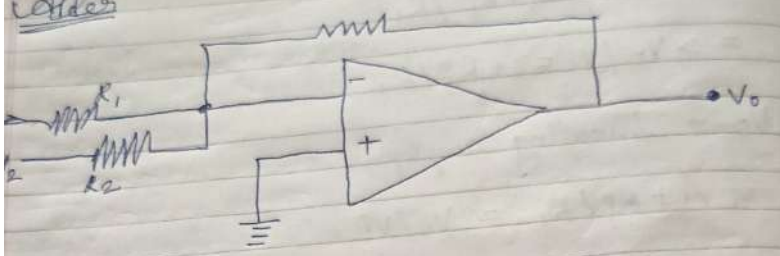
Adder



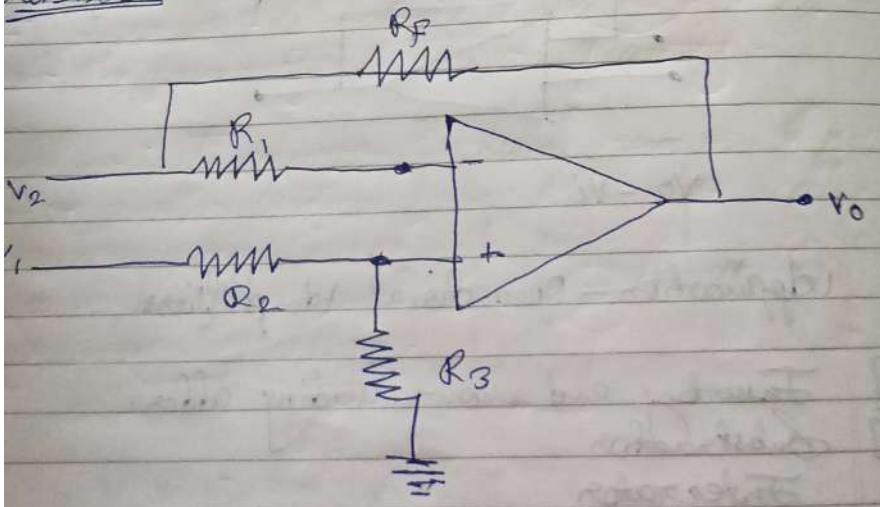
The nodal Equation :

$$I_1 + I_2 + I_f = 0$$

Given by R_1 at the nodal Equation inverting input terminals node is

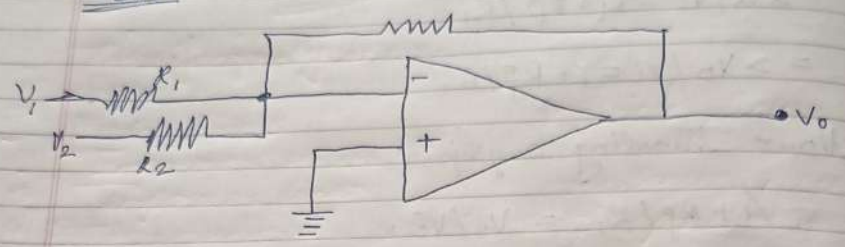
$$(0 - V_1/R_1) + (0 - V_2/R_2) + (0 - V_0/R_f) = 0$$

Subtractor



$$\Rightarrow Vp = V_1 \left(R_3 / R_2 + R_3 \right)$$

Adder



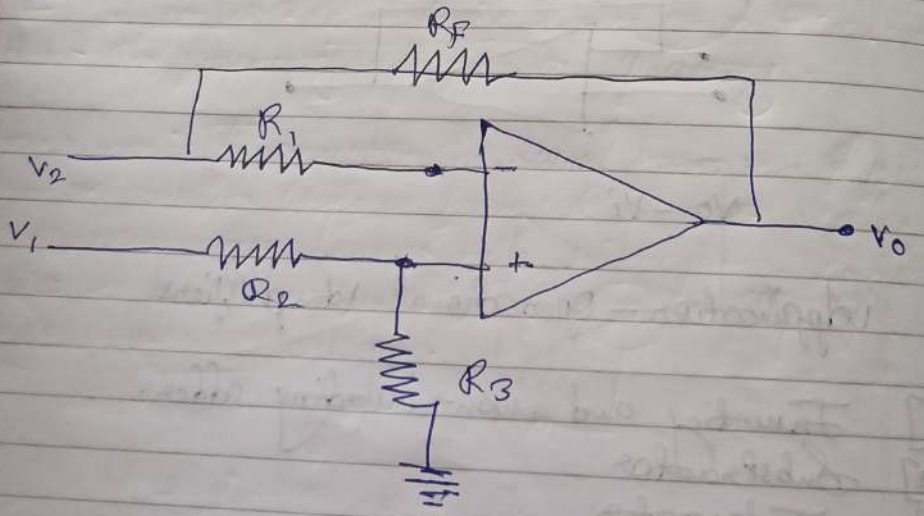
The nodal Equation :

$$I_1 + I_2 + I_f = 0$$

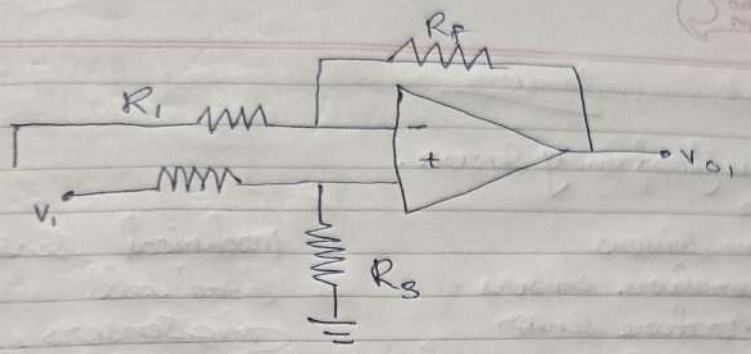
Given By R_1 at the nodal Equation inverting input terminals Node is

$$(0 - V_1/R_1) + (0 - V_2/R_2) + (0 - V_o/R_f) = 0$$

Subtractor



$$\Rightarrow V_p = V_1 \left(R_3 / R_2 + R_3 \right]$$



$$V_0 = V_{01} + V_{02}$$
$$V_0 = V_1 - V_2$$

. Thus the Op-amp based subtractor circuit above will produce an output, which is the difference of two input voltages V_1 and V_2 when all the resistors present

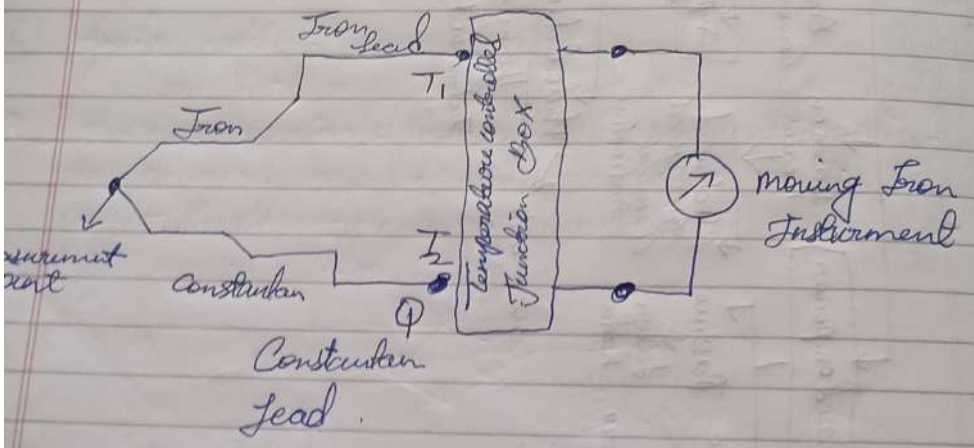
Enlist temperature sensor.

1) Thermocouple.
2) RTD
3) Thermistor.

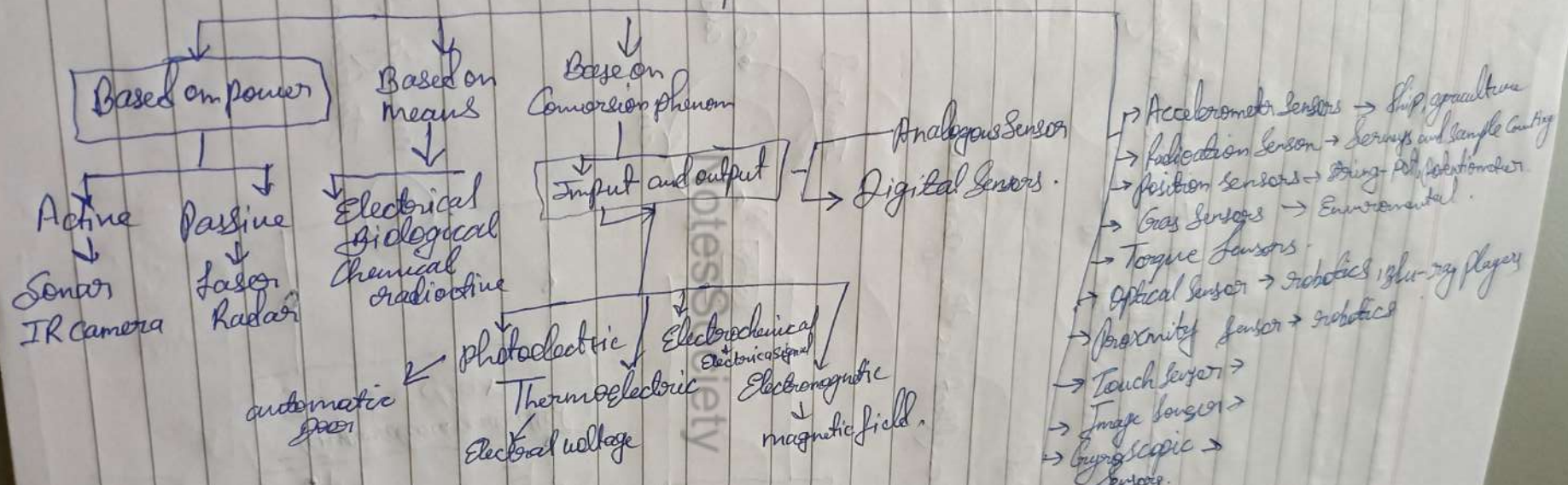
Thermocouple: is a device that converts temperature difference into an electric voltage, based on the principle of thermoelectric effect.

Thermoelectric effect.

→ The thermoelectric effect is the phenomen



Types of Sensors

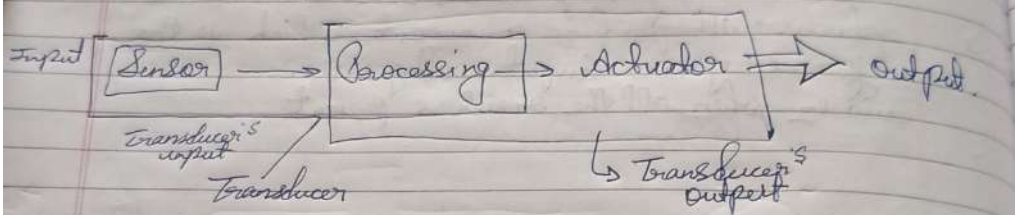


Sensors

Classification of Sensors.

1] Motion Sensors
2] Temperature Sensors.
3] temperature Sensor
4] Resistor Sensors
5] Optical Sensors

Mechnical Sensors
Load cell
Bio sensors, working principle and more Application.



1] A Sensor is a characteristic device or material to detect the presence of a particular quantity.

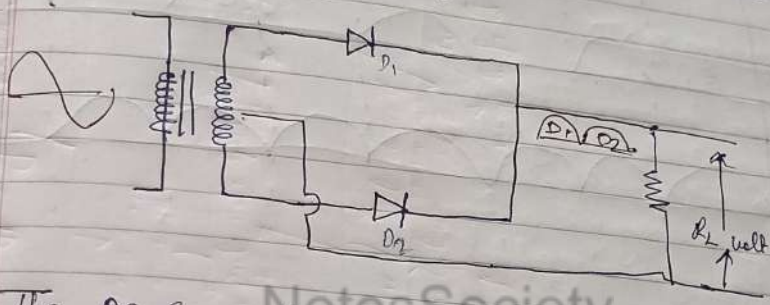
2] Transducer: It converts the signal from one physical form to another physical form it is also called Energy converter. For example microphone converts sound to electrical signal it is based on the principle of conversion of energy.

Q. Enlist rectifier which will give full cycle ~~rectifier~~ output. Explain Each type with waveform.

→ 1] A full wave rectifier is a type of rectifier which converts both half cycles of the AC signal into pulsating DC signals.

A 2] There are two types of full wave rectifier
a) Center tapped full wave Rectifier.
b) Bridge rectifier.

3] A center tapped full wave rectifier is a type of rectifier which uses a center tapped transformer and two diodes to convert the complete AC signal into DC signals.

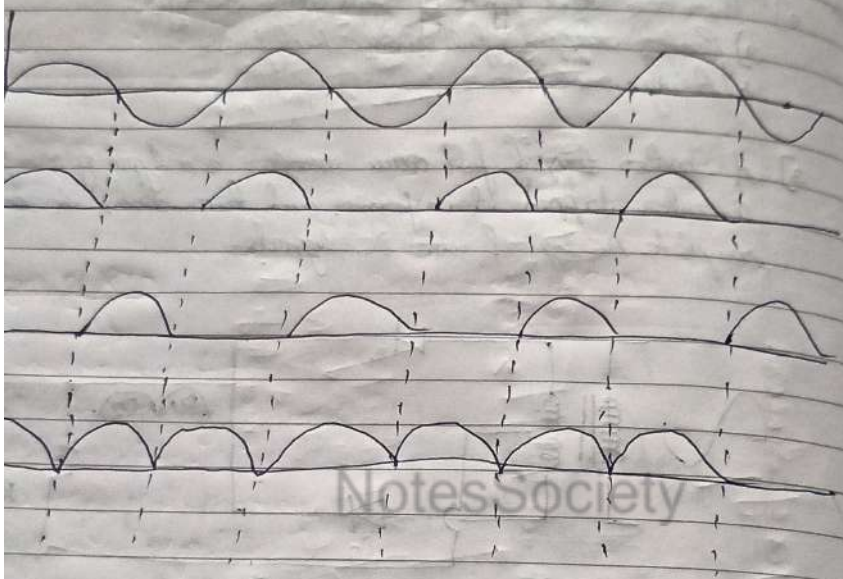


4] The AC source is connected to the primary winding of the center tapped transformer. A centre tap connected at the exact middle of the secondary winding divides the input voltage into two parts.

5] The upper parts of the secondary winding is connected to the diode D_1 and the lower part of the secondary winding is connected to the diode D_2. Both diode D_1 and diode D_2 are connected to a common load R_L with the help of center tap transformer.

an AC voltage is applied, the secondary winding of the center tapped transformer divides into AC voltage into two parts positive and negative.

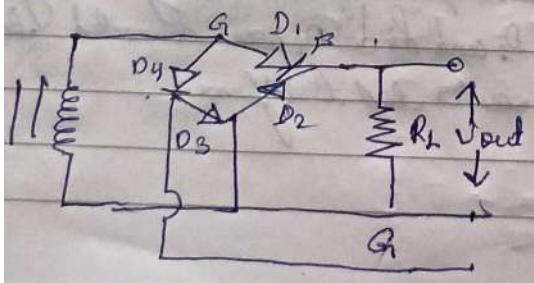
output waveforms of the full wave rectifier is shown in the



tifier.

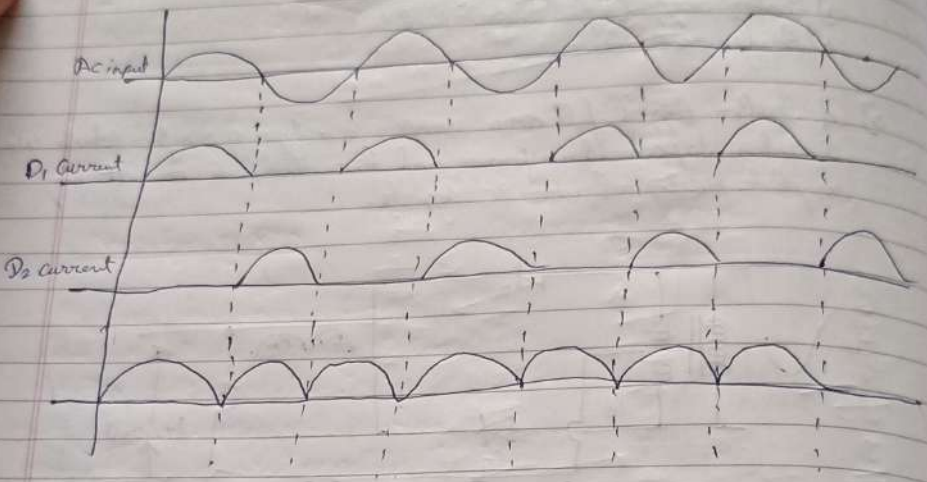
rectifier is a type of full wave rectifier which uses re diodes in a bridge circuit configuration to efficiency lternating current into Direct current.

n construction.



E] When AC voltage is applied, the secondary winding of the centre tapped transformer divides into AC voltage into two parts positive and negative.

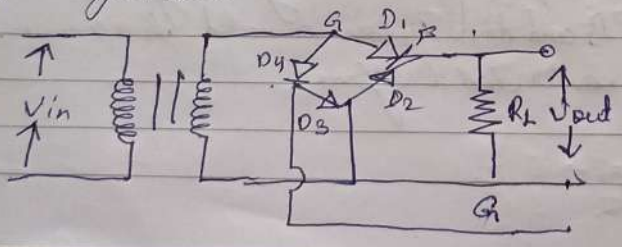
The output waveforms of the full wave rectifier is shown in the



Bridge Rectifier.

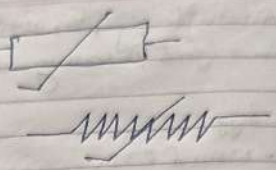
1] A bridge rectifier is a type of full wave rectifier which uses four or more diodes in a bridge circuit configuration to efficiency convert the alternating current into Direct current.

Bridge rectifier construction.

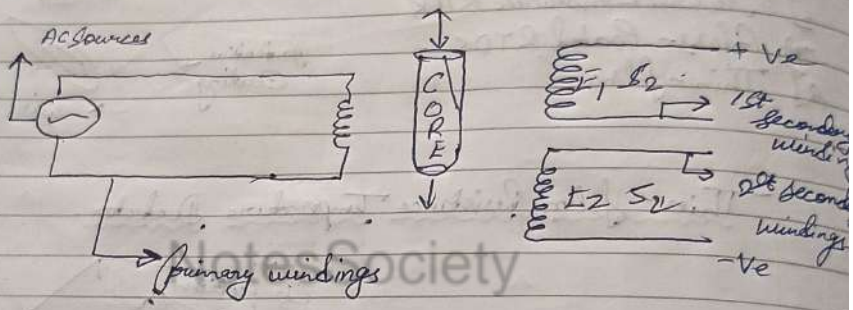


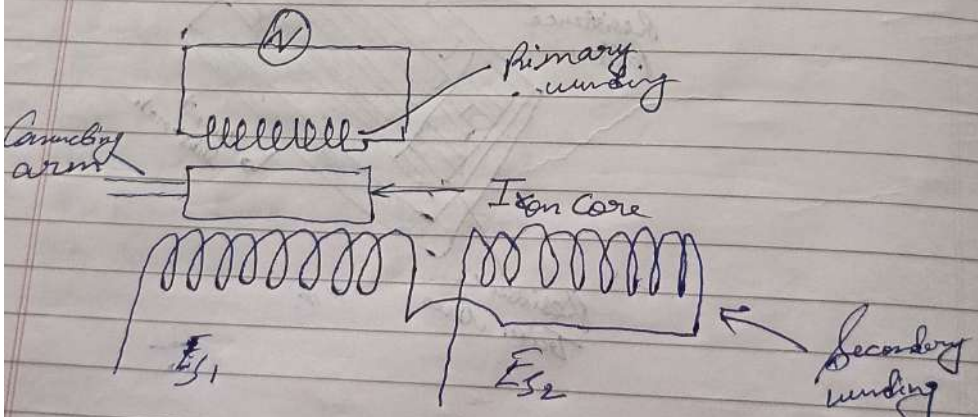
Thermistor Construction

- Disc thermistor
- Bread thermistor
- Rod thermistor



1] What is LVDT-

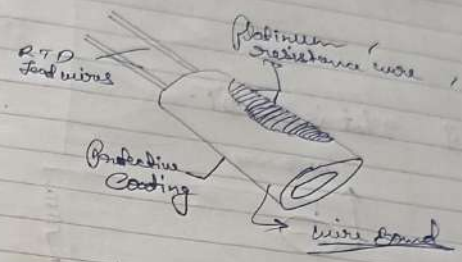




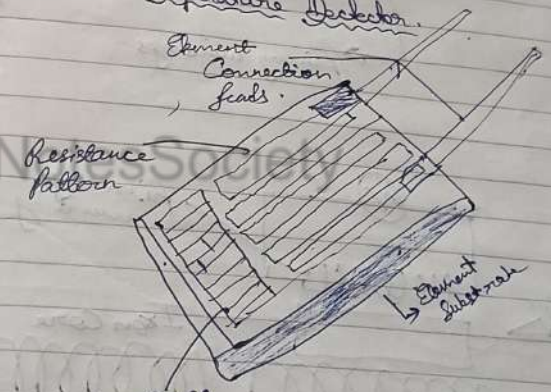
$$E_0 = E_{S1} - E_{S2}$$

1] Automotive industry uses RTDs largely for measuring the temperature change in various food processing devices like Ovens and Industries.

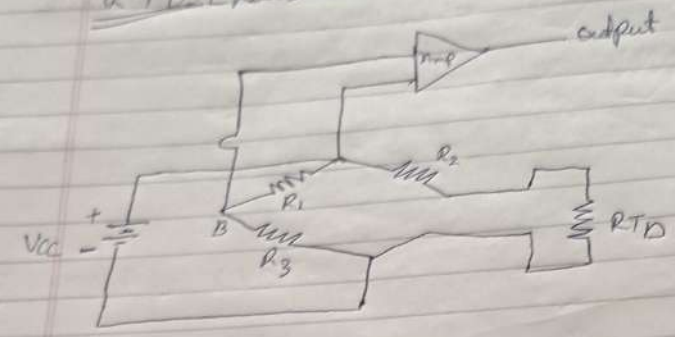
a] Enlist type.
1] Wire-Wound RTDs
2] Thin-Film RTDs
3] Coiled RTDs
4] Surface-Mount RTDs
5] Probe-RTDs
6] Mineral-Insulate RTDs
7] Glass-Coated RTDs
8] Thin-film



Thin-film Resistance Temperature Detector.



RTD [Resistance Temperature Detector]



→ Generally electrical resistance of any metallic conductor

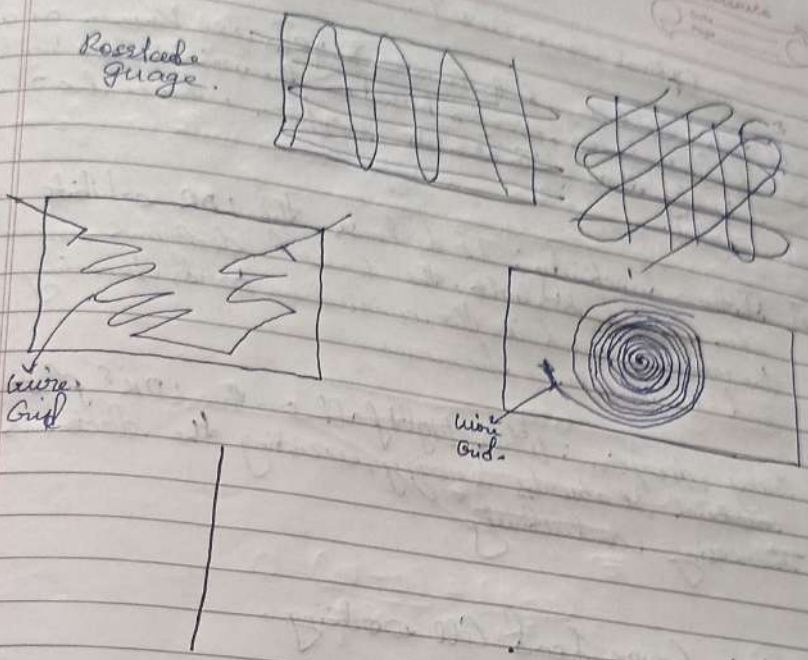
Advantages of RTD

1) Resistance temperature detectors have high intrinsic accuracy this means that their electric resistance varies practically in a range of temperature eliminating any cause of potential error.

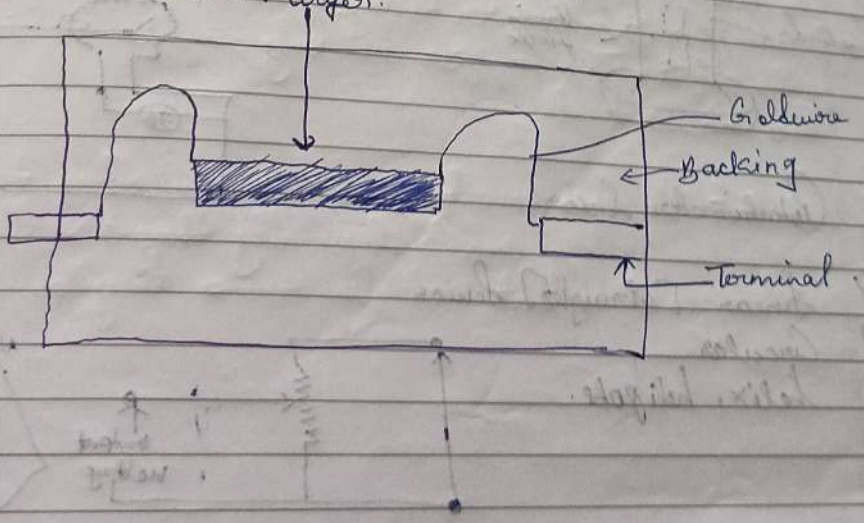
2) It is known that the metals used in RTDs show linear nature the variation

Disadvantages of RTD

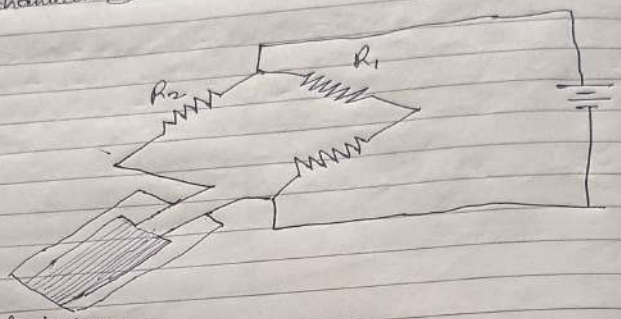
Rosette gauge:



~~Foil~~ Semiconductor Strain Gauge.



Mechanical Sensors.



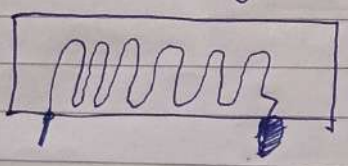
Strain gage.

Strain = change in length / original length = dL/Lo.

Enlist type of strain guages.

1] Wire strain guages.
2] Rosselle type
3] Torque type
4) helical type.
5] Foil strain gauges.
2] Semiconductor strain gauges.
2] Resistence curve gauge {Resistance wire guages are used as basic units}.

Grid type strain Gauage.



1] When the core is moving towards S_1.

→ 1] When the core of LVDT moves towards the second winding S_1, then the flux linkage S_1 will be more as compared to S_2. The EMF induced in S_1 will be more than the EMF of S_2 hence E_1 is greater than E and net difference voltage $E_0(E_1 - E_2)$ will be +ve. The more output voltage V_0 will be in phase with input AC voltage.

2] Case 2]
When the core is positional at it have null position

→ When the core is at a null position then the flux generated in both the secondary windings will be the same. The induced EMF E_1 & E_2 and both the windings will have same hence the net difference output voltage E_0 will be 0. It shows 0 displacement of the core.

3] When the core moving towards S_2.

→ When the core of LVDT moves towards secondary winding S_2. Then the flux linkage with S_2 will be more than S_1. It means the EMF induced in S_2 will more that the induced emf by S_1 hence. E_2 is greater than E_1 and net differential voltage $E_0(E_1 - E_2)$ will be negative. It means the output voltage will be of input AC voltage.

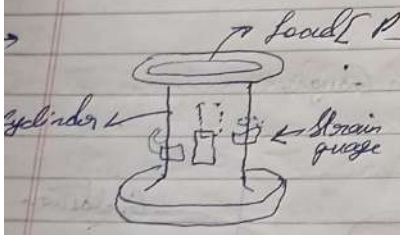
Optical Sensor [LDR].

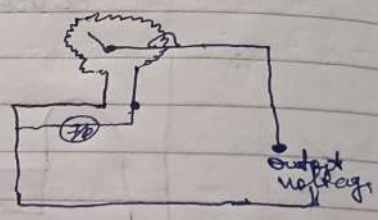
1] The Light Dependent Resistor [LDR] also known as a light & light sensor, operates based on the variation in light intensity that falls on its surface, hence how it works.

2] Photoconductivity: In darkness, the LDR exhibits resistance when exposed to light, the sensor's electrons move from the valance band to the conduction band, becoming energized and the resistance decreases.

3] Energy Absorption: When light fall on the LDR's photoconductive material it absorbs energy, exciting the electrons and increasing conductivity.

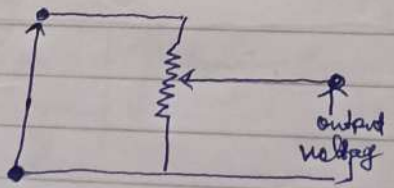
Strain Gauge Load Cell working:

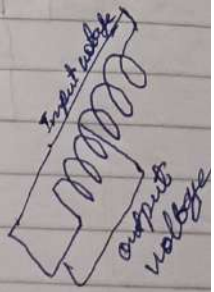




Potentiometer Sensors.

Linear [straight] Device
Circular
Helix, Helipots.





Operational Amplifier.

operational op-amp is a direct coupled high gain amplifier that can be operate in AC and DC voltage.

operational amplifier
- Inverting terminal
- Non-Inverting terminal.

Characteristic of operational Amplifier.
- open loop voltage gain
- output offset voltage
- Common mode Rejection ratio
- Slew Rate.

Operational Amplifier.

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- Inverting terminal
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Characteristic of operational Amplifier.
- open loop voltage gain
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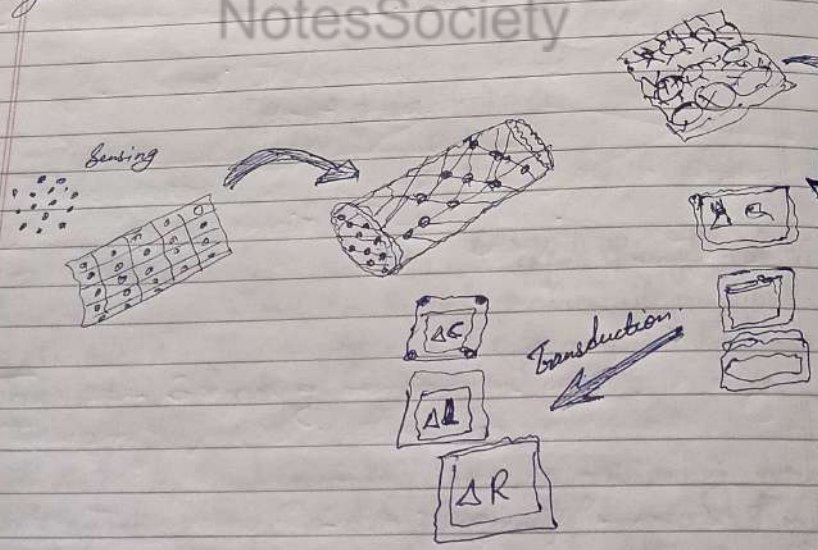
- Slew Rate.

Types

1] Electrochemical biosensors
2] Calorimetric
3] Optical biosensors.
4] Piezo - electric biosensors
5] Resonant biosensors.

1] What is gas sensors.

→ Gas sensors are primarily used to detect the surrounding gas.



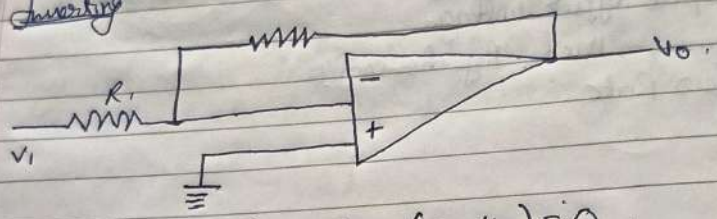
Advantages

Simple structure, low price, high detection sensitivity, fast response speed, and so on.

Biosensors

1] Explain inverting and non-inverting amplification.
2] Evaluate $v_o = [v_1 - 2v_2]$
3] Evaluate $v_o = -(v_1 + v_2)$
4] Explain integrator and differentiator with waveform
5] Enlist characteristic of an ideal op-amp.

1] Inverting



$$\frac{(0-v_1)}{R_1} + \frac{(0-v_2)}{R_f} = 0.$$

An inverting amplifier ~~take~~ the ~~out~~ input through its inver
terminal through a resistor R_1 and produces its amplified ver
is the output. This amplifier not only amplifies the input
also ~~out~~ invert it

ote that the ~~out~~ inverting and non-inverting termin
are equal voltage and physically ~~they~~ there is
rt between them but virtually ~~are~~ they are in s
tween them.

Operational Amplifier.

Operational op-amp is a direct coupled high gain amplifier that can be operate in ac and dc voltage.

operational amplifier → Inverting terminal
→ Non-Inverting terminal.

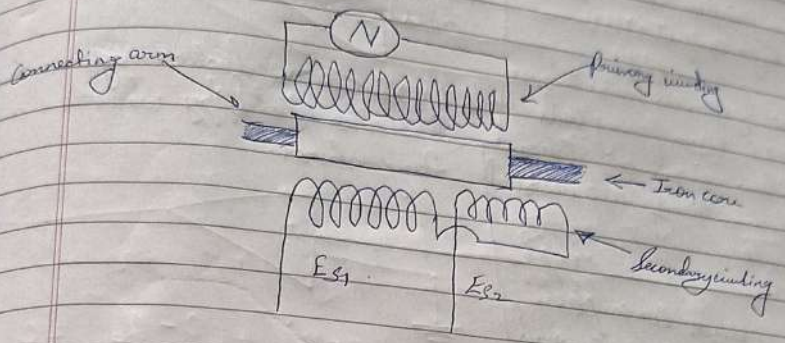
Characteristic of operational Amplifier.

- open loop voltage gain
- output offset voltage
- Common mode Rejection ratio
- Slew Rate.

3] Resistance temperature detectors have high ~~resistance~~ accuracy. This means that their electric resistance varies gradually

4] It is known that the metals used in RTD have linear relationship The variation in their resistance values follows a linear curve with respect to the temperature values.

(5)



1] The transformer and LVDT share a similar construction It consists of one primary windings and two secondary windings [S_1 & S_2].

2] The primary and secondary windings are bonded by a hollow cylinder known as the former.

3] The primary winding is at the centre and the secondary windings are present on both sides of the primary windings at an equal distance from the center.

1] Type of Sensors

a) Proximity Sensor: This Sensor is used to detect the distance between two object or detect the presence of an object.

b] Temperature Sensor: Monitoring temperature of used devices in industrial applications it is basically used to measure temperature.

c] Ultrasonic Sensor: can measure the distance to wide range of objects regardless of shape.

d] Vibration Sensor: Detect the vibration of any object.

e] Gas Sensors: It measures and detects concentration of different gases.

f] Touch Sensors: Touch Sensing devices detect physical contact on a monitored surface.

(2) There are 3 types of temperature Sensors namely Thermocouple, RTD, Thermistor.

2] Resistor Temperature Detector: Some of the metals that makes up RTDs are platinum, nickel and copper. Materials that make up RTDs must be conductive and must show linear change in resistance.

1] Enlist type of sensor. explain bio sensors with example.
2] Enlist type of temperature sensor and explain any one.
3] Draw and Explain Construction of LVDT with advantage and disadvantages.
4] Draw and explain Strain gauge
5] Explain the gas sensors
6] Explain thermocouple
7] Enlist type of sensors.

4] The entire coil assembly remains stationary during the displacement measurement. The moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer, it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have sensing coils with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Less power consumption: consume less power compared to other transducers.	

Strain Guage: A strain guage is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain guage detect minute geometrical changes as a resistance changes which indicate the level of stress of the material.

4] The entire coil assembly remains fixed during displacement measurement the moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: for minute variations in a magnetic core position LVDT's provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTS have bearing coils with low impedance they can produce extremly low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Lets power consumption consume less power compared to other transducers.	

5] Strain Guage: A strain guage is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain guage detect minute geometrical changes as a resistance changes which indicate the level of stress of the material

4] The armature coil assembly remains stationary throughout the distance measurement the moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have sensing coils with low impedence they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Less power consumption consume less power compared to other transducers.	

7] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detect minute geometrical changes as well as subsequent changes which indicate the level of stress of the material

4] The entire coil assembly remains fixed during the distance measurement the moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] high output: for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] low hysteresis noise because LVDTs have sliding scale with low impedance they can produce extremly low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Less power consumption consume less power compared to other transducers.	

7] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detects minute geometrical changes as well as resistance changes which indicate the level of stress of the material.

4] The entire coil assembly remains stationary during the distance measurement. The moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output : for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have bearing seals with low impedance. They can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also affected by vibrations and temperatures.
3] Less power consumption. Consume less power compared to other transducers.	

NotesSociety

Strain Guage: A strain guage is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain guage detect minute geometrical changes as a resistance changes which indicate the level of stress of the material

4] The armature coil assembly remains stationary throughout the distance measurement. The moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT:

1] High output: For minute variations in a magnetic core position LVDTs provide a high output.

2] Low hysteresis noise: Because LVDTs have bearing scale with low impedance they can produce extremely low electrical signals.

3] Lets power consumption: Consume less power compared to other transducers.

Disadvantages:

Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra shield is required to protect from stray magnetic field.

As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.

Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detect minute geometrical changes as well as changes which indicate the limit of stress of the material

4] The armature coil assembly remains stationary during the displacement measurement. The moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: Small minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra shield is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have sliding coils with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Less power consumption consume less power compared to other transducers.	

7] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detect minute geometrical changes as a resistance changes which indicate the level of stress of the material

4] The armature coil assembly remains stationary during the distance measurement as it is a moving part of the LVDT it an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra screen is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have sensing coils with low impedance they can produce extremly low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
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7] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detect minute geometrical changes as a result changes which indicate the level of stress of the material

4] The entire coil assembly remains stationary during the entire measurement & moving part of the LVDT is an core made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have bearing scale with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Less power consumption consume less power compared to other transducers.	

7] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detect minute geometrical changes as a result changes which indicate the level of stress of the material

4] The armature coil assembly remains stationary throughout the distance measurement the moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] high output: for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] low hysteresis noise because LVDTs have sensing coils with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Less power consumption consume the less power compared to other transducers.	

5] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detect minute geometrical changes as a result changes which indicate the level of stress of the material

4] The entire coil assembly remains left away bringing the distance measurement as moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic fields.
2] Low hysteresis noise because LVDTs have bearing scale with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also affected by vibrations and temperatures.
3] Less power consumption ensures the less power compared to other transducers.	

7] Strain Guage: A Strain guage is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain guage detect minute geometrical changes as well as resistance changes which indicate the level of stress of the material

4] The armature coil assembly remains fabricary during the distance measurement the moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have sensing coils with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Less power consumption consume less power compared to other transducers.	

7] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

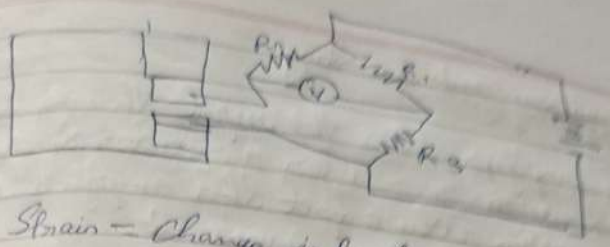
The strain gauge detect minute geometrical changes as a result changes which indicate the level of stress of the material

4] The entire coil assembly remains safe away during the balance measurement as mainly part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra shield is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have sliding scale with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also affected by vibrations and temperatures.
3] Less power consumption consume less power compared to other transducers.	

7] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detects minute geometrical changes as well as resistance changes which indicate the level of stress of the material.



Strain = Change in length / original length = dl / l

- The following type of Strain guages.

1) wire Strain guage
2) Rosette type
   Helical type
   Foil Strain guages.

4] The entire coil assembly remains fixed during the displacement measurement the moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: For minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have sensing coils with low impedance they can produce extremly low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Less power consumption ensures the less power compared to other transducers.	

5] Strain Guage: A strain guage is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain guage detect minute geometrical changes as well as resistance changes which indicate the level of stress of the material

4] The armature coil assembly remains stationary throughout the displacement measurement as moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have sensing coils with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Lets power consumption consume less power compared to other transducers.	

7] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detects minute geometrical changes as it's resistance changes which indicate the level of stress of the material

4] The entire coil assembly remains balanced during the distance measurement as moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: For minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have bearing coils with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Lets power consumption consume less power compared to other transducers.	

7] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detect minute geometrical changes as well as resistance changes which indicate the level of stress of the material

4] The armature coil assembly remains rotationary during the displacement measurement as moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: For minute variations in a magnetic core position LVDT's provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDT'S have sensing coils with low impedance they can produce extremly low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Lets power consumption consume less power compared to other transducer's.	

7] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detect minute geometrical changes as a resistance changes which indicate the level of stress of the material

4] The secondary coil assembly remains fixed during the displacement measurement and moving part of the LVDT is an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: For minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have sliding coils with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Less power consumption consume less power compared to other transducers.	

7] Strain Gauge: A strain gauge is a device that measures the deformation an object when force is applied through changes in electrical resistance.

The strain gauge detect minute geometrical changes as well as resistance changes which indicate the level of stress of the material

3) The entire coil assembly remains stationary during the displacement measurement as moving part of the LVDT is an core made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: for minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise because LVDTs have bearing scale with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Less power consumption consume less power compared to other transducers.	

7] Strain Gauge: A strain gauge is a device that measures the deformation of an object when force is applied through changes in electrical resistance.

The strain gauge detect minute geometrical changes as well as resistance changes which indicate the level of stress of the material

4] The armature coil assembly remains fabricary throughout the distance measurement. It is moving part of the LVDT it an arm made of magnetic material.

Advantages LVDT	Disadvantages
1] High output: For minute variations in a magnetic core position LVDTs provide a high output.	Since LVDT is an inductive transducer it is sensitive to the stray magnetic field hence an extra setup is required to protect from stray magnetic field.
2] Low hysteresis noise Because LVDTs have sensing coils with low impedance they can produce extremely low electrical signals.	As LVDT is an electromagnetic device it is also effected by vibrations and temperatures.
3] Lets power consumption Consume less power compared to other transducers.	

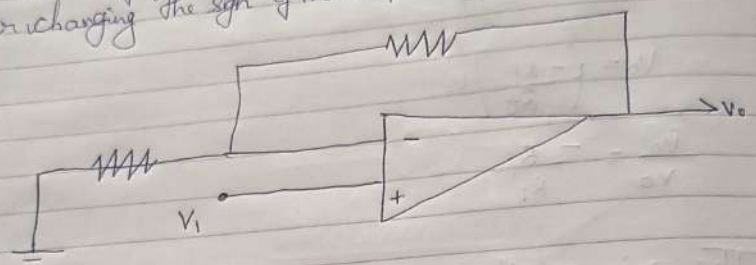
7] Strain Gauge: A strain guage is a device that measures the deformation an object when force is applied through changes in electrical resistance.

The strain gauge detect minute geometrical changes as a resistance changes which indicate the level of stress of the material

2] Non-inverting amplifier.

1] A non-inverting amplifier takes the input through its non-inverting terminal and produces its amplified version as the output.

2] This amplifier just amplifies the input without inverting or changing the sign of the output.



3] The input voltage V_i is directly applied to the non-inverting input terminal of op-amp so the voltage at the non-inverting input terminal of the op-amp will be V_i.

4] By using voltage division principle we can calculate the voltage at its non-inverting input terminal

$$V_1 = V_i$$

$$V_o \left(\frac{R_1}{R_1 + R_f} \right) = V_i$$

$$\frac{V_o}{V_i} = \frac{1 + R_f}{R_1}$$

5] According to the short virtual concept the voltage at the inverting input terminal of an op-amp will be zero volts.

6]
$$\frac{(0 - V_i)}{R_1} + \frac{(0 - V_o)}{R_f} = 0$$

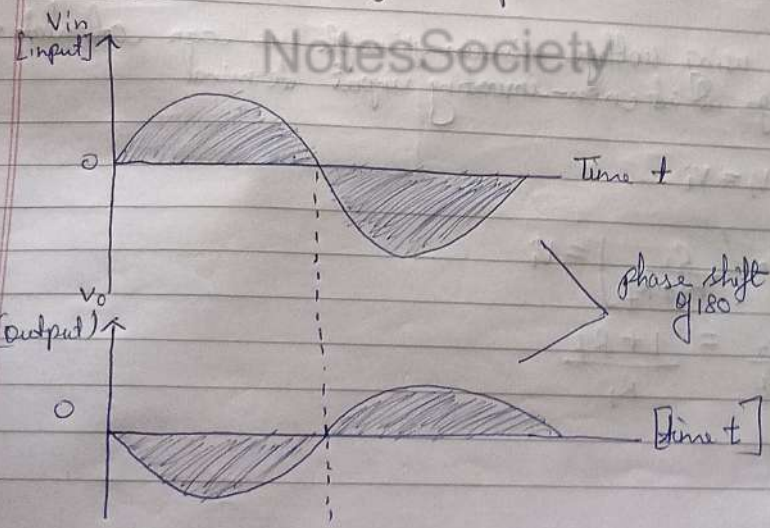
$$\frac{-V_i}{R_1} = \frac{V_o}{R_f}$$

$$V_o = \left(-\frac{R_f}{R_1}\right) V_i$$

$$\frac{V_o}{V_o} = -\frac{R_f}{R_1}$$

7] The gain of the inverting ~~amplified~~ amplifier is having a negative sign. It indicates that there exists a 180 phase difference between the input and the output.

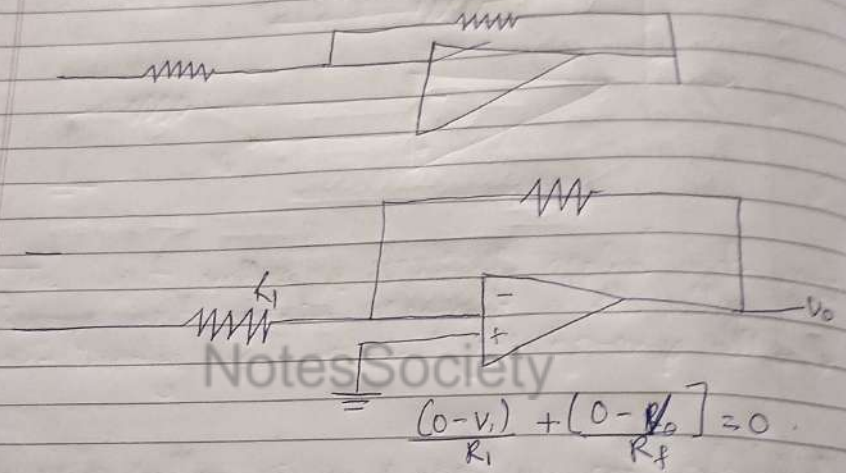
Waveform of Inverting op-amp



] Inverting and Non inverting.

→] An inverting amplifier takes the input through its inverting terminal through a resistor a resistor R_1 and produces its amplified version as the output this amplified not only amplifies the input but also inverts it

] The circuit diagram of amplified inverting.



$$\frac{(0-V_i)}{R_1} + \left[\frac{0-V_o}{R_f}\right] = 0$$

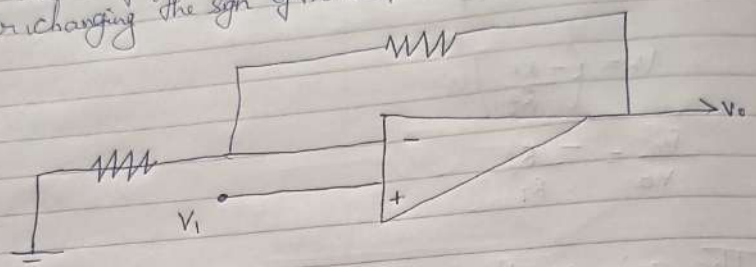
] Note that the voltage at the inverting input terminal is equal to the voltage of its non-inverting input terminal.

Physically there is no short between those two terminals but virtually there are in short with each other.

2] Non-inverting amplifier.

1] A non-inverting amplifier takes the input through its non-inverting terminal and produces its amplified version as the output.

2] This amplifier just amplifies the input without inverting or changing the sign of the output.



3] The input voltage V_i is directly applied to the non-inverting input terminal of op-amp so the voltage at the non-inverting input terminal of the op-amp will be V_i.

4] By using voltage division principle we can calculate the voltage at its non-inverting input terminal

$$V_1 = V_i$$

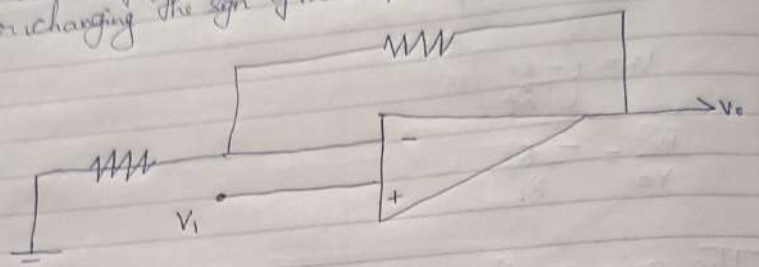
$$V_o \left(\frac{R_1}{R_1 + R_f} \right) = V_i$$

$$\frac{V_o}{V_i} = \frac{1 + R_f}{R_1}$$

1] Non-inverting amplifier

2] A non-inverting amplifier takes the input through its non-inverting terminal and produces its amplified version as the output.

3] This amplifier just amplifies the input without inverting or changing the sign of the output.



3] The input voltage V_i is directly applied to the non-inverting input terminal of op-amp so the voltage at the non-inverting input terminal of the op-amp will be V_i

4] By using voltage division principle we can calculate the voltage at its non-inverting input terminal

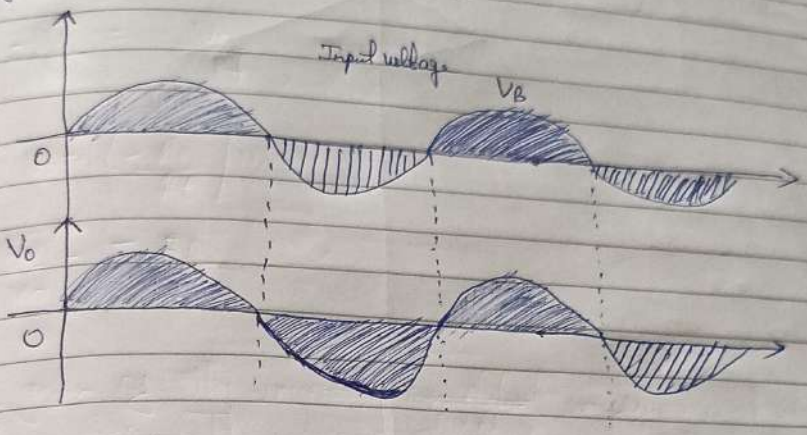
$$V_1 = V_i$$

$$V_o \left(\frac{R_1}{R_1 + R_f} \right) = V_i$$

$$\frac{V_o}{V_i} = \frac{1 + R_f}{R_1}$$

6) The gain of the non-inverting amplifier is having a positive sign it indicates that there is no phase difference between the input and the output.

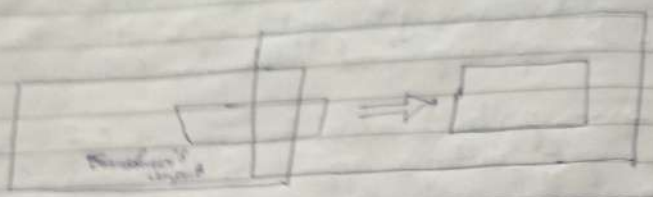
Waveforms

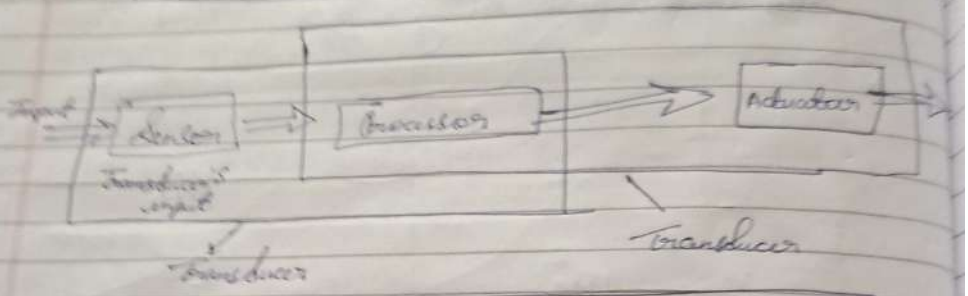


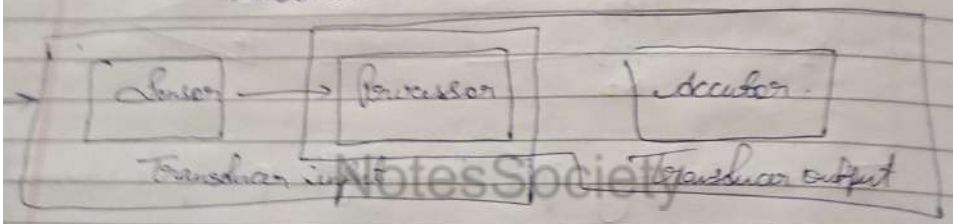
Waveforms of non-inverting amplifier.

1) Draw and explain block diagram sensors.

→





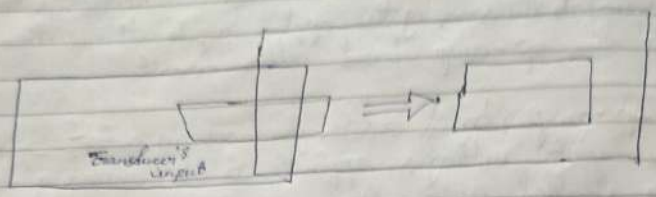


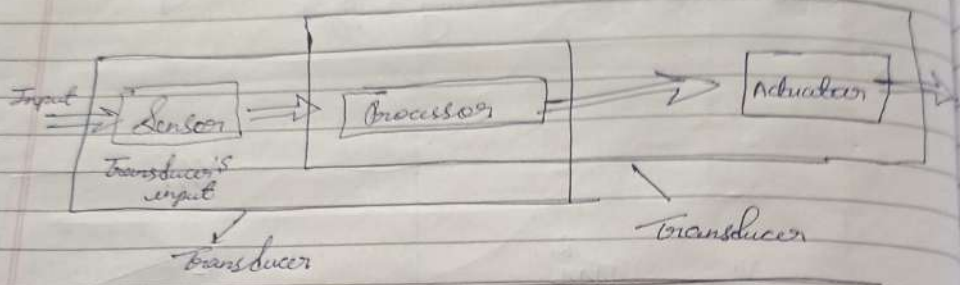
Input → Sensor → Processor → Actuator → output

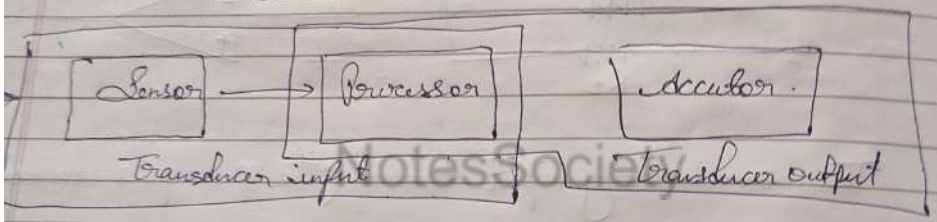
Input Sensor → Processor → Actuator → output
Input transducer
Output transducer

1] Draw and Explain block diagram Sensors.

→







Input → Sensor → Processor → Accutor → output

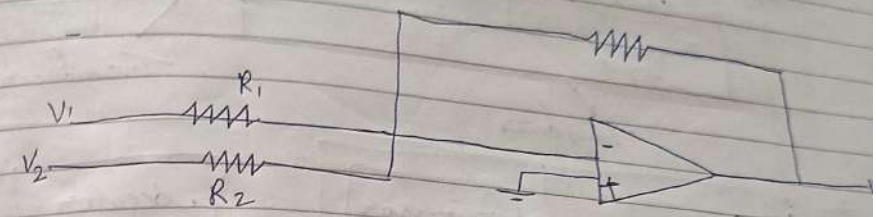
Input Sensor → Processor → Accurator → output
Input transducer
Output transducer

Q/

1] An adder is an electric circuit that produces an output which is equal to the sum of the applied inputs. This section discusses about the op-amp based adder circuit.

2] An op-amp based adder produces an output equal to the sum of the input voltages applied at its inverting terminal it is also called as a summing amplifier.

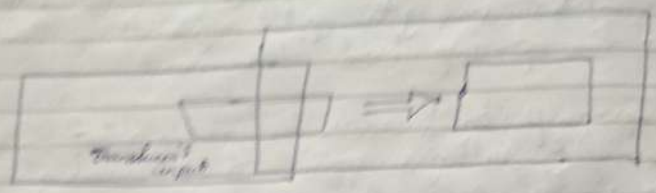
3]

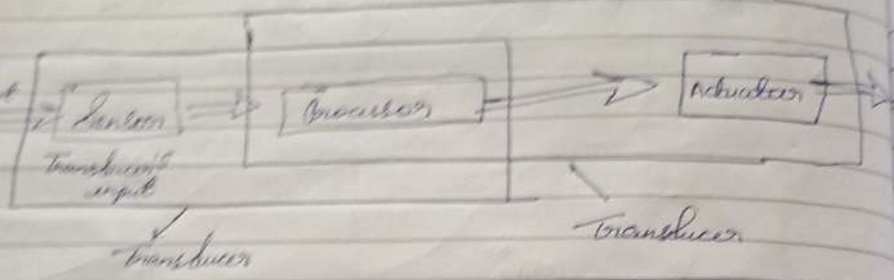


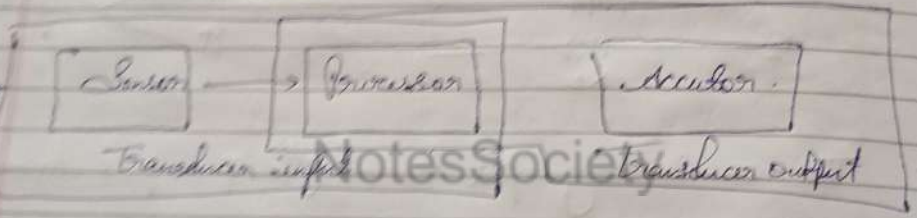
The non-inverting input terminal of the op-amp is connected

1] Draw and Explain block diagram sensors.

→





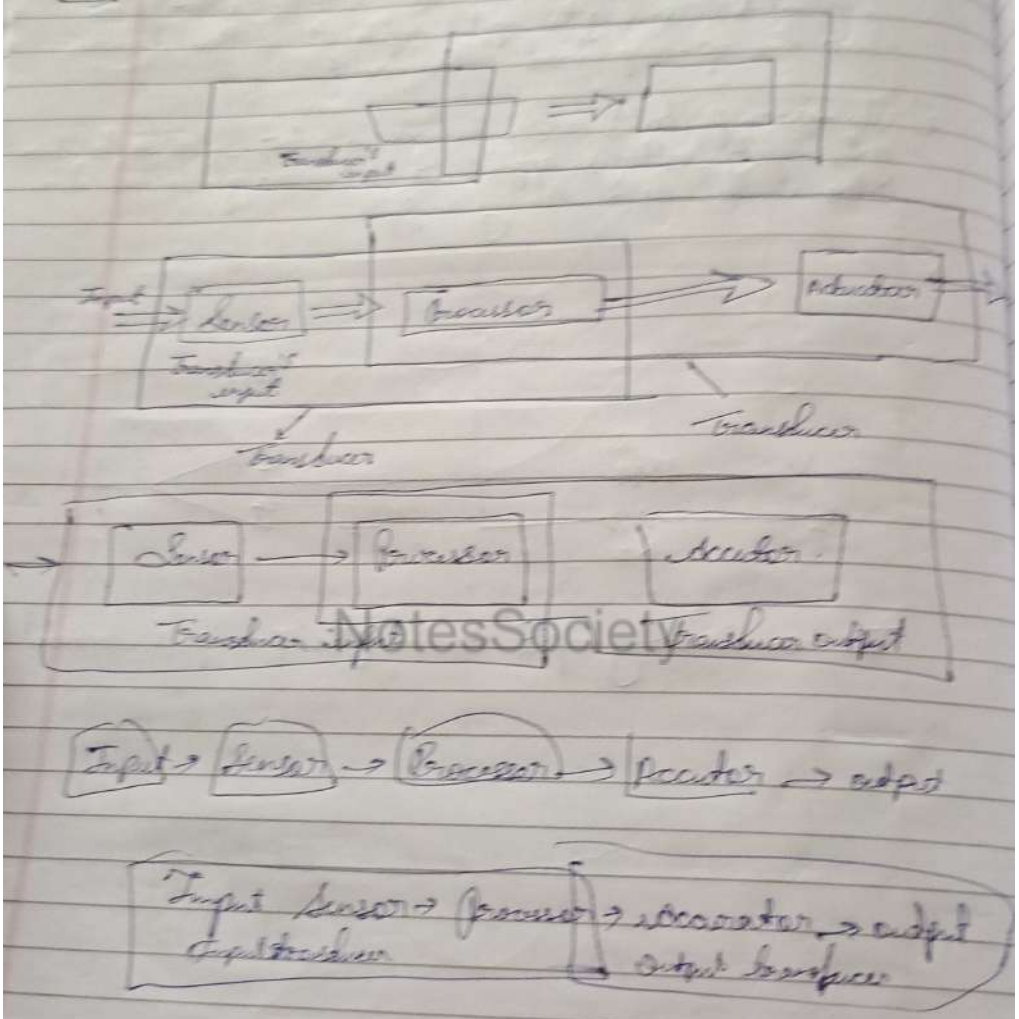


Input → Sensor → Processor → Actuator → output

Input Sensor → Processor → Actuator → output
Input transducer Output transducer

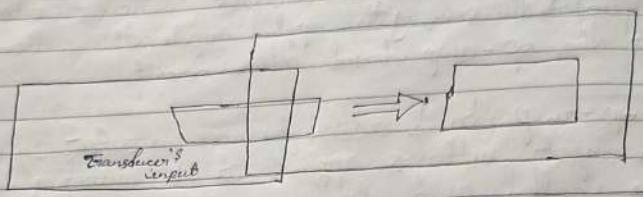
3 Draw and explain block diagram sensors.

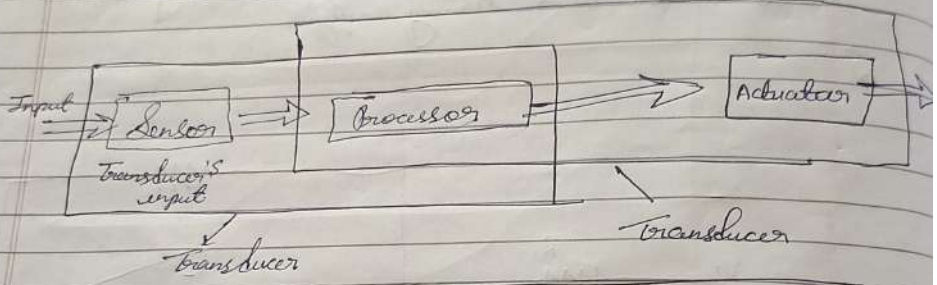
→

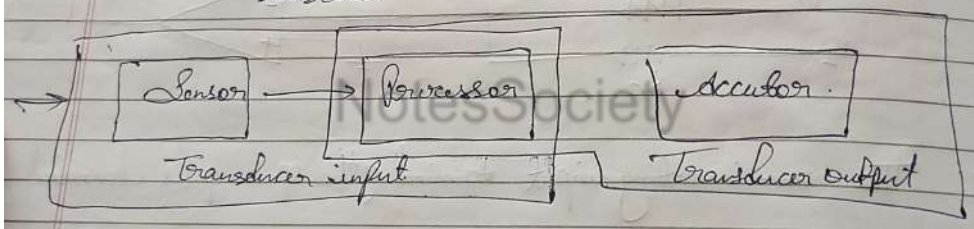


1] Draw and Explain block diagram Sensors.

→



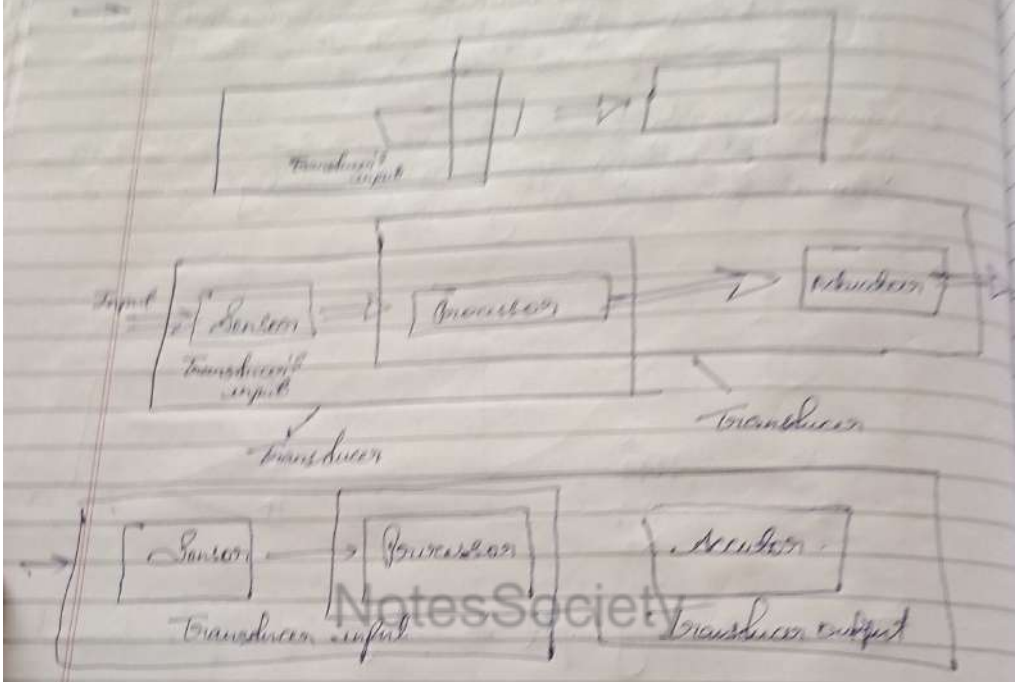




Input → Sensor → Processor → Accutor → output

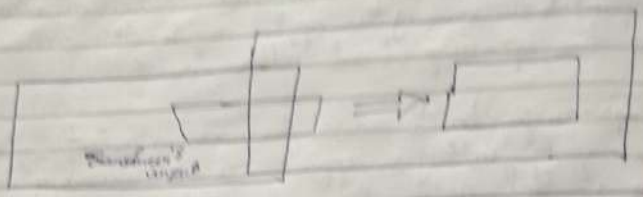
Input Sensor → Processor → Accurator → output
Input transducer
Output transducer

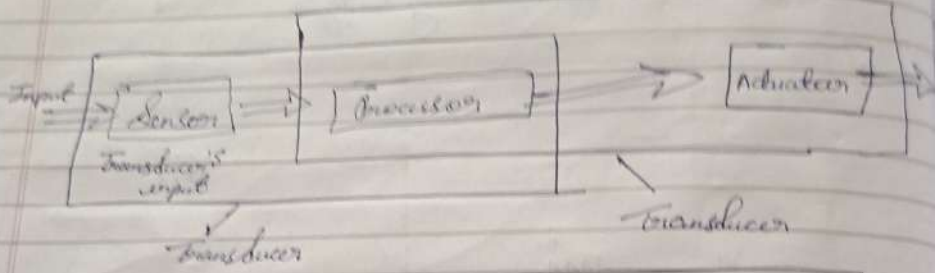
7. Draw and explain block diagram sensors

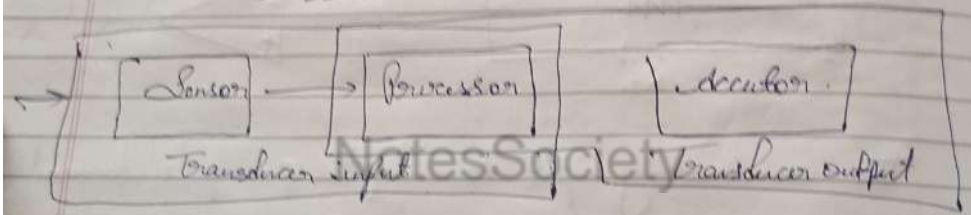


1] Draw and Explain block diagram Sensors

→





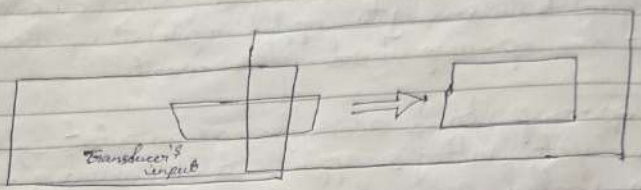


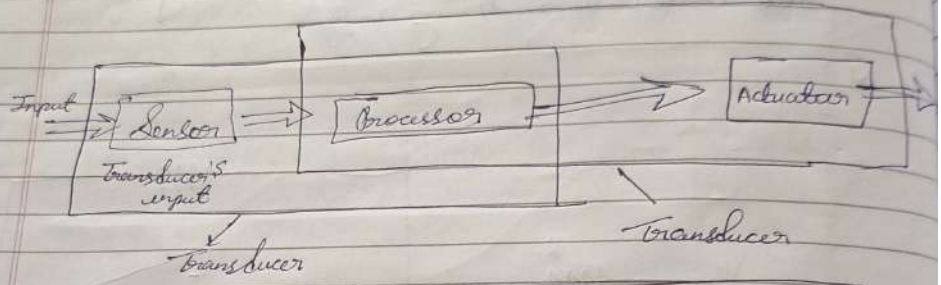
Input → Sensor → Processor → Accutor → output

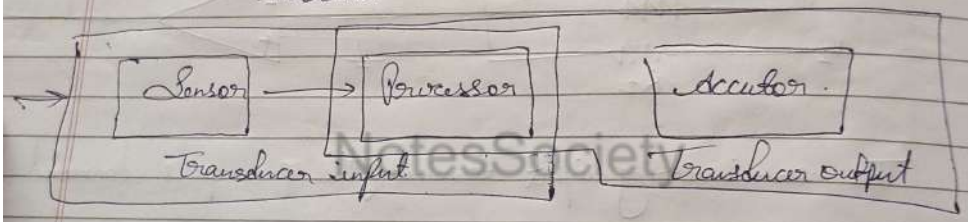
Input Sensor → Processor → Accurator → output
Input transducer
Output transducer

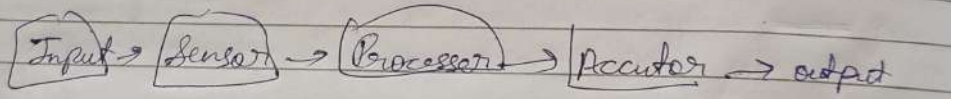
1] Draw and Explain block diagram Sensors.

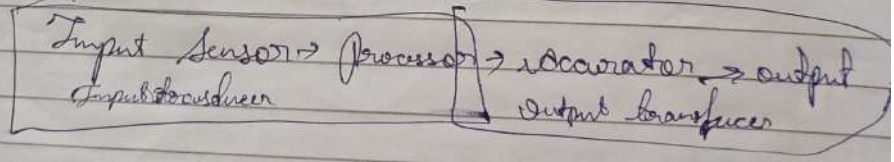
→





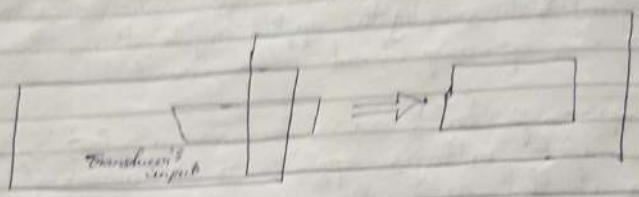


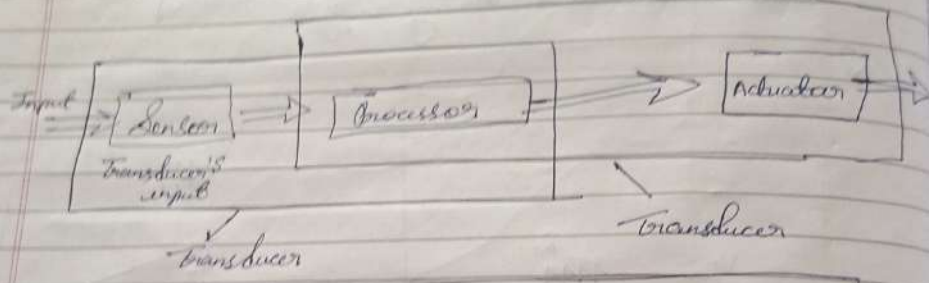


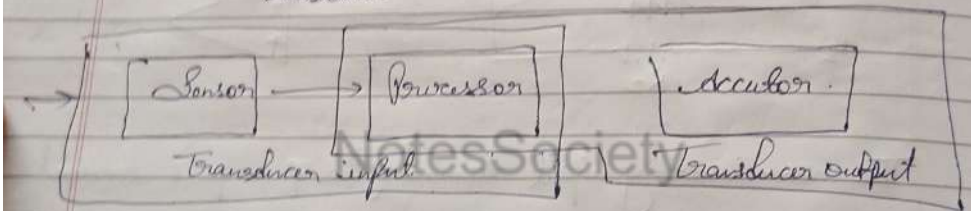


1] Draw and Explain block diagram sensors.

→



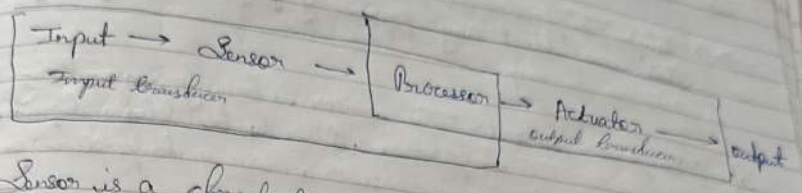




Input → Sensor → Processor → Accutor → output

Input Sensor → Processor → Accurator → output
Input transducer
output transducer

1] Draw and Explain block diagram of Sensors



→ 1] Sensor is a characteristics of any material which have a ability to detect any physical quantity.

2] Transducer is a device which convert the signal to another signal.

3] As the input is given to the sensor. as a signal through the transducer it convert the signal in other signal.

4] When the signal pass through sensor it detect the signal and send to the processor.

5] The processor process the signal and get to know which is present in front of the sensor or what not and according to sensor behaviour it sense the thing.

6] After processing the signal by the process it get sended to the actuator which make the signal again into possible way to make the output of the signal.

7] Then finally output come and sense the presence or ab of any quantity based upon the sensors ability.

5] Exist type of sensors.

→ 1] ~~Temp~~ Temperature is a characteristic of device or material that can detect any presence of physic quantity any particular quantity.

a] Temperature Sensors: This sensor is basically monitoring the temperature it could be solid, liquid, or in gases state the increase or decrease of temperature get detected.

b] Radiation Sensor: This sensory is used to get the radiation detection is any alpha, beta, gamma radiation is presence in air or any particular particle.

c] Position Sensor: This sensor is use to detect the position of any objects in.
It has wide orange in use of robotic because of this sensor robot get the ability to walk and etc.

d] Gas Sensor: It detect the so concentration of different ~~Sensors~~ gases present in the environment or in atmosphere.

e] Proximity Sensor: This sensors is used to detect the distance between two objects or detect the presence of any other objects it used in elevators, parking lots, autonomous robotics etc

f] Image Sensor: It is used for distance measurement, pattern matching color checking and also capture motions

Touch Sensing devices detect physical contacts on a monitored surface. Touch Sensors are

1) The circuit of the thermocouple is shown in figure below. The circuit consist of two dissimilar metals, these metals are joined together in such a manner that they are creating two junction

2) Let the P and Q are the two junction of the thermocouple and T_1 and T_2 are the temperature of the junction.

3) As the temperature of the junctions is different from each other. The EMF generates in the circuit.

If the temperature of the junction becomes equal the equal and opposite EMF generate in the circuit and zero current flow through it.

If the temperature of the junction become unequal the potential difference induces through it

Advantage		Disadvantage
	1) cheaper	1) low accuracy
	2) wide range	2) recalibration
	3) fast time response	3) nickel, alloy,

2] Enlist types of temperature sensor and explain any one.

→ 1] There are three type of temperature sensors.
1] Thermocouple.
2] RTD
3] Thermister.

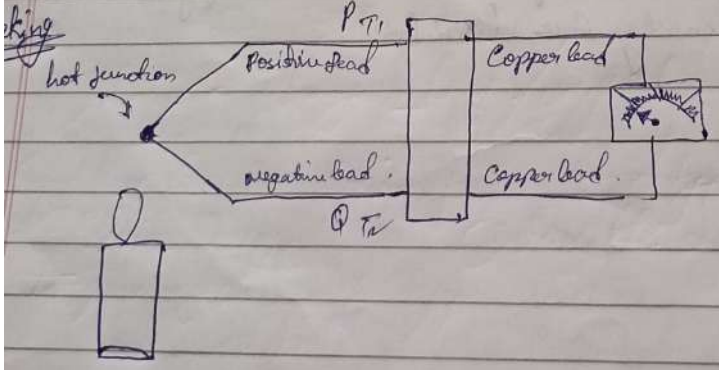
a] The thermocouple is a device that converts temperature difference into an electric voltage, based on the principle of the thermoelectric effect.

~~b] It is a type of sensor that can measure temperature at a specific point or location~~

b] Thermoelectric effect is the phenomenon of generating an electric voltage due to a temperature difference between two different metals and metal alloys.

c] Thermocouple sensor can measure temperature at a specific point or location.

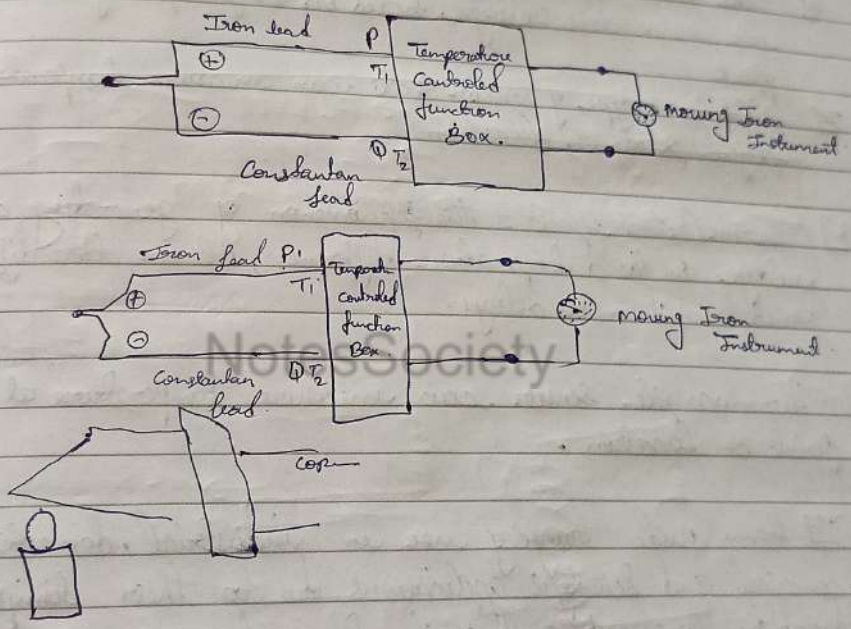
d] It have wide range of use in industrial, domestic, comerical and scientific applications due to their simplicity, durability, low cost, and wide temperature range.



3] Explain types of ~~Sensors~~ temperature sensor and explain any one.

→ There are three type of sensors which detect the temperature.

1] Thermocouple
2] RTD
3] Thermister



The circuit of the thermocouple is shown in the above figure.
The circuit consist of two dissimilar

Octal to binary.

$(637.736)_8 = (?)_2$.

~~(110011~~

$= (110\ 011\ 111\ 111\ 011\ 110)_8$.

Octal to decimal

$(6327.4051)_8 = (?)_{10}$.

$= 6\times8^3 + 6\times8^2 + 6\times8^1$

$(6\times8^3 + 3\times8^2 + 2\times8^1 + 7\times8^0) + (4\times8^{-1}) + 0\times8^{-2} + 5\times8^{-3} + 5\times10^{-3} + 1\times8^{-4}$

$= 3287.51001$

Octal to binary:

$(637.736)_8 = (?)_2$.

$= (110011$

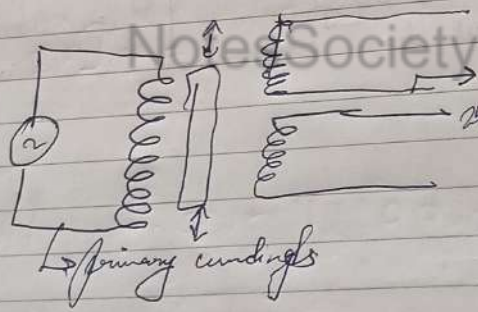
4] Draw and Explain construction of LVDT with advantage and disadvantage.

→ Linear Variable Differential transformer (LVDT) can be of many types based on their construction, size, and specific application

1] AC LVDT: The AC LVDT is the most common and most of LVD when in the

Many of type of LVDT → AC LVDT
→ DC LVDT
→ Miniature LVDT

Electromagnetic Induction
↓
Displacement
↓



Strain = Change in length / original length dl/lo

Grid type & wire strain gauges ~~Grid type &~~ Grid type
Rosette type ② Rosette type
Torque type ~~Torque~~ Torque type
Helical
Foil strain gauge Semiconductor strain gauge

Draw and explain construction of LVDT with advantage and disadvantage.

Liner variable Differential transformer (LVDT) can be of many types based on their construction, size, and specific application

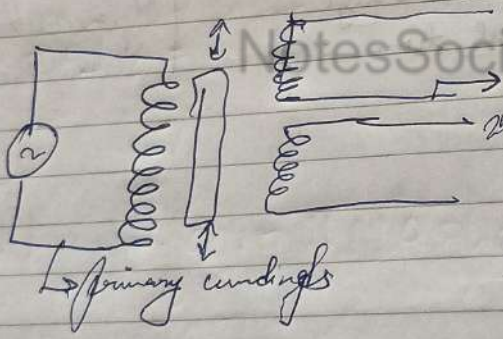
AC LODT: The AC LVDT is the most common and most of LVD when in th

Drawing

Type of LVDT → AC LVDT
→ DC LVDT
→ Miniature LVDT

Electromagnetic induction

Displacement



Strain = Change in length / original length dL/Lo

Type of wire strain gauges Grid type Grid type
Rosette type ② Rosette type
Wire type Tongue type
Helical
Foil Strain gauge Semiconductor Strain gauge

* Hexadecimal to decimal

$(3A.2F)_{16} = [?]_{10}$

$= 3\times16^1 + 10\times16^0 + 2\times16^{-1} + 15\times16^{-2}$

$= (58.1835)_{10}$

$[FFF\ F]_{16} = [?]_{10}$

$= 15\times16^3 + 16^2\times15 + 15\times16^{-1} + 15\times16^{-2}$

$= (255.9960)_{10}$

* Hexadecimal to octal

$[3A.2F]_{16} = [?]_8$

↓ Binary

$= (00011\ 1010.0010\ 1111\ 00)_2$

↓

$[072.136]_8$

Q. Hexadecimal to Binary.

=>

(2FE

Decimal to octal.

$[247.6875]_{10} = [?]_8$

8 |	247	7
8 |	30	6
	3	

$\therefore 247 = 367$

$0.6875 \times 8 = 5.5$

$0.5 \times 8 = 4.0$

$[0.6875]_{10} = 0.54$

$\therefore [247.6875]_{10} = (367.54)_8$

8 |	247
8 |	30

Decimal to hexadecimal.

$[675.625)_{10} = (?)_{16}$

16 |	675	3
16 |	42	10
	2	

$675 = 2A3$

$[As\ 10 = A]$

0.625×16

$10 \rightarrow A$

$[0.625] = A$

$\therefore (675.625)_{10} = [2A3.A]_{16}$.

Decimal ~~to~~ octal.

$[247.6875]_{10}$ in $= [?]_8$

8	247
8	3

2] ~~Binary to~~ decimal

$(101101.10101)_2 = (?)_{10}$

$(1 \times 2^5 + 0 \times 24 + 1 \times 23 + 1 \times 2 + 0 \times 21$
$+ 1 \times 20 + 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$
$+ 0 \times 2^{-4} + 1 \times 2^{-5}$

$= 45.65625.$

3] ~~Binary to~~ decimal

$(1100.1011) = [?]_{10}$

$(1 \times 2^3 + 1 \times 2^2 + 0 \times 2 + 0\ 2^0 + 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} +$

$= 12.6875.$

Binary to hexadecimal

2] $(1011101.10001001)_2 = (?)_{16}$ group of 4

$= [01011101.10010010]$

$= [5D.92]_{16}$

3] $(100100.111111)_2 = (?)_{16}$

$= (00100100.\overline{111}\ 1100)$ group of 4

$= [24.FC]$

8]

$$\begin{array}{r} 8 \\ 7 \\ \hline 01 \end{array}$$

Binary to hexadecimal

1] $(1011101 \cdot 10001001)_2 = (?)_{16}$

group of 4

$= [01011101 \cdot 10010010)$

$= [5D \cdot 92]_{16}$

3] $(100100 \cdot 111111)_2 = (?)_{16}$

$= (00100100 \cdot \overline{111}\ 11100)$ group of 4

$= [24 \cdot FC]$

8] 8
7
01