# MADE EASY
# ELECTRONICS ENGINEERING
## MICROPROCESSOR
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- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

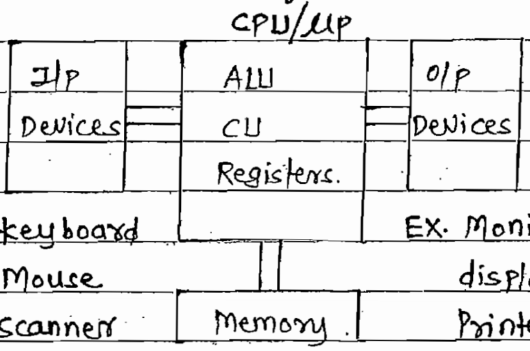
Ref. Book → B.RAM

## * Microprocessor :- *

Before 1947 → Vaccum tubes, 1947 → Transistor.

IC (Integrated Circuit) → Small Scale Integration (SSI) < 10 transistor
Medium " " (MSI) → 10-100 trans
Large " " (LSI) → 100-10k trans
Very large " " (VLSI) → >10k trans

### * Block diagram of a computer :-



Ex. keyboard
Mouse
Scanner
Joystick

Ex. Monitor
display
Printer
Speakers.

→ μp. it is a semiconductor component designed by VLSI technology and it contains ALU, CU & Register of a CPU in a single package.

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

In latest μp some memory can be present inside to store / Hold frequently used data or Instructions eg 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, parallely at a time & it depends on μp.

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

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

1972 → Intel 8008 → 8 bit µP.

1974 → Intel 8080 → 8 bit µP.

1976/77 → Intel 8085 → 8 bit µP.

} Word length of 8 bits / 1 byte

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

8088, 80186, 80286, 80886 (32 bit µP).

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

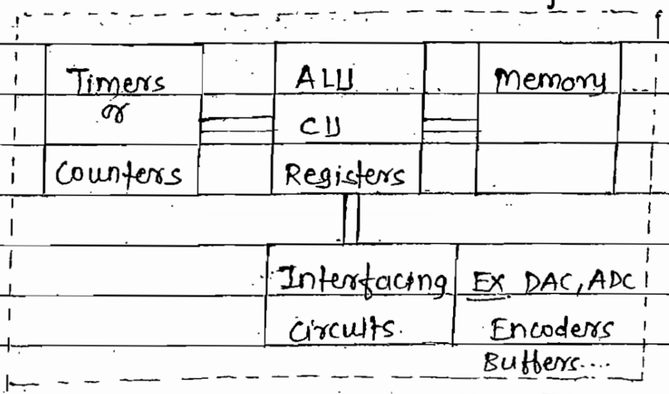
Dual core → single IC of µP internally contains 2 CPU's.

Quad core → " " " " " " 4 CPU's.

Octa core → " " " " " " 8 CPU's.

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

* Difference between µprocessor & µcontrollers :-



Microcontroller.

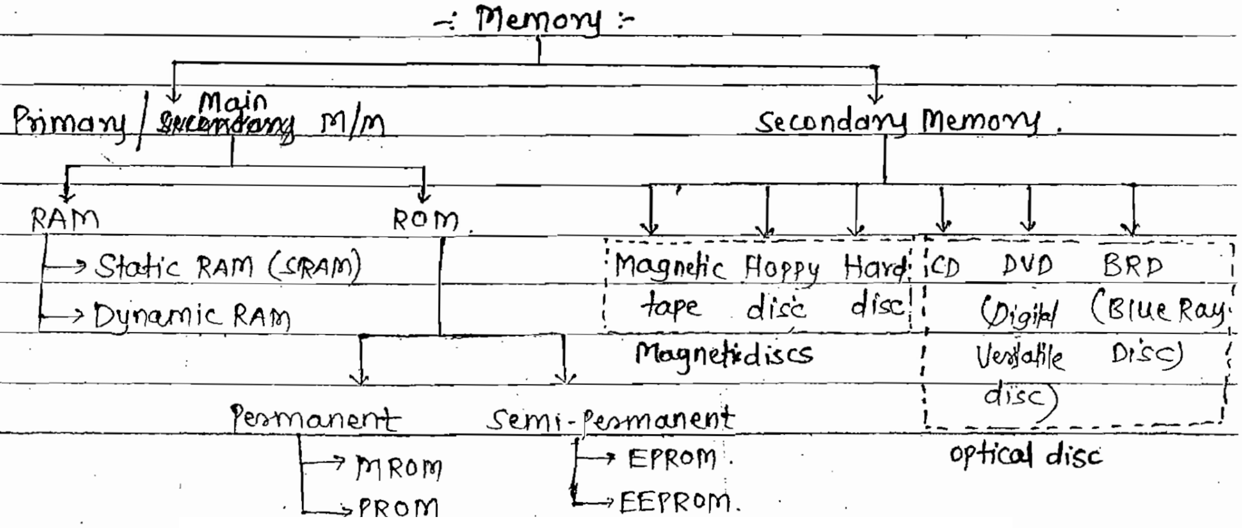
| Microprocessor :- | Microcontroller :- |
|---|---|
| → It has ALU, CU and Registers. | → It has ALU, CU and Registers. |
| → No Internal Memory | → Has Internal / on board memory. |
| → No Interfacing circuits, Timers & counters. | → Has interfacing ckts, Timers / counters. |
| → Used for general purpose applicatⁿ. | → Used for specific purpose applications |
| → Ex. Intel 8085, i7 ...., MC680, Z80 (Zilop), Fairchild, Rockwell, National semiconductor, Phillips, Toshiba Qualcomm, Snapdragon. | → Ex. TMS 1000 (4 bit), Intel 8051 (8bit 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 μprocessors.

→ Harvard architecture use the different memories for data (RAM) & Programmes (ROM).
Ex – Intel 8051 μcontroller.

* 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.

$$(\text{Wavelength of light}) \propto \frac{1}{(\text{Storage Capacity})}$$

CD → 780 nm,
DVD → 635 nm, BRD → 405 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 Data accessible memories. ie time taken to access any of the memory location is same

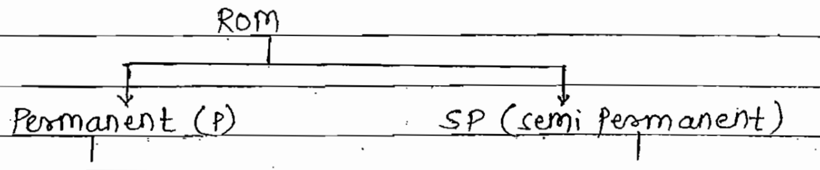
### i) RAM (Random Access Memory) :-

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

| Static RAM (SRAM) :- | Dynamic RAM (DRAM) :- |
|---|---|
| → Data is stored as Voltage<br>→ Flipflops are used.<br>→ 1 memory cell may have 3-6 transistors ie. 2 BJT's & 2 Registers or 4 Mos Transistors.<br>→ Less density / storage Capacity.<br>→ Faster than DRAM<br>→ More power consumption & cost. | → Data is stored as charge between gate to substrate of a Mos transistor as charge leaks off, it must be refreshed frequently.<br>→ 1 memory cell have only one transistor.<br>→ More density / storage capacity<br>→ slow in operation.<br>→ less power consumption and cost.<br>Ex. used in Laptops. |

## 2> ROM (Read Only Memory) :-

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



| MROM | PROM/OTROM | EPROM | EEPROM. |
|---|---|---|---|
| - fixed memory by manufacturer. | - One time only Programmable | - Erasable memory (UV light is used for Erasing)<br>- only Whole data is erased | - Electrically erasabl<br>- 10 msec to erase 1 byte data.<br>- sing byte /All data can be erased |

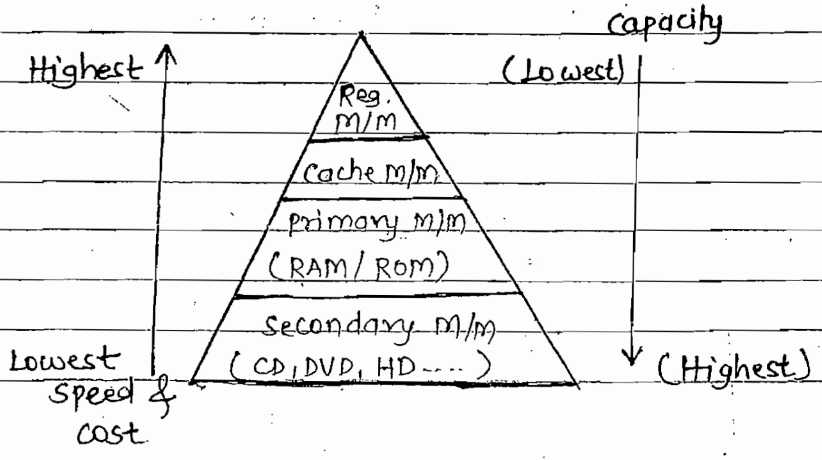
• Flash Memory → very less time to erase the data (1 Byte takes 10 usec.)
Ex pendrive ('Pendrive is secondary memory only but it is derivative of EEPROM).

## Cache Memory :-

- used to store frequently used data.
- It is used between main memory & microprocessor.

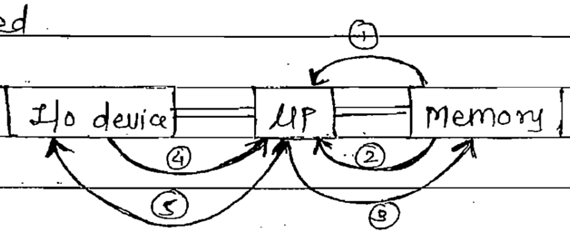
Level 1 cache → < 64 KB
Level 2 cache → < 2 MB.

## * 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 µp is also called as machine cycles.



1) Opcode fetch :-
- Reading / Accessing instruction ie. opcode / operation code from memory into processor. (In some instruction excecution may also be completed in fetch operation.)

2) Memory Read :-
- Reading / Accessing data from memory.

3) Memory Write :-
- sending / Transfering 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 / Transfering data to o/p port.

[As seen µp does two basics 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 ⟶ $(0)_{10}$ | 0 ⟶ $(0)_{10}$ | 0 ⟶ $(0)_{10}$ |
| ↓ | 1 ⟶ $(1)_{10}$ | ↓ ⋮ | ↓ |
| 9 | 10 ⟶ $(2)_{10}$ | 7 ⟶ $(7)_{10}$ | 9 ⟶ $(9)_{10}$ |
| 10 | 11 ⟶ $(3)_{10}$ | 10 ⟶ $(8)_{10}$ | A ⟶ $(10)_{10}$ |
| 11 | 100 ⟶ $(4)_{10}$ | 11 ⟶ $(9)_{10}$ | B ⟶ $(11)_{10}$ |
| | | | C ⟶ $(12)_{10}$ |
| | | | D ⟶ $(13)_{10}$ |
| | | | E ⟶ $(14)_{10}$ |
| | | | F ⟶ $(15)_{10}$ |

- converting decimal value to other number system.

**method** → 1) divide the decimal value with base of required of no. system and consider the Reminder from Last to first.

EX → $(14)_{10} \longrightarrow (\underline{\ ?\ })_2$

| | | |
|---|---|---|
| 2 | 14 | |
| 2 | 7 | 0 |
| 2 | 3 | 1 |
| 2 | 1 | 1 ↑ |
| | 0 | 1 |

$\therefore (14)_{10} \equiv (1110)_2$

EX:- $(79)_{10} \longrightarrow (\underline{\ ?\ })_H$

| | | |
|---|---|---|
| 16 | 79 | |
| 16 | 4 | 15 = F ↑ |
| | 0 | 4 |

$\therefore (79)_{10} \equiv (4F)_H$

- Converting other Number system to decimal value.

**method** →

- Additional of Hexadecimal Number ~~sys~~ :

**Tip 1** → 'F' plus anything is written as carry 1 & (that no. minus 1)

EX:- 1)
F H
⑧ → minus 1 = ⑦
17 H

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

Ex:-
10 H
8 H
18 H

10
F
1F H

B

EX. B 4 D 7 H
+ 5 1 6 A H

$(10641)_H$

que:- Find the 1's complement & 2's compl of given Binary no. $(01110100)_2$

→ 0 1 1 1 0 1 0 0

↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓

1 0 0 0 1 0 1 1 → 1's complement

\+ 1

(1 0 0 0 1 1 0 0) → 2's complement = 1's complement + (1) at LSB.

In general, n's complement = (n-1)'s complement + 1

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

que:- find (- 74 H) ?

→ (-74) H means 16's complement of 74 = 15's complement + 1

∴ FF H

\- 74 H

8B → 15's complem

\+ 1

8C H ∴ $(-74)_H = (8C)_H$

short cut Method → subtract the 'LSB' from 16 [ie $(10)_H$] and Remaining bits from F

EX. find $(-3AD7)_H$ = ?

F | F | F | $(10)_H$

\- 3 | A | D | 7

C | 5 | 2 | 9 H

que: solve :-

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

\- 29 H

5A H