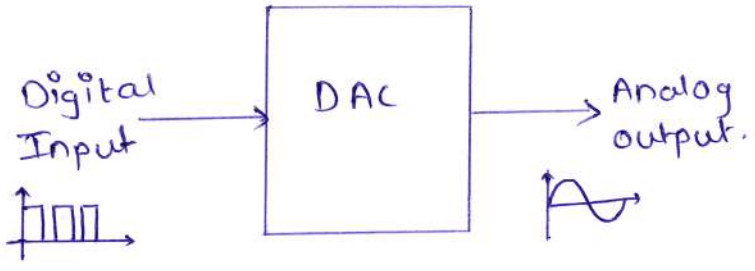
5.1 Data Converter:- The electronics circuit used for such a conversion are called as Data converter.

- **Types of Converters :-**

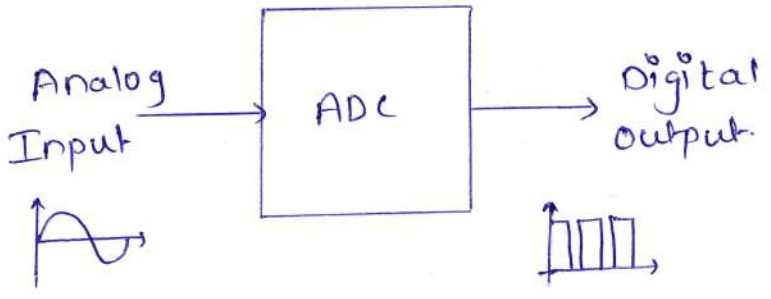
1) Digital To Analog Converter :-

- A Digital to Analog Converter converts a digital input signal into an anlog output signal.
- The digital signal is represented with a binary code, which is a combination of bits 0 & 1.

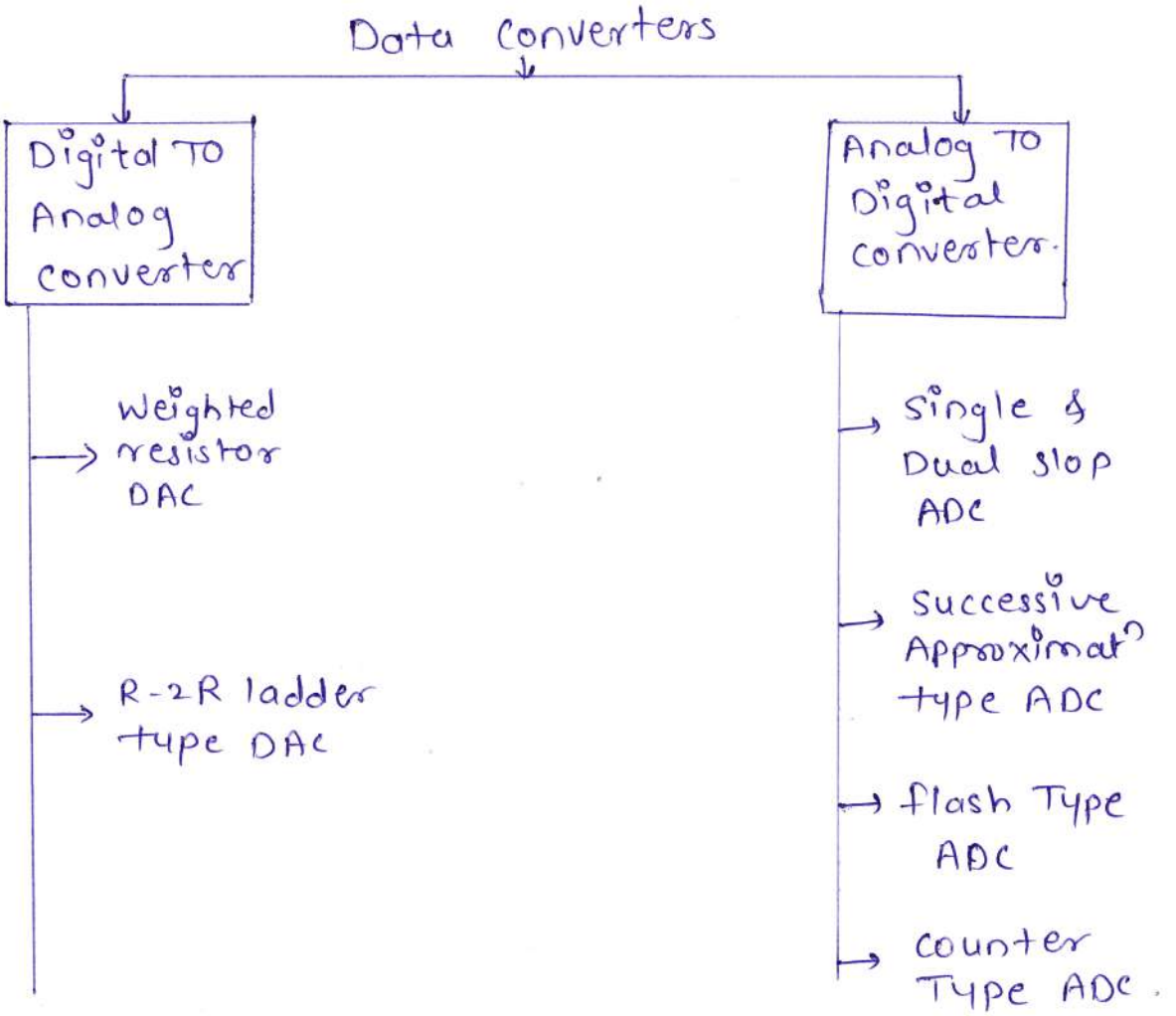


2) Analog TO Digital Converter :-

- A Analog to Digital Converter converts continous time, continous - amplitude analog signal into discrete - time, discrete amplitude digital signal.



• Classification of Data Converters :-

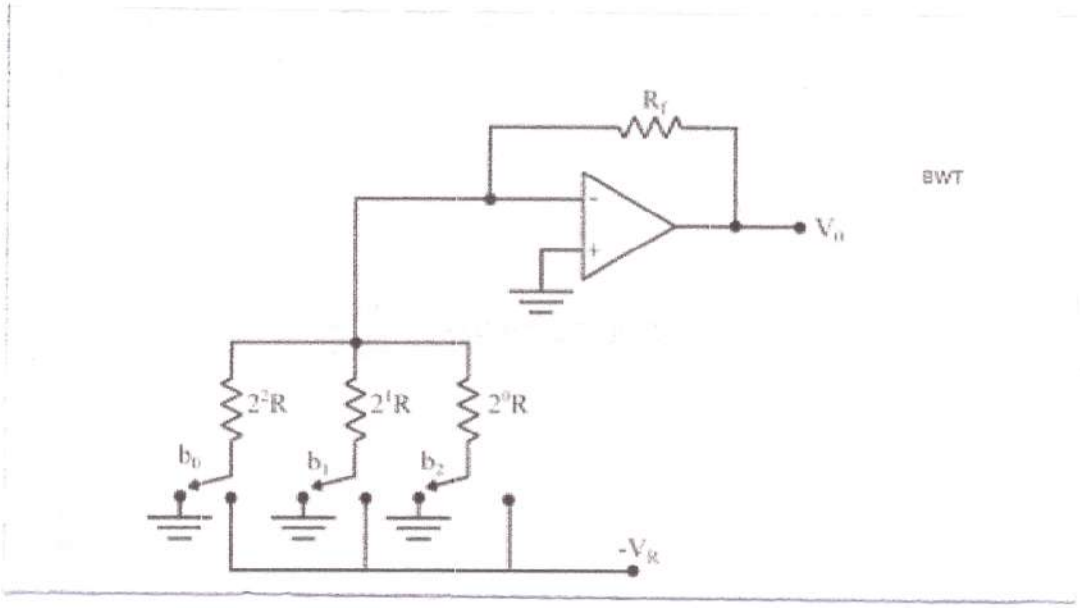


• Comparion of ADC and DAC :-

Feature	ADC	DAC
• Conversion	Analog → Digital	Digital → Analog
• Input	Analog signal	Digital Data
• output	Binary data	Analog Current / Vtg.
• use	Data acquisition	signal reconstruction.
• Example	Temp Sensor Interface	Audio Speaker Output.

• Digital To Analog Converters :-

1) Weighted Type of Digital to Analog Converters :-



• Working of Weighted Resistor DAC -

1) A weighted resistor DAC users a network of resistor whose values corresponds to the binary weights of the digital input bits.

2) Each digital input bit control a switch connected either to a reference voltage (Vref) to ~~the~~ ground.

3) The resistor values are weighted according to bit significance. for a 4-bit DAC, the resistor values are -

→ MSB (b3) - R
→ b2 → 2R
→ b1 - 4R
→ LSB (b0) → 8R.

4) When a bit is 1, its which connects the corresponding resistor to Vref.

5) When a bit is 0, its switch connects the corresponding resistor to ground.

6) The current through each resistor depends on its resistance value and the state of corres-ponding input bit.

7) The MSB contributes the largest current because it is connected through the smallest resistor (R).

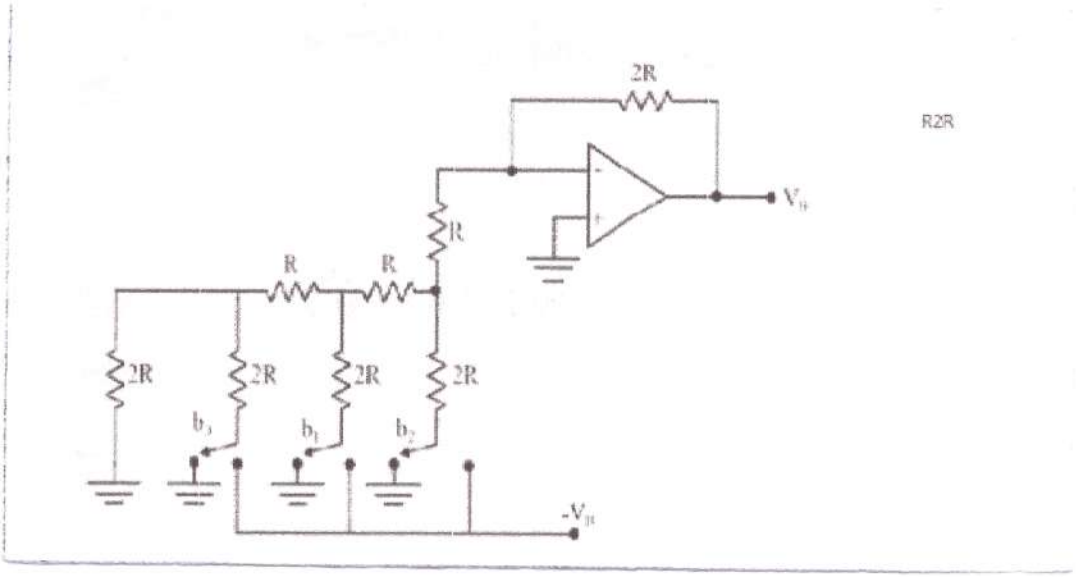
8) The LSB contributes the smallest current it is connected through the largest resistor (8R).

9) The current from all resistor are summed at a common summing junction, usually the input of an operational Amplifier.

10) The operational Amplifier converts the summed current into a proportional output voltage.

11) The output analog voltage is proportional to the binary value to digital input.

2) R-2R Ladder Type Digital TO Analog Convertor :-



• Working of R-2R Ladder :-

1) An R-2R ladder DAC uses a network of only two resistor values - R and 2R.

2) This method is suitable for realization of integrated circuit.

3) The value of R can be anywhere between 2.5 kΩ to 10 kΩ.

4) The value of R should not be less than 2.5 kΩ.

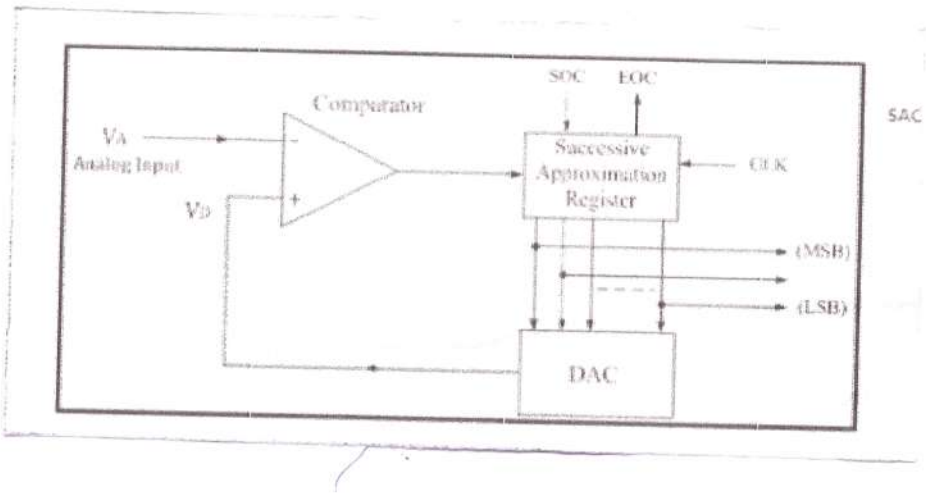
• Advantages of R-2R ladder :-

1) We need resistor of only two values (R & 2R) it is easier to build this circuit accurately.

2) We can increases the no. of inputs bits just by adding more section of same R / 2R values.

• Analog To Digital Converter :-

1) Successive Approximation ADC :-



• Working of successive Approximat? :-

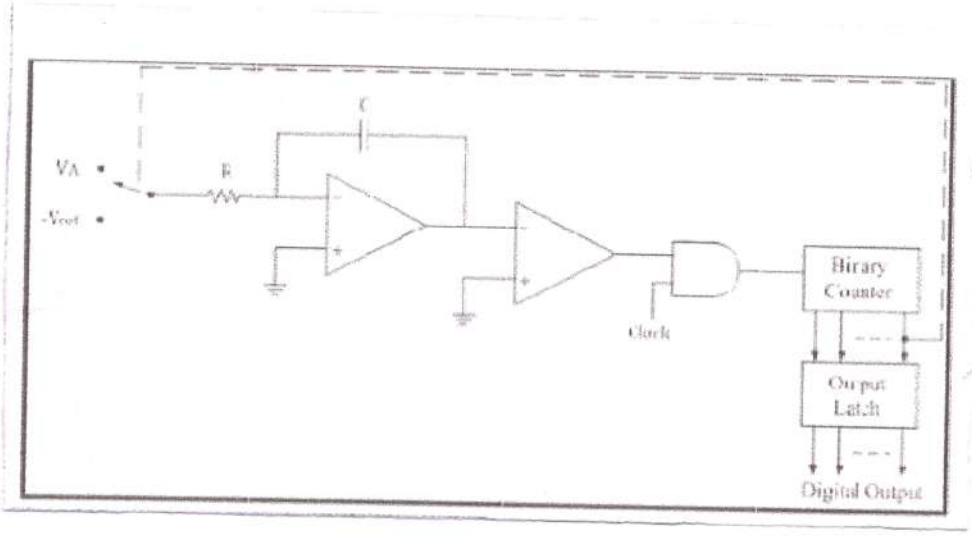
1) It is based on code search statergy to complete n bit conversion in n clock periods.
2) SAR stand for Successive Approximat? resistor which consists of SOC (start of conversion) and EOC (end of conversion) along with clock signal and end with clock signal and end with digital inputs.
3) If we initiates SOC. SAR will get set and d1 will become 1.
4) Hence, the trial code will be 10000000, this trial code goes to DAC as a input and produce V_0 as an input.
5) This V_D goes to comparater it compares V_0 & V_A.
6) If $V_A > V_D$ the output of comparater is high & this output goes to SAR again.

7) Due to which D1 will remain 1 as it is and d_2 becomes 1. Hence the trial code will be 11000000.

8) IF $V_A < V_D$, the output OF comparator is low & it goes to SAR again.

9) Due to which D1 becomes 0 & d_2 becomes 1, Hence the trial code is 01000000.

2) Single to Dual slop Type of ADC :-



• Working of Dual slope :-

1) In dual slope type ADC the integrator generates two different ramps, one with the known at analog input Vtg V_A and another with a known reference Vtg. -Vref. Hence it called as dual slope.

2) The binary counter is initially reset to 0000, the output of integrator reset to 0V & the input to the ramp generator is switch to the unknown analog Vtg V_A.

3) The ~~analog~~ output of comparator is positive & the clock is passed through the AND gate, this result in counting up of the binary counter.

4) At the end of the fixed time period t1, the ramp o/p of integrator is given by $V_S = -\frac{V_A}{RC} \times t_1$.

- **ADC selection factor :-**

1) Resolution :-
   - No. of o/p bits.
   - Higher resolution
   - Resolution $= 2^n$.

2) Conversion Time -
   - Time taken to convert analog to Digital
   - Important in real-time & high speed applicat^n.

3) Sampling Rate -
   - No. of times the input signal is sampled per second.

4) Input Range -
   - The Range of analog Vtg the ADC can accept (e.g. 0 to 5V).

- **DAC selection factor :-**

1) Accuray - It should be as high as possible.

2) Resolution - It should be as high as possible $R = 2^n$

3) Temperature Sensitivity -
   It should be as low as possible due to change in temperature analog output voltage also changes.

4) Speed -

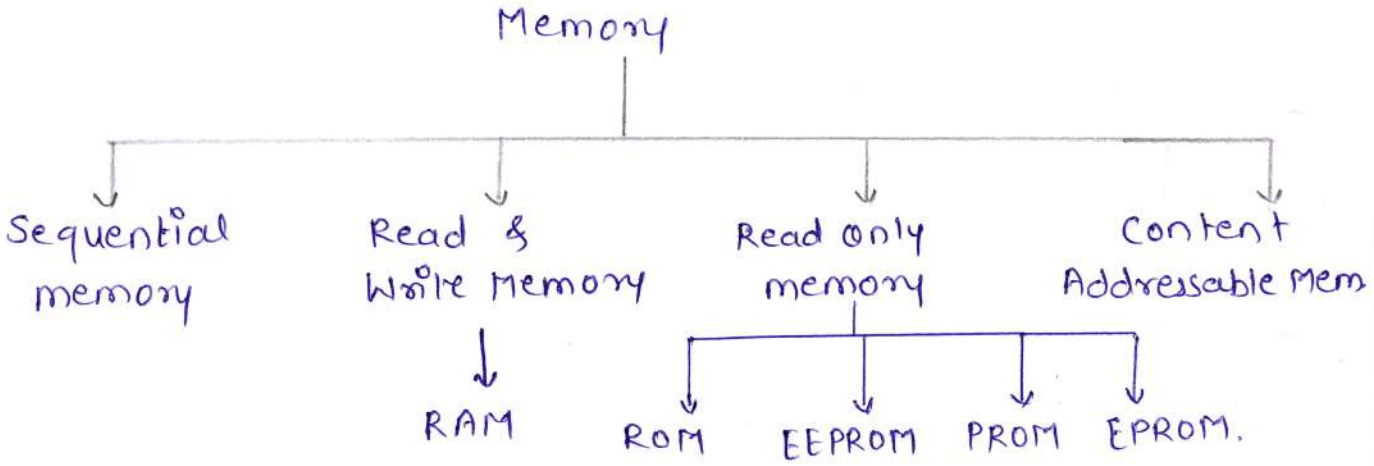
5) Setting Time - It is as short as possible.

6) Linearity.

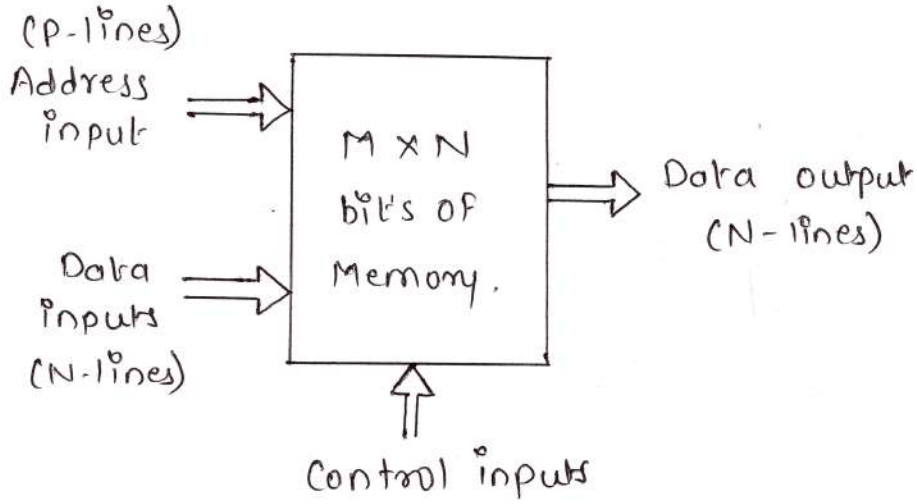
5.3 Memories :-

Memory is define as the part of Computer in which data or program instruction can be store for retriver.

- Classification of Memory :-



- Block Diagram of Memory Device :-



• Memory Organization :-

1) Memory Organization refers to the arrangment of memory cells and storage units in a computer system.

2) Memory is organized to :-
   - Words
   - bytes
   - Address Location.

3) Each memory location has a unique address.

4) CPU Addresses data using these Address.

• Memory Dimension :-

1) Word length :-
   → Number of bits stored in one memory word.
   → Ex - 8-bit, 16 bit, 32 bit.

2) No. of words :-
   → Total storage location available.

• Memory Bank :-

1) A Memory bank is a group of memory chips / modules used together.

2) Memory bank improve.
   → storage capacity.
   → Data transfer speed.

3) Multiple banks allow simultaneous access to memory.

- Compare Primary Memory and secondary Memory :-

Parameter	Primary Memory	secondary Memory
1) Speed	Very High speed	slower speed.
2) Access	Directly access by CPU	Not directly access by CPU.
3) Cost	More expensive	Less expensive.
4) Capacity	Smaller capacity	larger capacity.
5) Volatility	Volatile	Non-Volatile.
6) Usages	Stores data and instr° currently being used.	Stores data and program for long term used.
7) Types	SRAM, DRAM, ROM, EPROM EEPROM.	SSD's, flash Memory.
8) Example	Cache Memory, main Memory	HDD, SDD, USB.

- Compare RAM Memory and ROM Memory :-

Parameter	RAM Memory	ROM Memory.
1) Application	calculator, computer	Computers, microprocessor.
2) Types	SRAM, DRAM ↓ Static ↓ Dynamic	PROM, EPROM, EEPROM.

3) Operation	Read & write	Read only.
4) Storage	Temporary.	Permanently.
5) Stands for	Random Access Memory	Read only Memory.

- Compare Volatile and Non-Volatile Memory :-

Parameter	Volatile	Non-Volatile.
1) Defination	Data gets loss if power is turned off	Data doesn't get loss.
2) Application	for temporary storage information.	for permanent storage informat°.
3) Classification	All RAMs.	ROMs, EPROMs
4) Effect of Power.	Information is available till power ON	No effect of power.

- Compare PROM and EPROM Memory :-

Parameter	PROM	EPROM.
1) Stand for.	Programable Read only memory.	Erasible programable Read only memory.
2) Reusable	Not possible	possible.
3) Program	only one	Multiple times.
4) Memory.	Permanent.	Can be Erasaid.

- Compare EPROM and EEPROM Memory :-

Parameter	EPROM	EEPROM
1) Stands for	Erasible Read only Memory	Electrical Erasible Read only Memory.
2) Cost	Low Cost	High Cost.
3) Remove PROM from Ckt	necessary	not necessary.
4) Time required	long time required (10 to 15 min)	short time required (10 ms)
5) Erasing	Selective erasing is not Possible.	selective erasing is possible.
6) Technique required for	Exposure to UV lights.	Voltage of 20 to 25 V is applied.

- Compare EPROM and flash Memory :-

Parameter	EPROM	flash Memory.
1) Type	Non-volatile	Volatile
2) Erasing Tech.	Exposure to UV light	Electrical signal used for erasing.
3) Time for Erasing.	long time	Instant.

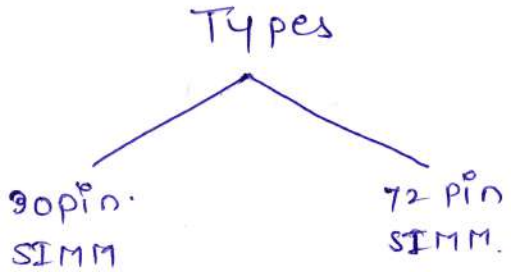
4) Selective Erasing.	Not possible	possible
5) Need to remove Memory	Necessary	Not Necessary
6) Application.	Cell Phone, Digital Camera	Computers.

- Compare SRAM and DRAM Memory:-

Parameter	SRAM	DRAM
1) Stands for	static Random access memory.	Dynamic random access memory.
2) No. of Components per cell	more	less
3) Refreshing.	Not requried	Requried.
4) Cost	More	less
5) Power Consuption	less	More
6) Access time	less	More
7) Primary cell / Unit area.	less	More.

• SIMM (single Inline Memory Module) :-

- It a type of memory module used in older computer system to provide Random Access memory.
- It has single row of electrical contacts on one side of module.



• features of SIMM :-

1) Memory Capacity :-
It typically range from 1MB to 32MB in capacity.

2) Data width :-
It has data width of 8 bits.

3) Voltage requirement :-
It operates at a standard operating voltage typically 5V.

4) Speed rating :-
SIMM are rated by their access time measured in nano seconds.

5) Parity checking :-
It help to detect & correct error in memory.

- SSD (solid state Drive) :-

  - SSD are a type of storage device that uses solid state memory to store data.

- features of SSD :-

1) Non-volatile :-

It detains the data even when the power is turned off.

2) fast access :-

SSD offeres faster read and write speed compare to tranditional HDD. leading to quicker boot time.

3) Transfer speed :

SSD provides faster file transfer system.

4) Realiability

SSD provide more realiability as compare to HDD in due respect to the mechanical failuare.

5) less power consumption :

SSD consums less power as compare to HDD.

- Application of SSD

1) Laptops
2) Consumer electronics.
3) Gaming System.

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QUESTION BANK

1) Draw the block Diagram and explain the working of Successive approximation method of ADC.

2) Explain the Working of Dual slop ADC.

3) Give any two specification of DAC. Draw the circuit diagram of weighted resistor DAC and give the expression for output.

4) Compare weighted resistor DAC and R-2R DAC. (any four points).

5) Draw the circuit Diagram of R-2R ladder and explain it's working.

6) Compare the following (4 Point)
   1) Volatile and Non-Volatile memory.
   2) SRAM and DRAM memory.

7) Compare the following Memories with respect to given points.
   1) PROM Memory
   2) EPROM Memory
   3) EEPROM Memory
   - Working Principle
   - Types of storage technology
   - Internal or External
   - Cost.
   - Application.

8) Give any four specification of ADC.

9) Compare the following :-
   1) primary Memory and secondary Memory.

10) Compare :- EPROM and flash Memory.

11) Compare :- RAM Memory and ROM Memory.

12) Draw the Block Diagram of Memory device.

13) Describe the features of SIMM Memory.

14) Explain the features of and advantages of SSD Memory.

15) Define Memory and its classification.

16) Calculate the analog output of 8-bit DAC for digital input 10011100. Assume $V_f = 5V$.

17) Calculate the analog output of 5-bit DAC for digital input 10011. Assume $V_f = 5V$.

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