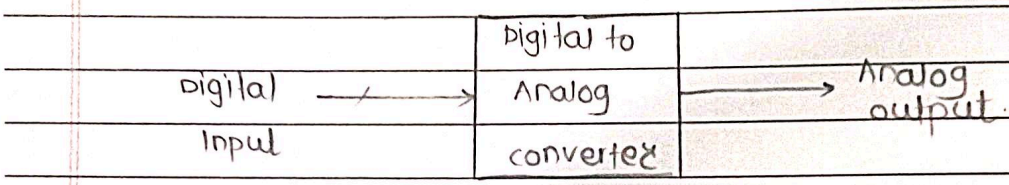
13) Explain Working of DAC with ~~examples~~ suitable block dig & truth table.

→ A Digital to Analog converter (DAC) converts a digital input signal into analog output signal. The digital signal is represented with a binary code which is a combination of bits 0 & 1.

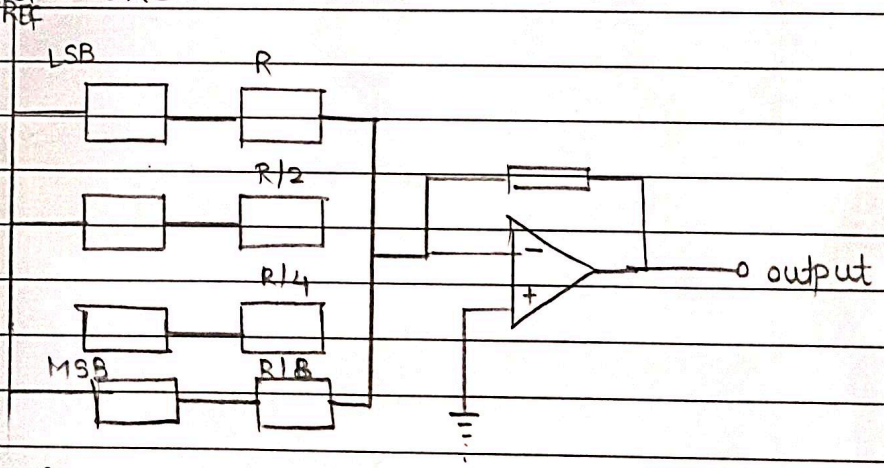
Block diagram (DAC)



Types of DACs

1) Weighted Resistor DAC:
2) R-2-R ladder DAC

1) Weighted Resistor DAC:

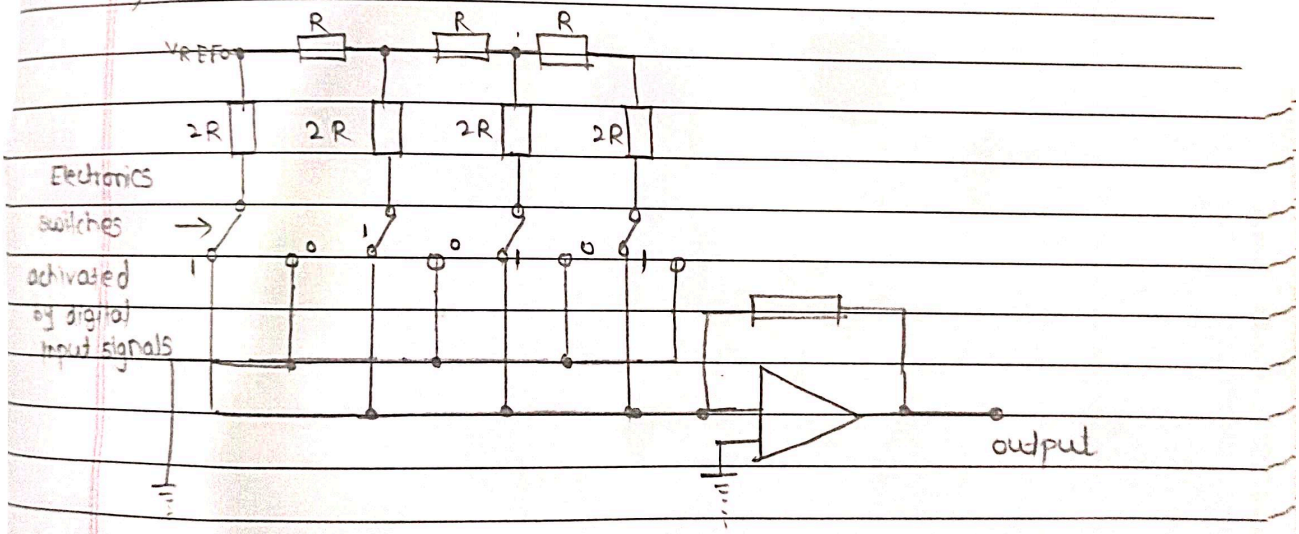


A simple form of DAC uses a summing amplifier to form the weighted sum of all nonzero bits in the input word. The reference voltage is connected to the resistors by the means of electronics switches which responds to binary one. The valves of input resistances depends on which bit in the word a switch is responding to the value of the resistor for successive bit

from LSB being halved Hence the sum of the voltages is a weighted sum of the digits in the word such a system has an op Amp to act as a buffer to ensure that the current out of the resistor network is not affected by the output load & the gain is also adjusted

The only problem with this system is that accurate resistances have to be used for each of the resistors & it is difficult to obtain such resistances over wide range so this DAC is limited to 4 bit conversions only

2) R-2-R ladder DAC



Another commonly used DAC is R-2-R ladder network It overcomes the problem of obtaining accurate resistances over a wide range of values, only two (2) values being required. The o/p vtg. is generated by switching sections of ladder to either the reference voltage or zero (0) volt according to wheather their is 1 or 0 in the digital input.

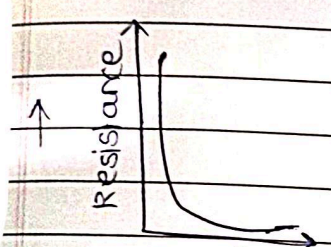
12) provide an overview of two types of temperature sensors that could be used in Mechatronics system identifying the advantages & disadvantages of each & the temperature range that it can measures.

→

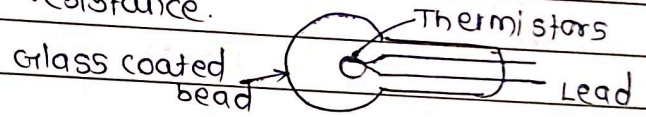
Temperature sensors

- Thermistors

- Thermistors follows the principle of decrease in resistance with increasing temperature. The material used in thermistor is generally a semiconductor material such as a sintered metal oxide (mixtures of metal oxides, chromium, cobalt, iron maganese & nickel).



As temp of semiconductor material increases the number of elections able to move about increases which results in more current in the material & reduced resistance.



Advantages -

1) large temperature coefficient of Resistance.
2) high sensitivity
3) small heat capacity
4) small size

Disadvantages -

1) The thermistors not suitable for a large temperature range
2) Narrow working temperature range compared to other sensors such as RTD & thermocouple.
3) Extremely non linear.

4) Working temperature range for most thermistors is bet° 0°C and 100°C

2) Resistance temperature detectors (RTDS)

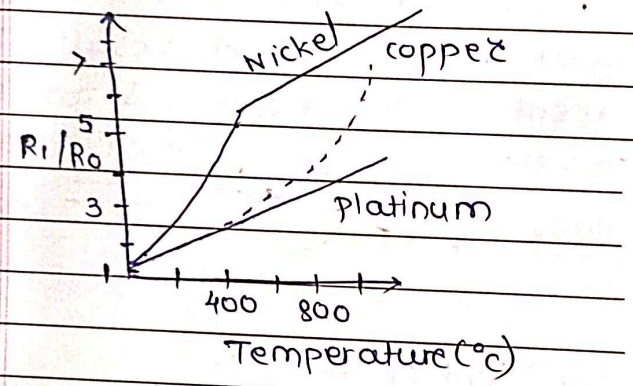
RTDs work on the principle that the electric resistance of a metal changes due to changes in its temperature. on heating up metals, their resistance increases & follows linear relationship.

The correlation is

$$R_t = R_0(1 + \alpha T)$$

Where R_t is the resistance at temperature T (°C) & R_0 is the temperature at 0°C & α is the constant for the metal termed as temeperature coefficient of resistance.

The sensor is usually made to have resistance of 100 Ω at 0°C.



Advantages -

1) It is available in wide range
2) Most stable, most Accurate
3) No necessity of temperature compensation

Disadvantage -

1) It is expensive.
2) It required current source
3) sensitivity is low.