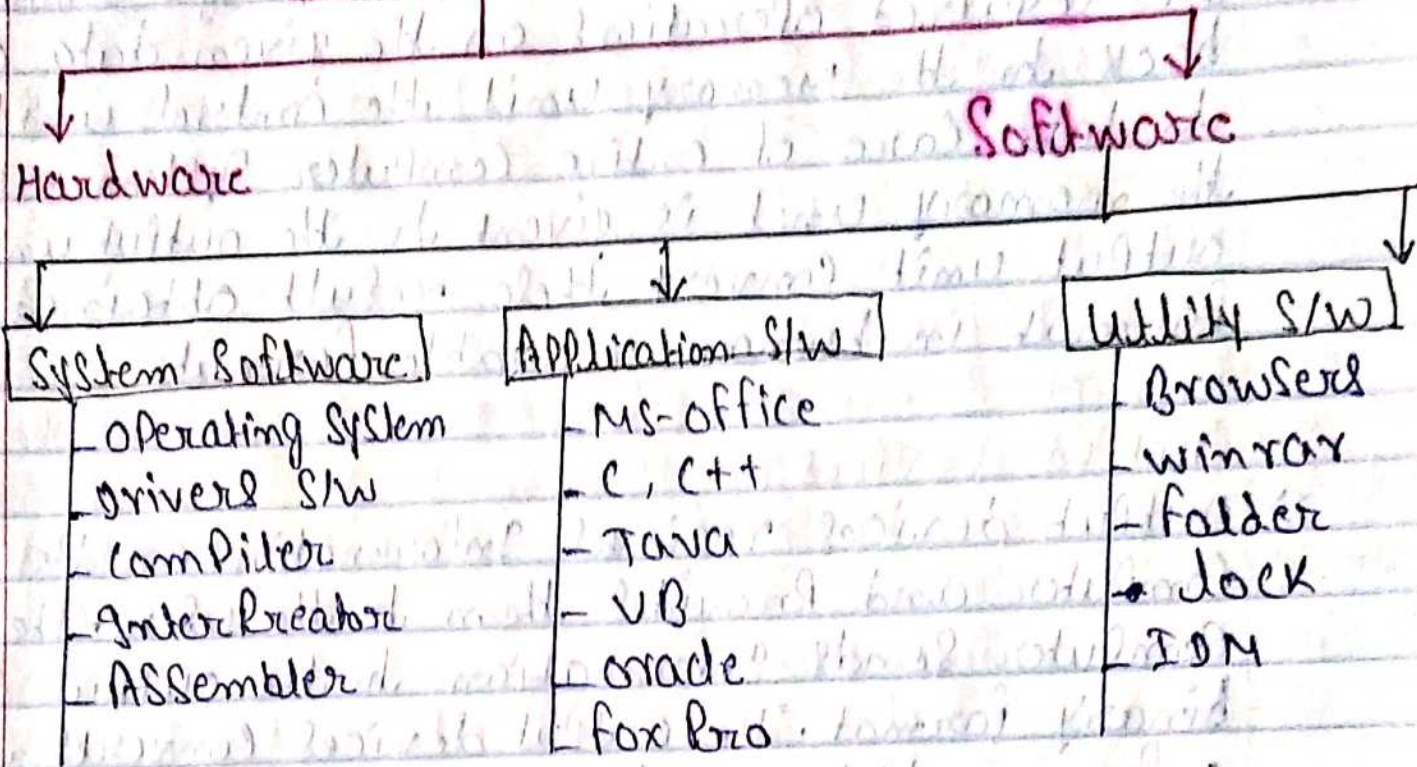
The interpreter converts high level language written source code into machine level language source code.

Assembler :-

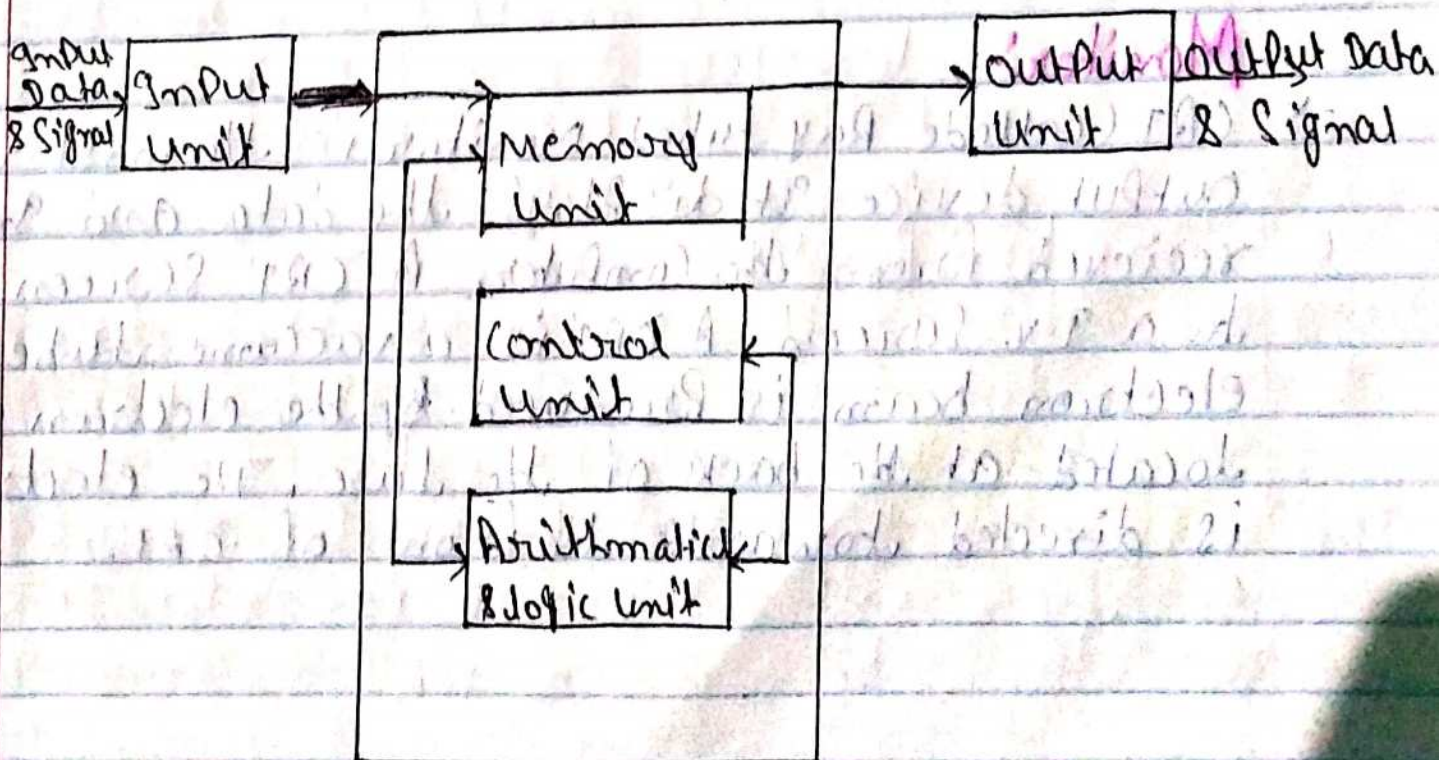
⇒ Assembler is used to execute assembly level language into machine code. It executes the assembly

Program and if any error occurs it will get message otherwise the program will execute and get output.

COMPUTER



★ Basic Block Diagram of Computer:



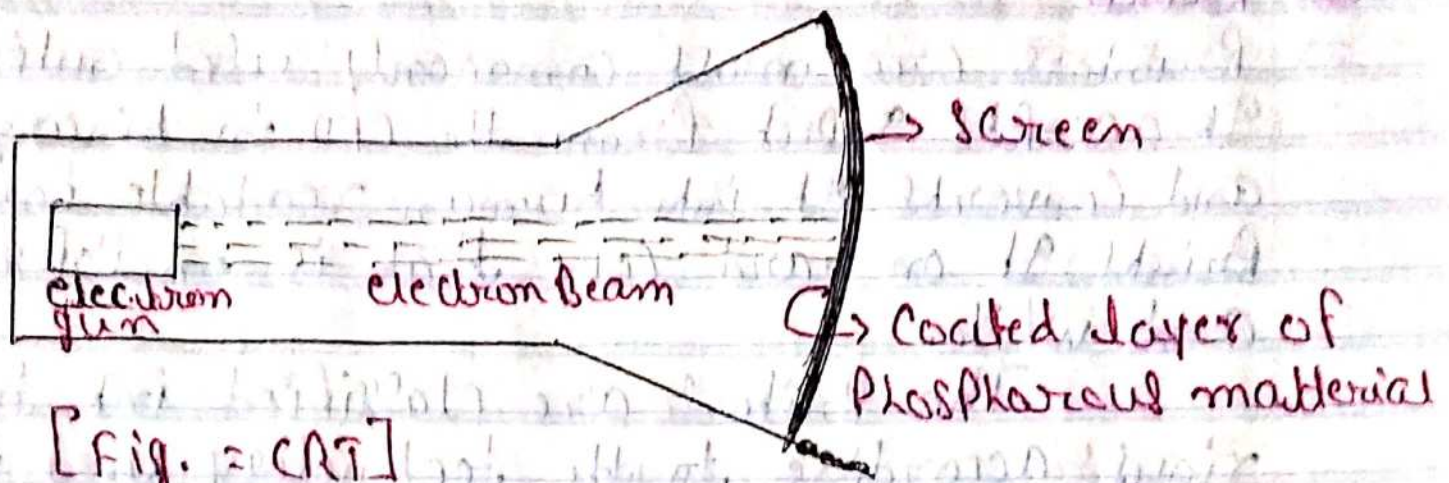
⇒ The Input unit accepts data and signal from the user. It converts these data and signal into binary form and gives it to the memory unit of CPU. Here, the data is decided what operations need to be performed. The Arithmetic, logic unit performs the required operations on the given data and gives back to the memory unit. The control unit is used to take care of entire computer system. The data from the memory unit is given to the output unit. The output unit converts the result obtained in binary format in human readable format.

★ Output Devices:-

⇒ Output devices receive information from the computer and provide them to the user. The computer sends information to the output device in binary format. The output device converts them into a form which can be used by users. Such as printed form or, display on the monitor.

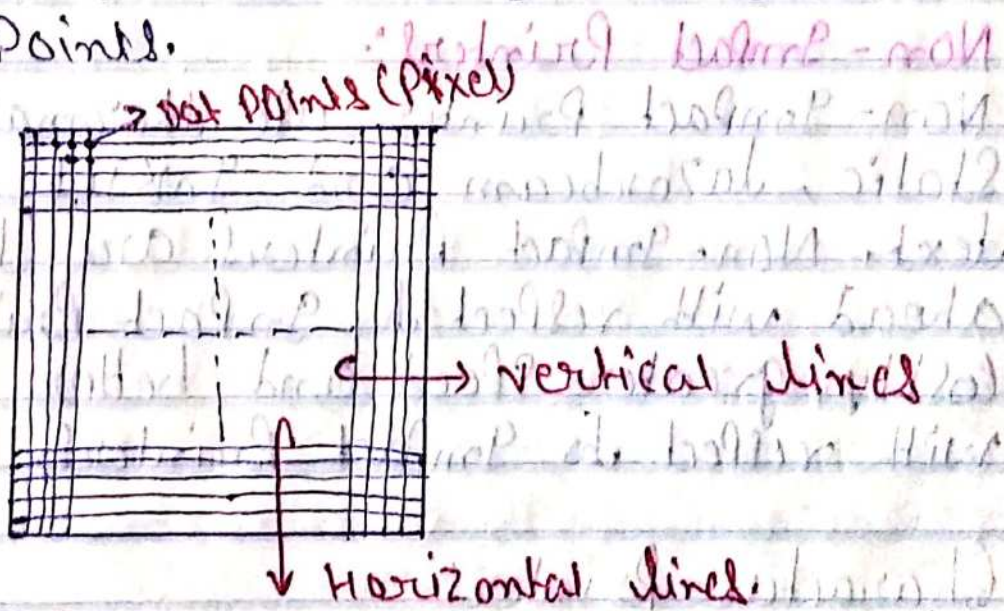
Monitor:-

⇒ CRT (Cathode Ray tube) Monitor is the most widely used output device. It displays the data and information received from the computer. A 'CRT' screen is similar to a T.V. screen. A CRT is a vacuum tube and electron beam is produced by the electron gun located at the back of the tube. The electron beam is directed towards the front of CRT.



[Fig. = CRT]

A coating of Phosphorous material is made on inner surface of the screen. The Phosphorous emitted light when it is struck by electron beam. A "CRT" may be either monochrome (black and white), only one colour, or, multicolour. To produce colour display three Phosphorous red, green and blue are used. The 'CRT' screen are formed no. of data points.



Higher the scanning and density of pixel, better the display and clarity of image.

There are variety of monitors LED (light emitting diode) monitor, Plasma monitor, TFT (Thin film transistor) monitor. TFT monitor provides the best resolution of all the flat panel techniques but it's most expensive.

★ Printers:-

⇒ Printers are most commonly used output device. It accepts input from the CPU in binary format and converts it into human readable format and prints it on hard copy that is on paper in black and white.

The Printers are classified into two categories according to the technology used in their manufacturing.

i) Impact Printers:-

⇒ Impact Printers use "electro mechanical mechanism" that uses hammer and pin to strike against a ribbon and a paper to print the text.

ii) Non-Impact Printers:-

⇒ Non-Impact Printers use thermal, chemical, electrostatic, laserbeam and Inkjet technology to print text. Non-Impact Printers are technologically far ahead with respect to Impact Printers. It is more costly, greater speed and better quality of output with respect to Impact Printers.

● Character Printer:-

⇒ Character Printer prints one character at a time. It is low speed printer. Its printing speed lies between 30 to 600 characters per second depending upon the type of the printer. Character Printers are used with Personal Computers. Printers are used for low volume printing.

- Dot Matrix Impact Type Character Printers:-

⇒ In Dot Matrix Impact Character Printer a character is printed by selected number of dots form a matrix of dots. A Dot Matrix is faster. Its Printing Speed lies between 30-600 CPS (Character Per Second). Dot Matrix is very flexible. It don't have fixed character format. It is also used to print graphics of not very complex nature.

- Ink-Jet Printer:-

⇒ Ink-Jet Printer uses the dot matrix technique to print characters. The Ink-Cartridge contains a column of tiny heaters. When a heater is activated a drop of Ink is exploded onto the paper and desired character or graphics appear.

- Laser Printer:-

⇒ The Laser Printers are Page Printers and entire page is processed at a time. It uses laser beam to produce an image of the page containing graphics on a photo sensitive drum. The drum is coated with negatively charge photo conductive material. An Inbuilt Computer controls the laser beam to turn it on and off when it is sent to the drum.

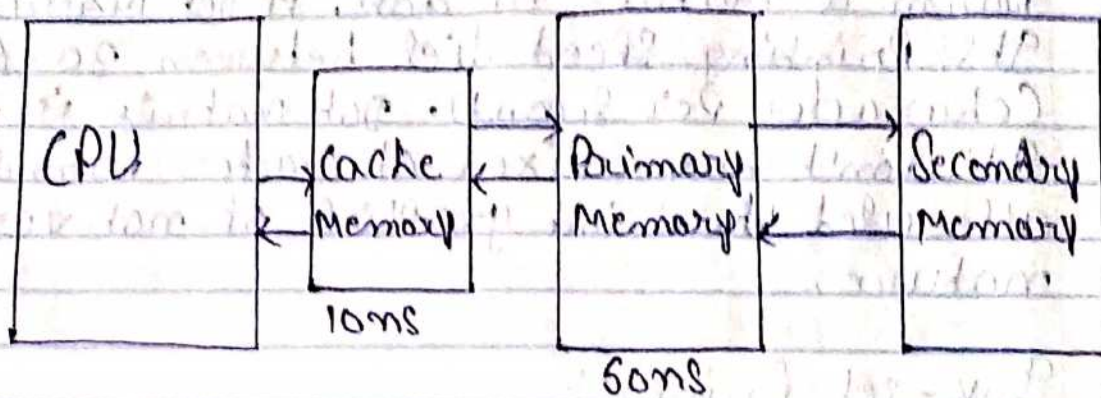
- Plotter:-

⇒ Plotters are output devices as printers. It is used to produce precise and good quality graphics and drawings under computer control. It uses Ink Pen or Inkjet to draw graphics or drawings. The Pen

Can be single or multi-coloured.

★ Cache Memory:-

⇒



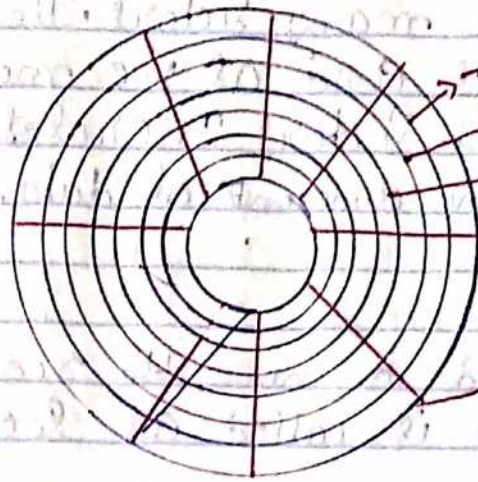
[Fig: Memory Hierarchy with Cache Memory]

The Cache Memory is placed between CPU and main memory. It is a semiconductor memory. It consists of static RAMs. Its access time is 10ns ($1\text{ns} = 10^{-9}\text{sec}$). It means that its access time is much less than the main memory. The access time of main memory is 50ns. The capacity of cache memory is $2-3\%$ of main memory. It stores data and instructions which are to be correctly executed by the CPU. It is used to reduce the average access time for instructions and data which are normally stored in the main memory.

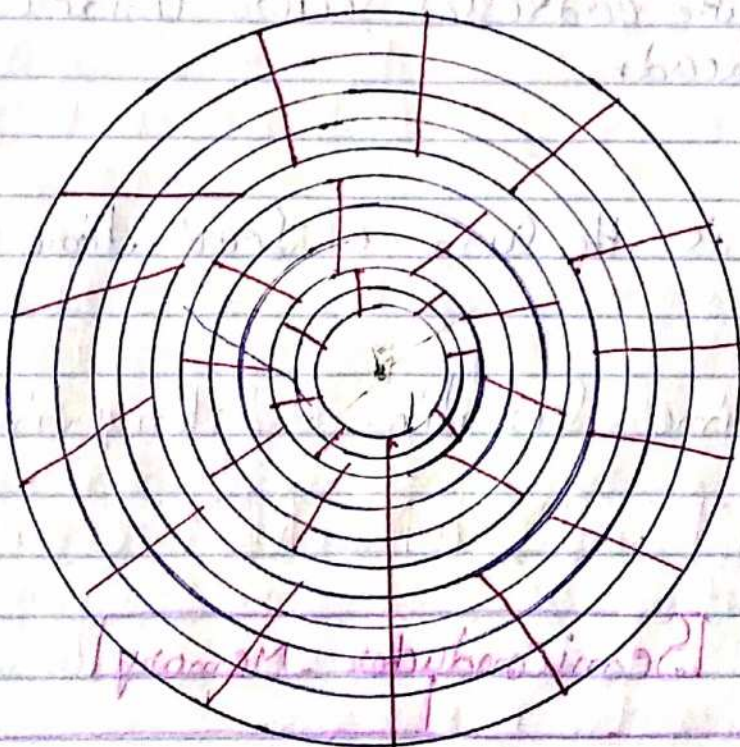
★ Memory Associated Concepts:-

i) Tracks:-

⇒ The circular division of a disk is known as track. A disk can have many no. of tracks. It can be 7, 8, 9, 10, 11, 12 -- etc.



[Fig (a) magnetic disk showing tracks & sectors]



[Fig (b) outer tracks have more sectors than inner tracks]

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ii) Sectors:-

⇒ The division of tracks in Part 1 is known as Sectors. A disk can have many Sectors. The inner tracks have less no. of Sectors and as we move towards outer tracks the no. of Sectors increases. Each Sector in a track stores same amount of data.

iii) Seek time:-

⇒ The time required to move the read/write head to the addressed track is called as Seek time.

iv) Latency time (Search time):-

⇒ Latency time is the time required to bring the starting position of the addressed Sector under the read/write head.

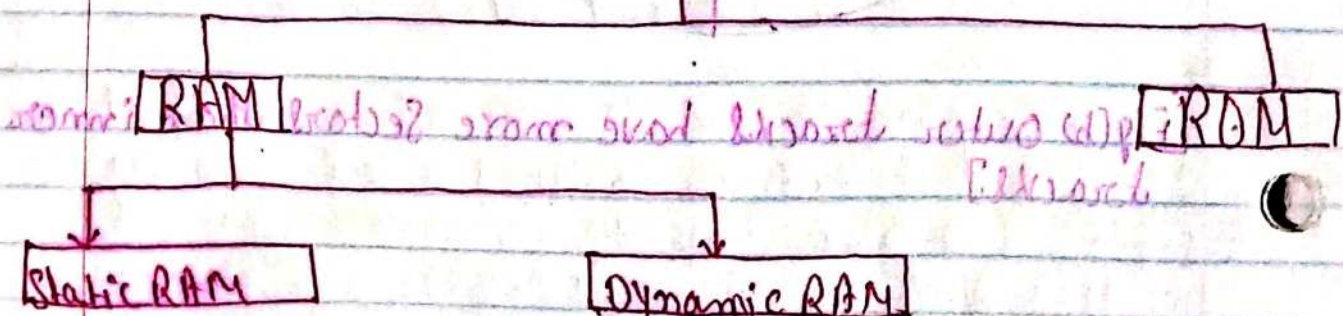
v) Access time:-

⇒ Access time is the sum of Seek time and Latency time.

$$[\text{Access time} = \text{Seek time} + \text{Latency time}]$$

★ Static RAM, DYNAMIC RAM:-

[Semiconductor Memory]



Semiconductor Memories are of two types RAM and ROM. RAM is of mainly two types - **Static RAM** and **Dynamic RAM**.

Static RAM written & stored information as long as the power supply is ON. It means **Static RAM** is volatile in nature. **Static RAMs** are costly and consume more power. It has higher speed than **D-RAMs**. **Static RAM** being faster is used in cache memory. **Static RAM** holds information in flip-flop circuit.

Dynamic RAM uses its store information in a very short time even though the supply is on. **D-RAM** has to be refreshed periodically (at every 2 milli sec). **D-RAMs** are cheaper and consume less power. It is used where large capacity of memory is required.

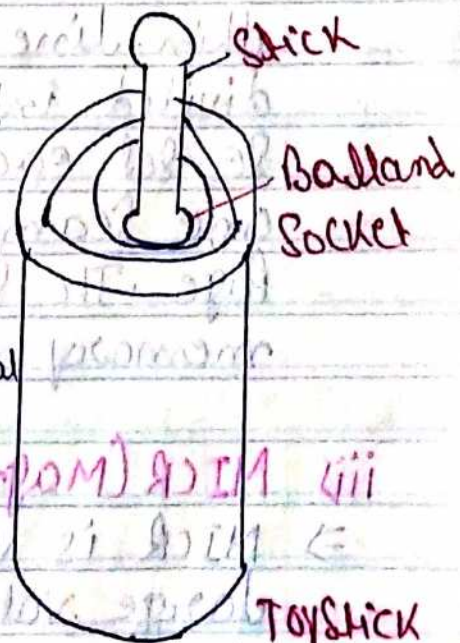
★ Input Devices:-

⇒ Keyboard, mouse, Joystick, MICR, OMR, Scanner

is Joystick:-

⇒ Joystick is also a pointing device.

It is used to move the cursor on a CRT/Monitor screen. Its function is similar to that of a mouse. A Joystick is a stick which has spherical ball at its lower end as well as at its upper end as shown in the figure. The lower spherical ball moves in a socket. The Joystick can be moved right or left, backward or forward.



According to the movement of Joystick the cursor moves on the CRT Monitor Screen. It is used to play videogames.

ii) Scanner:-

⇒ Scanner is an input device which converts pointed text, graphics, pictures -- etc to digital form. Scanners are able to enter information directly into the computer. The advantage of entering information directly into the computer is that the user doesn't have to press keys. This provides faster and more accurate data entry.

Flatbed Scanner:-

⇒ In a flatbed scanner, the page to be scanned is placed over the glass plate. The light source kept below the glass plate which moves from left to right horizontally. Each page is treated as a matrix of dots. Each dot is sensed whether it reflects light or absorbs it. The light source focuses light on very thin line called scan line. The entire page is divided into a no. of scan lines. The scanner senses each scan line one by one after scanning one scan line, the scanner scans the entire page. The scan page is stored in the computer's memory in Bitmap form.

iii) MICR (Magnetic Ink Character Reader):-

⇒ MICR is widely used by banks to process large volume of cheques and deposit forms written everyday. A special ink called magnetic

INK which contains iron oxide particles is used to write characters on the cheque and deposit forms which are to be processed by MICR. The MICR is a device which is capable of reading characters written on a paper with magnetic ink. The magnetic ink is magnetised during the input process. The MICR reads the magnetic pattern of the written characters. To identify the characters these patterns are compared with special patterns stored in the memory. Before cheques are issued to the customers the identification numbers of the bank and the depositor's account numbers are written on the cheque with magnetic ink. When a cheque is entered into MICR, it passes through a magnetic field. The iron oxide particles are magnetised under the magnetic field. It interprets the information and sends the data directly to the computer for further processing. upto 2600 cheques are processed per minute by MICR device.

IV) DMR (Device Master Recorder):-

⇒ A DMR is a compilation of all the instructions, drawings and other related records that must be used to produce a product. It is often referred to as DMR. It contains everything which is required to know to build and make the device. It keeps device specifications, component specifications and software specifications.