

Ref. Book → B.RAM

### \* Microprocessor :- \*

Before 1947 → Vacuum tubes, 1947 → Transistor.

IC (Integrated Circuit) → small scale Integration (SSI) & 10 transistors

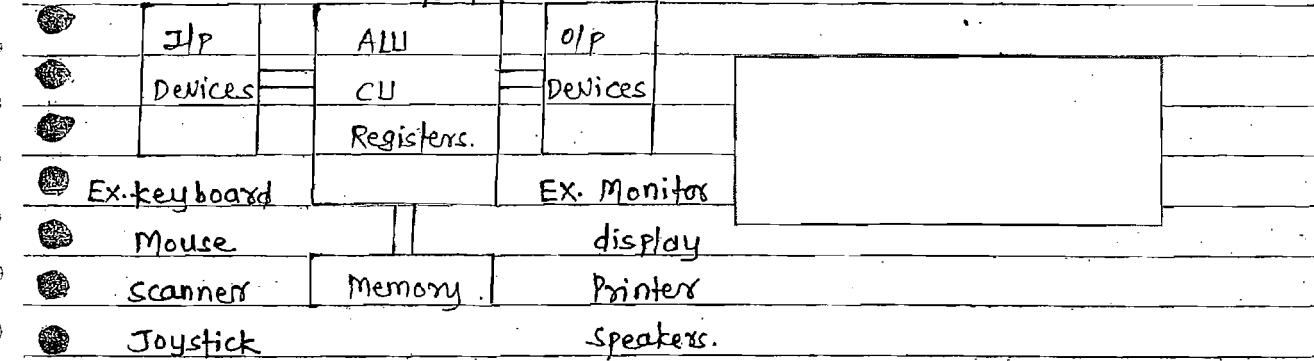
Medium " " (MSI) → 10-100 trans

Large " " (LSI) → 100-10k trans

Very Large " " (VLSI) → >10k trans

### \* Block diagram of a computer :-

CPU/UP



→ UP, it is a semiconductor component designed by VLSI technology and it

contains ALU, CU & Registers of a CPU in a single package.

- For a Basic UP, memory is externally connected. The Registers inside the processor are meant for temporary data storage hence they are not considered as memories.

In latest UP some memory can be present inside to store / Hold frequently used data or Instructions. e.g. cache memory.

### \* Basics for subject :-

• Bit → Binary Digit (0/1)

• Nibble → group of 4 bits

• Byte → group of 8 bits / 2 Nibbles.

• Word length → No. of bits that can be processed by a processor, parallelly at a time & it depends on UP.

- Intel is the first company who integrated ALU, CU and Registers in a single package.

1971 → Intel 4004 → 4 bit UP. (works on two 4 bit datas) ie word length

1972 → Intel 8008 → 8 bit UP. } is 4 bit

1974 → Intel 8080 → 8 bit UP. } Word length of 8 bits / 1 byte

1976/77 → Intel 8085 → 8 bit UP.

1978 → Intel 8086 → 16 bit UP. → Word length of 16 bits / 2 bytes.

8088, 80186, 80286, 8086 (32 bit UP)

Pentium, ..., Dual core, ... (i3, i5, i7) (64 bit UP).

Dual core → single IC of UP internally contains 2 CPU's.

Quad core → " " " " " " 4 CPU's.

Octa core → " " " " " " 8 CPU's.

Deca core → " " " " " " 10 CPU's (2017 launched by Lenovo)

\* Difference between Microprocessor & Microcontrollers :-

Timers or Counters	ALU CU Registers	Memory
		Interfacing circuits.

Microcontroller.

### Microprocessor :-

- It has ALU, CU and Registers.
- No Internal memory
- No Interfacing circuits, Timers & counters.
- Used for general purpose applications.
- Ex. Intel 8085, i7..., MC680, z80 (Zilog), Fairchild, Rockwell, National Semiconductor, Phillips, Toshiba, Qualcomm, Snapdragon.

### Microcontroller :-

- It has ALU, CU and Registers.
- Has internal / on board memory.
- Has interfacing ckt., Timers / counters.
- Used for specific purpose applications.
- Ex. TMS 1000 (4 bit), Intel 8051 (8 bit), Intel 80196 (16 bit), AT89C51, Motorola Phillips, Toshiba, Dallas Semiconductors PIC → 8 bit & 16 bit.

- Depending on how programmes and data are stored in a memory, there are two types of architecture → i) Von-Neumann / Princeton Architecture.  
ii) Harvard Architecture.

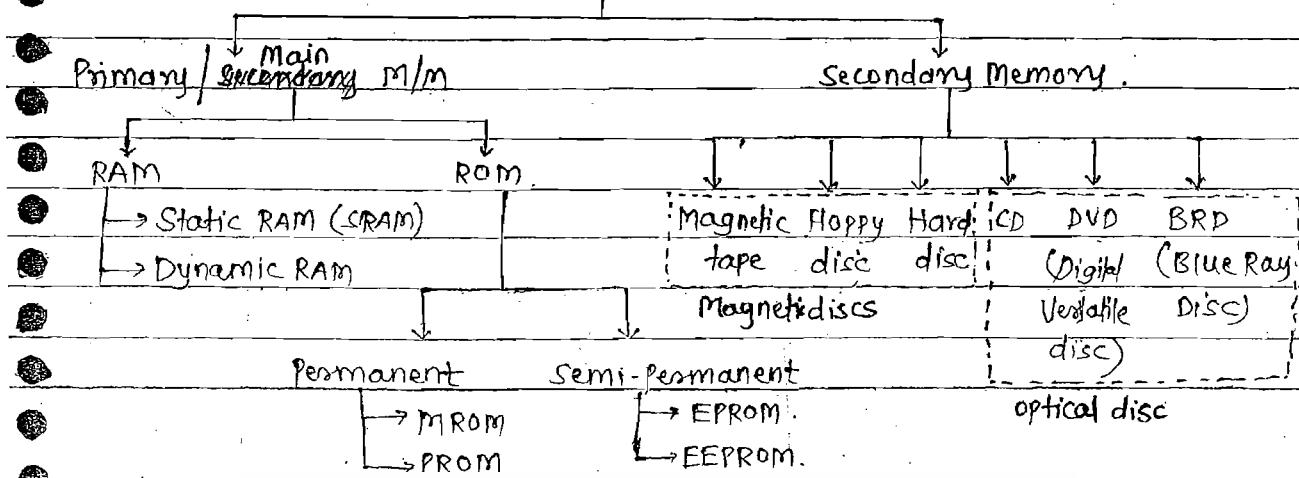
→ Von Neuman architecture uses the same memory for data & programme.  
Ex - Intel 8085 & Intel 8086 Microprocessors.

→ Harvard architecture uses the different memories for data (RAM) & programmes (ROM).

Ex - Intel 8051 Microcontroller.

### \* Memory :-

#### - Memory :-



## Secondary Memories :-

- Magnetic tape, Floppy disc and Hard discs → Magnetism principle for storing data.
- CD, DVD, BRD → optical / Light principle for storing data.  
CD → 700 MB ; DVD → 4.7 GB / 15 GB ; BRD → 25 GB / 50 GB.
- for writing → High intensity Light is used. (writing is called burning).
- for reading → Low intensity Light is used.
- Depending on the wavelength of light, storage capacity is decided.  

(Wavelength of light) $\propto$	1	CD → 780 nm,
		DVD → 635 nm, BRD → 485 nm
- data '1' is stored as 'pit' and data '0' is stored as 'blank'.
- In case Rewritable discs, alloys are used as materials. For writing and erasing also high intensity light is used.

## \* Primary Memories :-

- Both RAM & ROM are Random Accessible memories. ie time taken to access any of the memory location is same

### » RAM (Random Access Memory) :-

- It is also known as Read-Write / temporary / volatile memory.
- The data is present only with supply of power.

#### Static RAM (SRAM) :-

- Data is stored as Voltage
- Flipflops are used.
- 1 memory cell may have 3-6 transistors ie. 2BJT's & 2 Registers or 4 MOS Transistors.
- Less density / storage capacity.
- faster than DRAM
- More power consumption & cost.

#### Dynamic RAM (DRAM) :-

- Data is stored as charge between gate to substrate of a MOS transistor as charge leaks off, it must be refreshed frequently.
- 1 memory cell have only one transistor.
- more density / storage capacity
- slow in operation.
- less power consumption and cost.

Ex. used in Laptops.

### ⇒ ROM (Read Only Memory) :

- It is also known as Permanent / Non volatile memory.

ROM

Permanent (P)

SP (semi permanent)

MROM

PROM / OTPROM

EPROM

EEPROM

- fixed memory by manufacturer.
- one time only programmable
- Erasable Memory (UV light is used for Erasing)
- Electrically erasable (10 msec to erase 1 byte data.)
- only whole data is erased
- single byte / All data can be erased

• Flash Memory → very less time to erase the data (1 byte takes 10 usec.)

Ex Pendrive (Pendrive is secondary memory only but it is derivative of EEPROM).

### Cache Memory :

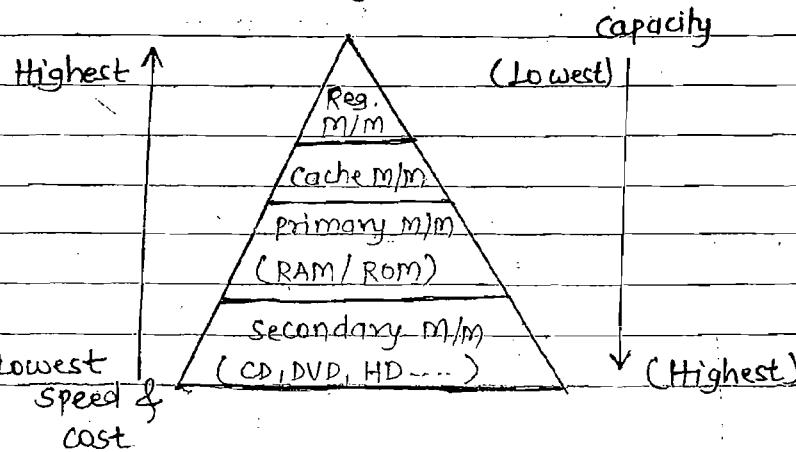
- used to store frequently used data.

- It is used between main memory & microprocessor.

Level 1 Cache → < 64 KB

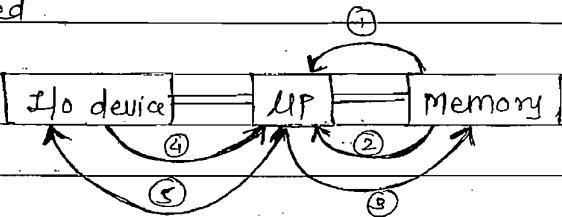
Level 2 Cache → < 2 MB.

### \* Memory Hierarchy :



### \* Basic operations of microprocessor :-

- programme → set of instructions. Instructions are the opcodes (operational codes) which is group of binary code used to perform specific task
- Basic operation of MP is also called as machine cycles.



#### 1) opcode fetch :-

- Reading / Accessing instruction i.e. opcode / operation code from memory into processor. (In some instruction execution may also be completed in fetch operation.)

#### 2) Memory Read :-

- Reading / Accessing data from memory.

#### 3) Memory Write :-

- sending / Transferring data to memory.

#### 4) I/O Read :-

- Reading / Accessing data from I/O ports or I/O devices.

Port indicates connection of an I/O device

#### 5) I/O Write :-

- sending / Transferring data to I/O port.

[As seen MP does two basic operations only Read & write either with respect to memory or I/O devices]

### \* Number Systems :-

Decimal :-	Binary :-	Octal :-	Hexadecimal :-
- Base 10.	- Base 2	- Base 8	- Base 16.
0	0 → (0) <sub>10</sub>	0 → (0) <sub>10</sub>	0 → (0) <sub>10</sub>
1	1 → (1) <sub>10</sub>	1	1
2	10 → (2) <sub>10</sub>	2	2
3	11 → (3) <sub>10</sub>	3	3
4	100 → (4) <sub>10</sub>	4	A → (10) <sub>10</sub>
			B → (11) <sub>10</sub>
			C → (12) <sub>10</sub>
			D → (13) <sub>10</sub>
			E → (14) <sub>10</sub>
			F → (15) <sub>10</sub>

• Converting decimal value to other number system.

Method → 1) divide the decimal value with base of required number system  
and consider the remainder from last to first.

$$\underline{\text{Ex}} \rightarrow (14)_{10} \rightarrow (?)_2$$

$$\begin{array}{r} 2 | 14 \\ 2 | 7 \quad 0 \\ 2 | 3 \quad \{ 1 \\ 2 | 1 \quad \uparrow \\ 0 \quad 1 \end{array}$$

$$\underline{\text{Ex}} \rightarrow (79)_{10} \rightarrow (?)_H$$

$$\begin{array}{r} 16 | 79 \\ 16 | 4 \quad 15 = F \uparrow \\ 0 \quad 4 \end{array} \therefore (79)_{10} = (4F)_H$$

• Converting other Number system to decimal value

Method →

• Addition of Hexadecimal Numbers:

Tip 1 → 'F' plus anything is written as  $^1\cancel{F}$  (that no. minus 1)

$$\underline{\text{Ex: }} 1) \ F \ H$$

$$(8) \rightarrow \text{minus } 1 = 7$$

$$17 \cancel{F}$$

$$2) \ F \ H$$

$$9 \ H$$

$$(18) \ H$$

$$3) \ F \ H$$

$$4 \ H$$

$$(13) \ H$$

Tip 2 → '10 H' plus 'x H' is written as '1x' H

$$\underline{\text{Ex: }} \begin{array}{r} 10 \ H \quad 10 \quad B \\ 8 \ H \quad F \end{array}$$

$$18 \ H \quad 1F \ H$$

Ex.  $B_4 D_7 H$

+  $5_1 6 A H$

$(10641)_H$

{ 1's compl

que:- Find the 1's complement of given Binary no.  $(01110100)_2$

$\rightarrow 01110100$

+  $1000\bar{1}011 \rightarrow 1^{\text{'}}\text{ complement}$

+ 1

$(10001100) \rightarrow 2^{\text{'}}\text{ complement} = 1^{\text{'}}\text{ complement} + (1) \text{ at LSB}$

In general,  $n^{\text{'}}\text{ complement} = (n-1)^{\text{'}}\text{ complement} + 1$

'n's complement means -ve value of that number.

que:- find  $(-74)_H$  ?

$\rightarrow (-74)_H$  means 16's complement of  $74 = 15^{\text{'}}\text{ complement} + 1$

:  $FF H$

-  $74 H$

$8B \rightarrow 15^{\text{'}}\text{ complement}$

+ 1

$8C H$

$\therefore (-74)_H = (8C)_H$

short cut method  $\rightarrow$  subtract the 'LSB' from 16 (ie  $(10)_H$ ) and Remaining bits from F

Ex find  $(-3A.D7)_H = ?$

F	F	F	$(10)_H$
- 3	A	D	7
C	S	2	<u>9 H</u>

que:- solve :-

1)  $83 H$       2) microprocessor will do like  $83 + (-29)_H$

-  $29 H$

$5A H$

## \* System Bus :- \*

- Bus is a group of conductors / wires used for communication between processor, memory and I/O devices.

- There are 3 types of Buses : 1) Address bus 2) Data bus 3) Control Bus.

### 1) Address Bus :

Purpose → i) It is used to transfer the address of memory, I/O device from memory.

ii) It defines the max. memory that can be connected or interfaced with the processor given by

$$2^n = N \quad n = \text{No. of address lines.}$$

$N = \text{No. of addresses / memory location}$

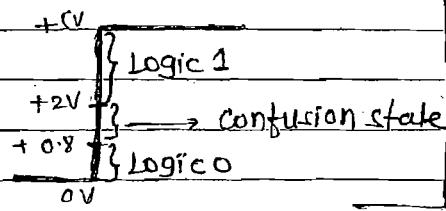
Length → It is of 16 bits in length for 8085 CPU.

- Length of address bus is given in no. of bits because each line is able to carry 1 bit (0/1) at a time.

Transistor-Transistor Logic (TTL) :-

- To avoid confusion state

a tristate buffer is used



Direction → Address bus is unidirectional.

### \* Memory :

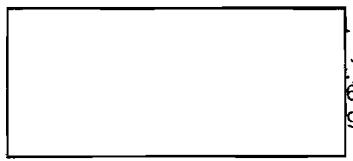
- Memory is a group / set of Registers. A Register is a group of flip-flops.

A flip-flop is a memory cell which can store a 1 bit (0/1).

- Most of the semiconductor memories are designed to store / hold 8 bits

per each Register / Memory location / Address : Memory is represented in terms of bytes.

- Standard word length of memory is 1 byte / 8 bits.



• Relations between address lines & memory :-

'n' address lines will address ' $2^n$ ' memory locations.

Ex 10 Address lines  $\rightarrow 2^{10} = 1024$  Bytes = 1 KB.

20 Address lines  $\rightarrow 2^{20} = 1$  MB. (Mega Byte)

30 Address lines  $\rightarrow 2^{30} = 1$  GB. (Giga Byte)

40 Address lines  $\rightarrow 2^{40} = 1$  TB (Tera Byte)

Ques:- A processor has 22 address lines find the max. memory can be interfaced.

$\rightarrow 2^{22} \rightarrow 2^9 \cdot 2^{10} \Rightarrow 4$  MB. Memory can be interfaced.

Ques:- The max. memory that can be interfaced with 512 TB processor find address lines.

$$2^n = 512 \times 2^{40} = 2^{49}$$

$n = 49 \rightarrow 49$  address lines.

Ques:- It is required to interface a memory of 100 GB to a processor find the min. address lines required.

$$100 \text{ GB} = 100 \times 2^{30}$$

As near to 100, 128 is the nearest value which is  $2^7$ 's power

$30 + 7 \rightarrow 37$  min. lines are required for interfacing 100 GB Memory.

Max. Memory that can be interfaced / connected with 8085 UP is  
 $2^{16}$  Bytes = 64 KB = 65,536 bytes.

Note:-

With respect to memory, there is no difference between opcode and data

both are present in binary. When 16 bit address is placed on address bus

from UP, based on the internal decoding logic of memory one Register selected.