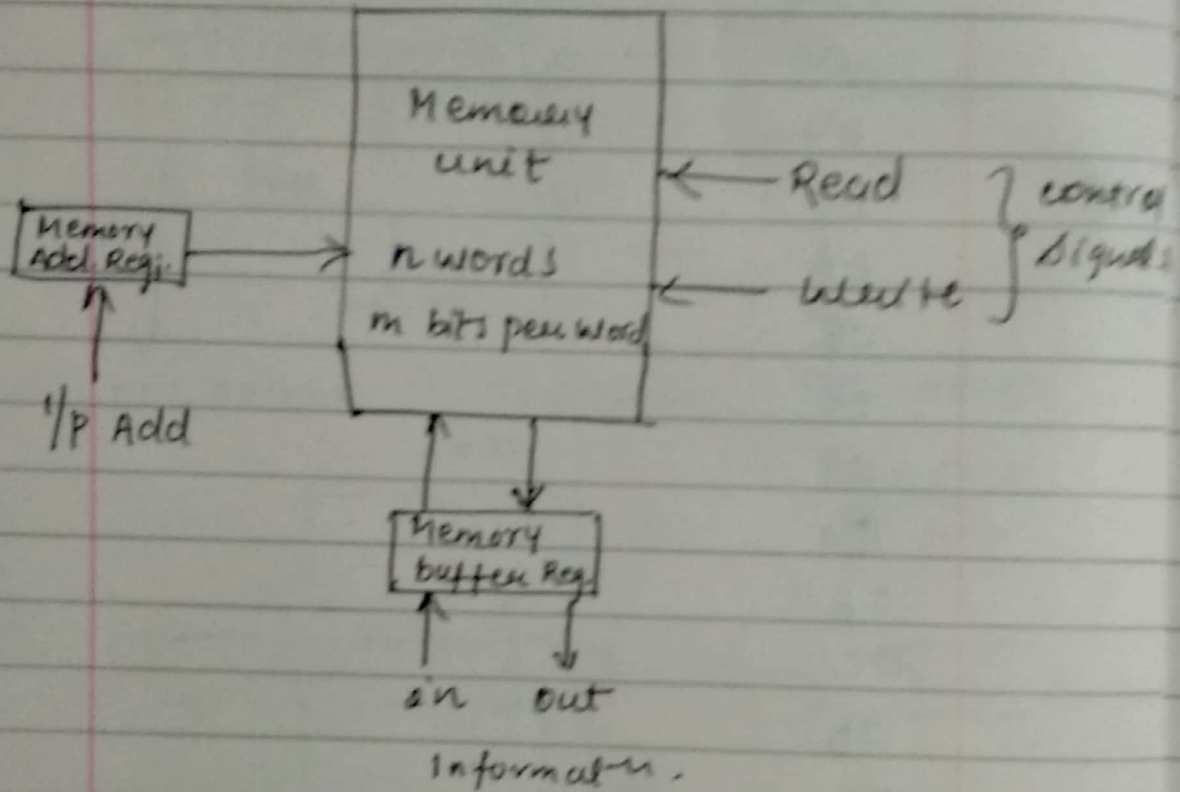


## UNIT - IV

### MEMORIES



- Memory is an essential component of a digital computer. it is needed to store programs, data and result.
- A memory unit stores binary information in groups called words, each word being stored in a memory register.
- A word in memory is an entity of n bits that moves in and out of storage as a unit.



→ A memory word may represent an operand, an instruction, a group of alphanumeric characters or any binary-coded information.

Address Register —  $n$  bits.

can specify upto —  $2^n$  memory words.

↳ memory location  
1 location — 1 word ( $m$  bits)

$2^n \text{ location} = 2^n \times m \text{ bits} \rightarrow \text{memory capacity.}$

8085  $\rightarrow 2^{16} \times 8 \text{ bits}$

$\Rightarrow \frac{2^{10} \times 2^6 \times 8 \text{ bits}}{1024 = 1 \text{ KB}}$

$= 1 \text{ K} \times 2^6 \times 8 \text{ bits} \quad (8 \text{ bit} = 1 \text{ Byte})$

$= 1 \text{ K} \times 2^6 \times 1 \text{ Byte}$

$= 2^6 \times 1 \text{ KB}$

$= 64 \text{ KB.}$

32 KB memory — Add pins.

$32 \times 2^{10} \times 8 \text{ bits}$

$\Rightarrow 2^{15} \times 8 \text{ bits.}$

15  $\rightarrow$  Add lines.

$2^{20} \times 16 \text{ bits.}$

1 MB X

$2^n \times m$

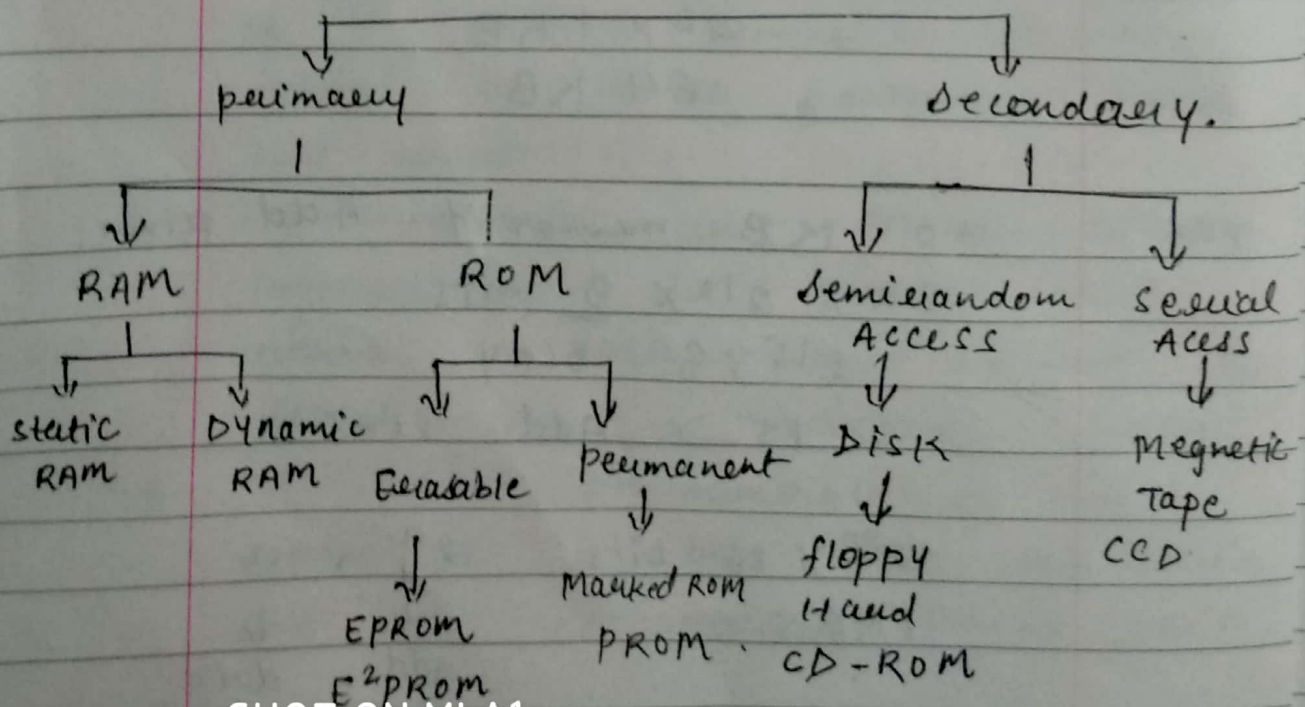
↓  
Add.  
line

↓  
data  
line.



- MAR specifies the memory word selected. to communicate with a specific memory word, its location Address is transferred to the Address Register.
- A write signal specifies a transfer in function.
- A read signal specifies a transfer out function.
- The information transfer to and from registers in memory and the external environment is communicated through a memory buffer Register.

### Memory





## RAM

Read / Write  
Volatile

Temporary storage  
user data / programs /  
results.

## ROM

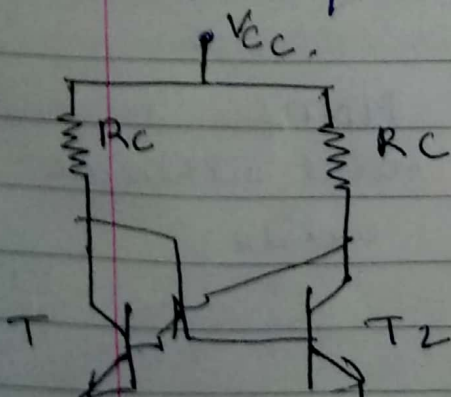
Read

Non-volatile.

permanent storage  
system programs.

### Static RAM

- Basic memory cell is 1F1
- Implemented with BJT & Mosfet
- faster
- more power dissipation
- cache memory
- ~~A~~
- NO refreshing required
- less memory capacity.



### Dynamic RAM

Basic Memory cell is 1M1 capacitor.  
with Mosfet only.

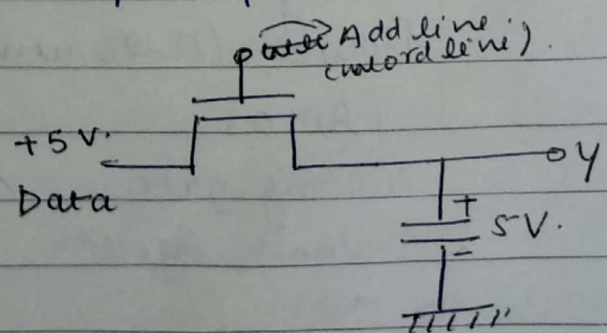
Slower

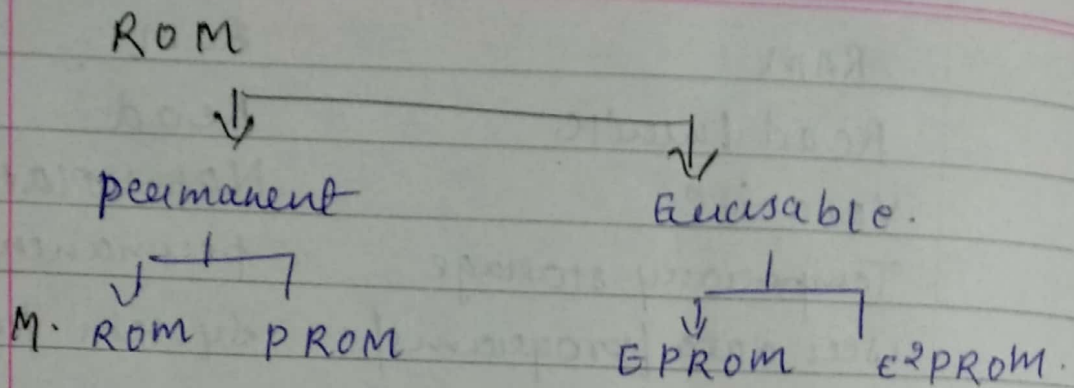
less power dissipation

Main memory of computer.

Refreshing required.

More memory capacity more.





~~Masked ROM~~ → →

	Masked ROM	PROM
→	Data stored by manufacturer during fabrication.	User can store data but only one time.
→	User can't write into this memory.	User can't rewrite this memory.

**EPROM**  
Erasable programming ROM.  
erasing is done using UV light.  
erasing process slower. (15-20 min)

**EEPROM**  
electrically erasable programming ROM.  
Information can alter by electrical signal.  
a few seconds.

**AMOS**  
floating gate  
avalanche injection  
mos.

**MNOS**  
metal nitride  
oxide.







Address line  
( $A_2 A_1 A_0$ )

o/p of ROM  
( $D_2 D_1 D_0$ )

000

010

001

101

010

011

011

111

100

100

101

000

110

110

111

001

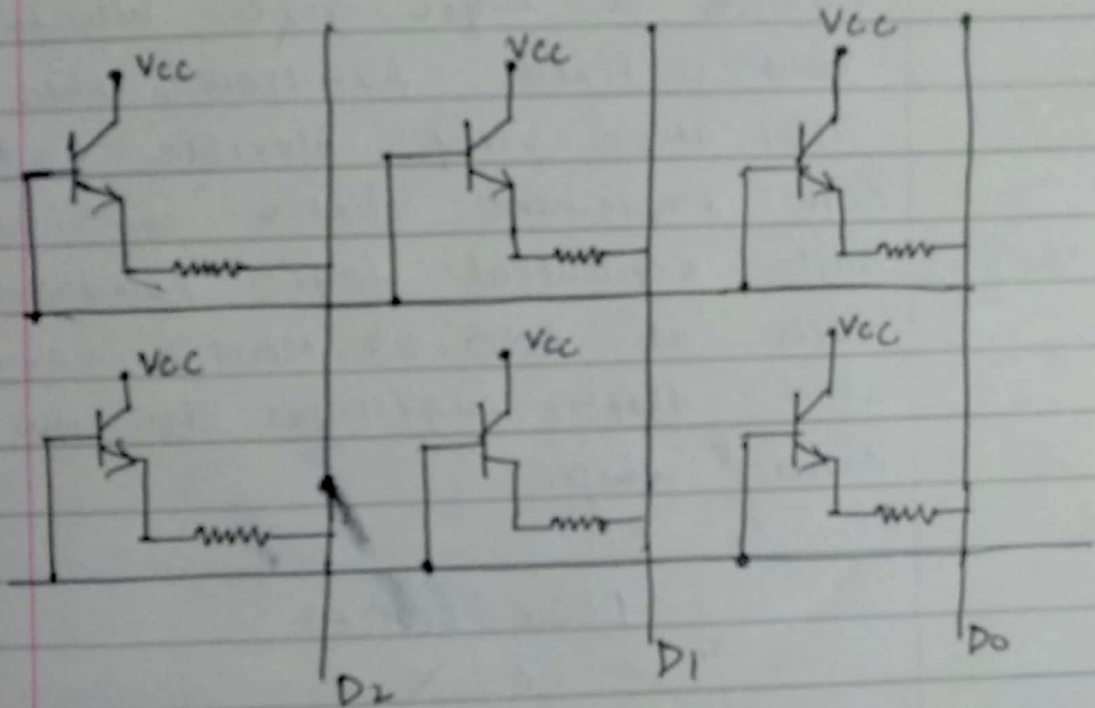
### Bipolar ROM-

- each horizontal Row is a Register.
- Register contain diode as coupling cells.
- A diode that is present at the intersection represent logic 1 whereas absence of a diode at the intersection indicates 0.
- The decoder select one of the 8 words by increasing raising the voltage of the corresponding word line.



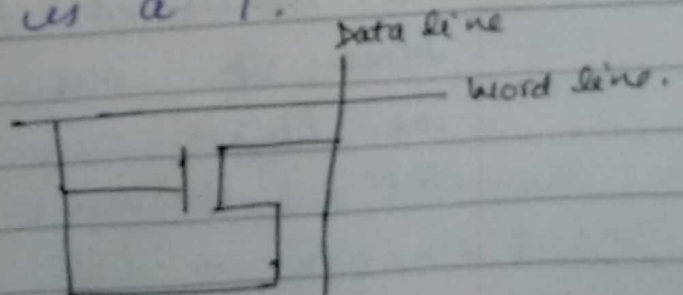
## Bipolar ROM-

The bipolar transistor is used to connect 2 intersecting conductance in place of diode matrix.



→ when decoder selects one of the word by raising the voltage of the corresponding word line, the emitter base junction of transistor  $Q$  is FB, which allows current to flow through resistor  $R$  and that bit of the word is a 1.

## MOS ROM -

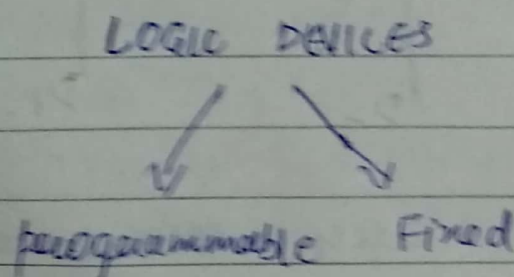




PLD (programmable logic Device)

A PLD is a device which is used in many digital electronic designs.

unlike a logic gate, which has a fixed function, these PLDs are very flexible and can implement both combinational and sequential logic functions such as AND, OR, NAND, counter and shift registers on the same chip.



PLD - A PLD is an electronic component used to build digital cks. unlike a logic gate which has a fixed function, a PLD has an undefined function at the time of manufacture. Before the PLD can be used in a ckt it must be programmed.



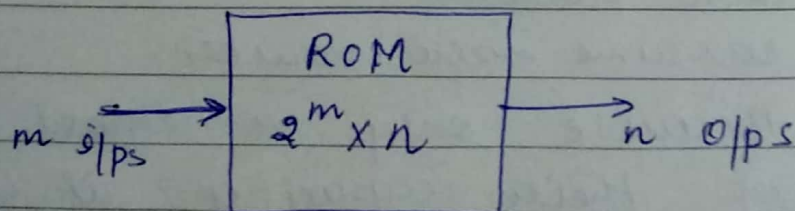
A fixed logic device are permanent. They perform one specific function or set of fixed functions - once manufactured, they cannot be changed.

PLD Advantages -

- 1) short design cycle
- 2) compact circuitry
- 3) PLDs can be reprogrammed even after a piece of equipment is shipped to a customer.
- 4) high switching speed.
- 5) low development cost.

ROM as a PLD -

Before PLDs were invented, ROM chips were used to create arbitrary combinational logic function of a no. of i/p's.



$m \rightarrow$  Address lines

$n \rightarrow$  data lines

There are  $2^m$  possible boolean functions of these  $m$  signals but





Structure of the ROM allows just  $n$  of these function to be produced at the o/p.

The ROM therefore becomes equivalent to a combinational unit with AND gates connected as a decoder and a no. of OR gates equal to the no. of o/p in the unit.

Advantage of using ROM as PLD -  
1) ease of design. Since no. simplification of boolean function is required.

2) ROM can be reprogrammed rapidly.

3) high switching speed.

4) low development cost.

Disadvantage -

1) much slower.

2) consume more power.

3) Because only a small fraction of their capacity is used in any one app. they often make an inefficient use of space.

4) They can not easily be used

SHOT ON MI A1  
MI DUAL CAMERA

for sequential logic, they contain no ff.

5) Increase in size with increase in no. of i/p variables.

Q → Design a combinational ckt using a ROM. The ckt accepts a 3-bit binary no. and generates an o/p binary no. equal to the 2's complement of the i/p no.

i/p			o/p		
A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	F <sub>2</sub>	F <sub>1</sub>	F <sub>0</sub>
0	0	0	0	0	0
0	0	1	1	1	1
0	1	0	1	1	0
0	1	1	1	0	1
1	0	0	1	0	0
1	0	1	0	1	1
1	1	0	0	1	0
1	1	1	0	0	1

i/p → 3

o/p → 3

Size of ROM =  $2^3 \times 3 = 8 \times 3$

