15EI203J-TRANSDUCER ENGINEERING LAB MANUAL

Department of Electronics and Instrumentation Engineering

Faculty of Engineering and Technology
Department of Electronics and Instrumentation Engineering
SRM University, SRM Nagar
Kattankulathur – 603203
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Tamil Nadu

CONTENTS

1. MARK ASSESSMENT DETAILS

ALLOTMENT OF MARKS:

Internal assessment = 60 marks

Practical examination = 40 marks

Total = 100 marks

INTERNAL ASSESSMENT (60 MARKS)

Split up of internal marks

Record	5 marks
Model exam	10 marks
Quiz/Viva	5 marks
Experiments	40 marks
Total	60 marks

PRACTICAL EXAMINATION (40MARKS)

Split up of practical examination marks

Aim and Procedure	25 marks
Circuit Diagram	30 marks
Tabulation	30 marks
Result	05 marks
Viva voce	10 marks
Total	100 marks

2. GENERAL INSTRUCTIONS FOR LABORATORY CLASSES

1. Enter the Lab with CLOSED TOE SHOES.
2. Students should wear lab coat.
3. The HAIR should be protected, let it not be loose.
4. TOOLS, APPARATUS and COMPONENT sets are to be returned before leaving the lab.
5. HEADINGS and DETAILS should be neatly written
   i. Aim of the experiment
   ii. Apparatus / Tools / Instruments required
   iii. Theory
   iv. Procedure / Algorithm / Program
   v. Model Calculations/ Design calculations
   vi. Block Diagram / Flow charts/ Circuit diagram
   vii. Tabulations/ Waveforms/ Graph
   viii. Result / discussions .
6. Experiment number and date should be written in the appropriate place.
7. After completing the experiment, the answer to pre lab viva-voce questions should be neatly written in the workbook.
8. Be REGULAR, SYSTEMATIC, PATIENT, ANDSTEADY.

3. SYLLABUS

15EI203J	Transducer Engineering			L	T	P	C
				2	0	2	3
Co-requisite:	NIL						
Prerequisite:	NIL						
Data Book / Codes/Standards	NIL						
Course Category	P	PROFESSIONAL ENGINEERING	INSTRUMENTATION ENGINEERING				
Course designed by	Department of Electronics and Instrumentation Engineering						
Approval	32nd Academic Council Meeting held on 23rd July, 2016						

PURPOSE	To enable the students to select and design suitable instruments to meet the requirements of industrial applications and various transducers used for the measurement of various physical quantities							
INSTRUCTIONAL OBJECTIVES		**STUDENT OUTCOMES**						
At the end of the course, student will be able to								
1.	Know the various types of error in instruments	a	c					
2.	Obtain the knowledge about various types of Sensors & Transducers and their working principle	b						
3.	Understand the various types of transducers like Resistive, Capacitive and Inductive	a	c					
4.	Learn some of the miscellaneous transducers	a		c				

Sl. No.	Description of experiments	Contact hours	C-D-I-O	IOs	Reference
1.	Characteristics of Strain gauge	2	C,O	3	1,2
2.	Characteristics of load cell	2	C,O	3	1,2
3.	Characteristics of thermistor	2	C,O	3	1,2
4.	Characteristics of RTD	2	C,O	3	1,2
5.	Characteristics of Thermocouple	2	C,O	3	1,2
6.	Loading effect of Potentiometer	2	C,O	3	1,2
7.	Characteristics of Synchros	2	C,O	4	1,2
8.	Characteristics of LVDT	2	C,O	4	1,2
9.	Characteristics of Piezo-electric transducer	2	C,O	4	1,2

10.	Characteristics of Hall-effect transducer	2	C,O	4	1,2
	Total contact hours	20			

LEARNING RESOURCES	
Sl. No.	**REFERENCE BOOKS**
1.	Sawhney. A.K, "*A Course in Electrical and Electronics Measurements and Instrumentation*", 18th Edition, DhanpatRai& Company Private Limited, 2007.
2.	Renganathan. S,"*Transducer Engineering*", 4^{th} edition Allied Publishers, Chennai, 2003.

Course nature				**Practical**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Experiments	Record	MCQ/Quiz/Viva Voce	Model examination	**Total**	Experiments
	Weightage	**40%**	**5%**	**5%**	**10%**	**60%**	**40%**
						End semester examination Weightage :	**40%**

STUDENT OUTCOMES:

a. An ability to know the standards to measure and to compute the statistical error analysis.

b. An ability to analyze and understand various sensors based on its classification and working principle.

c. An ability to identify the problem use the appropriate sensors with resistive, capacitive inductive or any other modern sensor technologies like fiber optic MEMS, nano, etc for multidisciplinary applications.

Exercise Number: 1

Title of the Experiment: **CHARACTERISTICS OF STRAIN GAUGE**
Date of the Exercise:

OBJECTIVE (AIM)

FACILITIES REQUIRED AND PROCEDURE OF THE EXPERIMENT

To verify the characteristics of strain gauge.

a) FACILITIES REQUIRED TO DO THE EXPERIMENT:

S.NO	APPARATUS	QUANTITY
1	Strain gauge	1
2	Digital multimeter	1
3	Weights(100-500gms)	5

b) THEORY:

Each metal has its specific resistance. An external tensile force (compressive force) increases (decreases) the resistance by elongating (contracting) it. Suppose the original resistance is R and a strain-initiated change in resistance is ΔR. Then, the following relation is concluded:

$$\Delta R = Ks\ \Delta L = Ks\ .\varepsilon\ R\ L$$

Where, Ks is a gauge factor, the coefficient expressing strain gauge sensitivity.

c) PROCEDURE:

1) Connect the multimeter to the strain gauge as shown

2) Verify the system and check if it is calibrated

3) Measure the output voltage for empty pan

4) Add 100 gram of weight and measure the output voltage and record it

5) Repeat the above process.

d) DESIGN PROCEDURE/ DESIGN CALCULATIONS:

Theoretical strain= (6*P*L)/(b*t^2*Y)us

P=applied load to the beam-1kg

t=thickness of beam=0.25cm

B=breadth of beam=2.8cm

L=length of the beam=21.58cm

Y=young's modulus=2*10^6 kg/cm^2

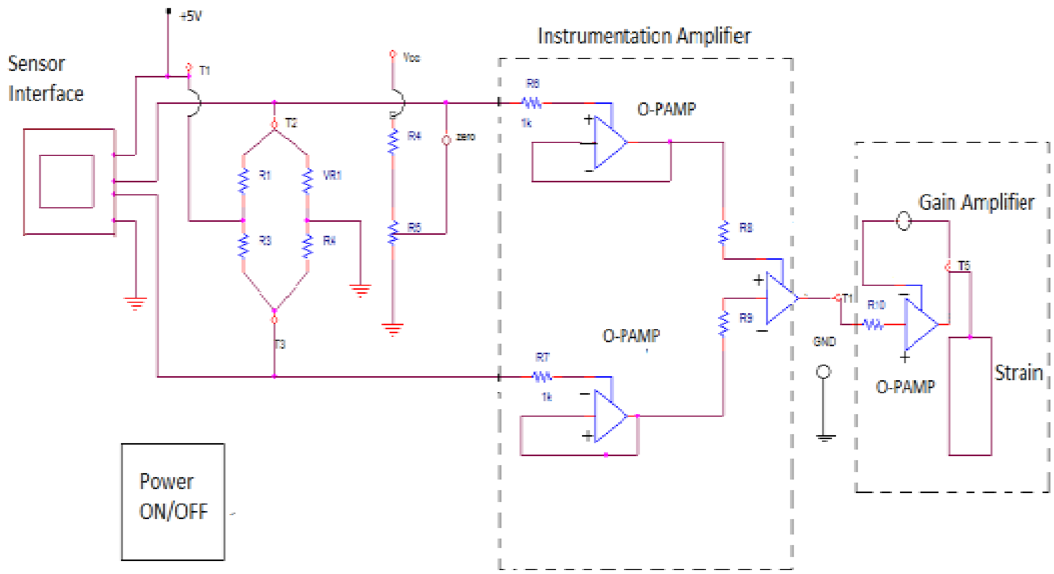
Gauge factor= (ΔR/R)/strain

Vin=5V

R=350 ohm

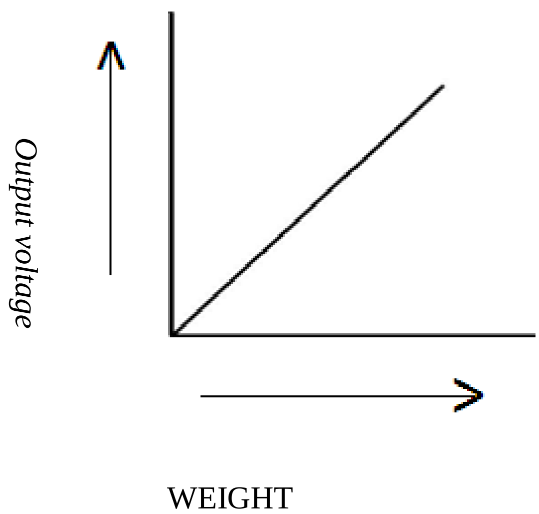
Vo/Vin=ΔR/R (at balanced condition)

e)CIRCUIT DIAGRAM:



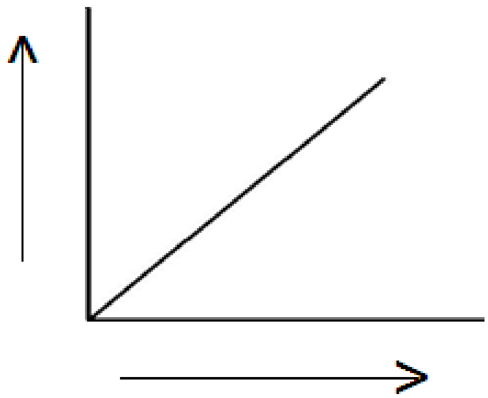
e) MODEL GRAPH:

Output voltage vs weight:



Strain vs weight

STRAIN



WEIGHT

f) TABULATION:

Loading			Unloading		
Applied load (gms)	Theoretical strain(μs)	Bridge voltage(v)	Applied load (gms)	Theoretical strain(μs)	Bridge voltage(v)

RESULT: Thus the characteristics of strain gauge were verified and the graph was plotted.

Pre lab questions:

1. What is the working principle of strain gauge?
2. What is piezo resistive effect?
3. What are the types of strain gauge?
4. Define gauge factor
5. What is inside the strain gauge?

Post lab questions:

1. How can you apply the principle of stain gauge?
2. What is passive transducer?
3. What are the application of stain gauge?

Exercise Number: 2

Title of the Experiment: **CHARACTERISTICS OF LOAD CELL**

Date of the Exercise:

OBJECTIVE (AIM) OF THE EXPERIMENT

To verify the characteristics of Load Cell.

FACILITIES REQUIRED AND PROCEDURE

a) FACILITIES REQUIRED TO DO THE EXPERIMENT:

s.no	Apparatus	Quantity
1	Load cell	1
2	Weights (50-500 gms)	1
3	Multimeter	1

b) THEORY:

A Load Cell is transducer that is used to create an electric signal whose magnitude is directly proportional to the force being measured. Load Cell utilises an electric membrane as the primary transducer and strain gauge as secondary transducer. The various type of load cell includes hydraulic load cell, pneumatic load cell, and strain gauge load cell. The other types include vibrating wire load cells which are useful in geo mechanical applications due to low amount of drift and capacitive load cells where capacitance of the capacitor s load presses the two plates of capacitor making them come closer to each other.

c) PROCEDURE:

1. Connections are made as per the circuit diagram.

2. Load in steps of 50gm is placed and the corresponding output voltage is noted and tabulated.

3. Similarly each load is removed one-by-one and the corresponding output voltage is noted down and tabulated.

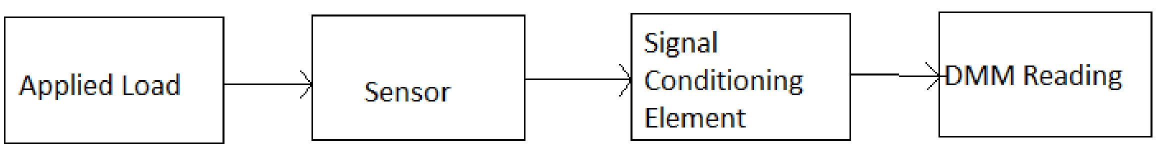
4. A graph is drawn with load on X-axis and output voltage on Y-axis.

d) DESIGN PROCEDURE/ DESIGN CALCULATIONS:

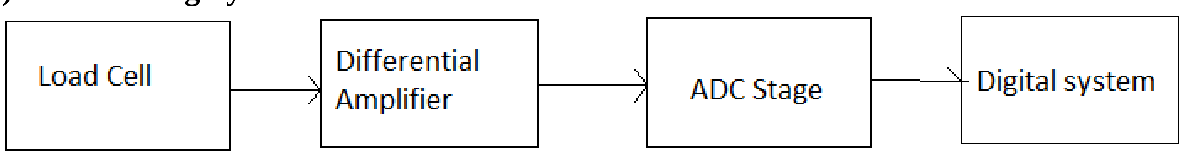
1. Sensitivity = $\frac{\text{Output voltage (mV)}}{Load\ (gm)}$

2. % Error = $\frac{\text{(Indicated value –Actual value)}}{Actual\ Value}$

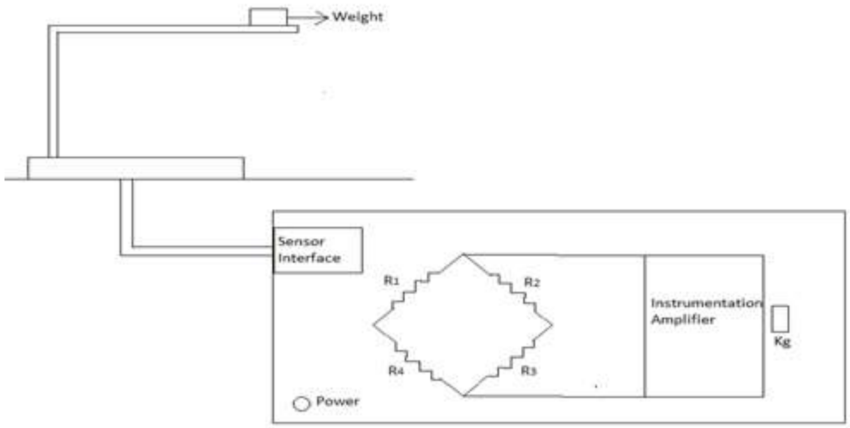
e) Block Diagram:



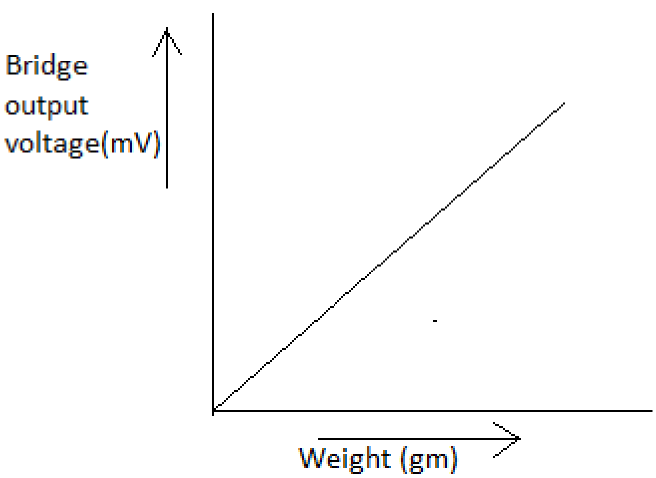
f) Measuring System:



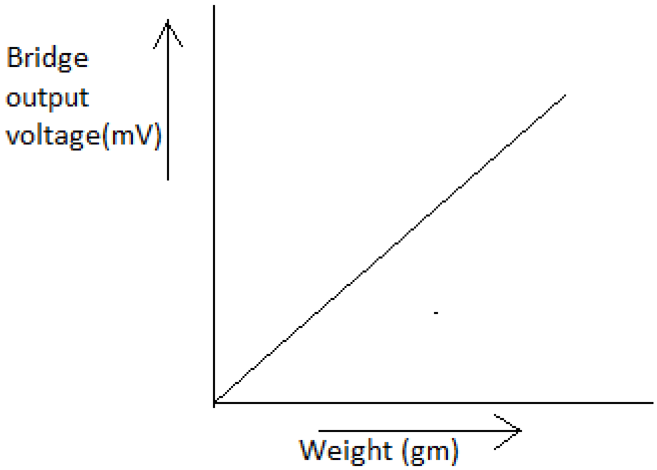
g) Load Cell Measurement:



h) MODEL GRAPH:



a. Loading



b. Unloading

i) **TABULATION:**

1. Loading

Weights (gms)	Indicated weights(kg)	Output voltage (mV)	Error%

2. **Unloading**

Weights (gms)	Indicated weights(kg)	Output voltage (mV)	Error%

RESULT: The characteristics of load cell were verified and the sensitivity of the load cell was found.

Pre lab questions:

1. What is the difference between strain gauge and load cell
2. What are the types of load cell?
3. What is the principle of load cell?
4. What is the sensor used in load cell?

Post lab questions:

1. What is the working principle of load cell?
2. What is the difference between load cell and strain gauge?
3. What are the applications of load cell?

Exercise Number: 3

Title of the Experiment: **CHARACTERISTICS OF THERMISTOR**

Date of the Exercise:

OBJECTIVE (AIM) OF THE EXPERIMENT

To verify the resistance temperature characteristics of given thermistor.

FACILITIES REQUIRED AND PROCEDURE

a) FACILITIES REQUIRED TO DO THE EXPERIMENT:

S.No	Apparatus	Range	Quantity
1	Thermistor	-	1
2	Thermometer	-	1
3	Multimeter	-	1
4	Heater	-	1

b) THEORY:

The thermistor is also a temperature sensitive resistor. While the thermocouple is the most versatile temperature transducer and the PRTD is thus sensitive. Of the three major categories of sensors, the thermistor exhibits by far the largest parameter change with temperature. Thermistors are generally composed of semiconductor materials. Although positive temperature coefficient units are available, most thermistors have a negative temperature coefficient (TC); that is, their resistance decreases with increasing temperature. The negative T.C. can be as large as several percent per degree Celsius, allowing the thermistor circuit to detect minute changes in temperature which could not be observed with an RTD or thermocouple circuit. The price we pay for this increased sensitivity is loss of linearity. The thermistor is an extremely non-linear device which is highly dependent upon process parameters. Consequently, manufacturers have not standardized thermistor curves to the extent that RTD and thermocouple curves have been standardized.

c) PROCEDURE:

1. Thermistor and thermometer are dipped into a beaker containing water.

2. Water is heated using heater.

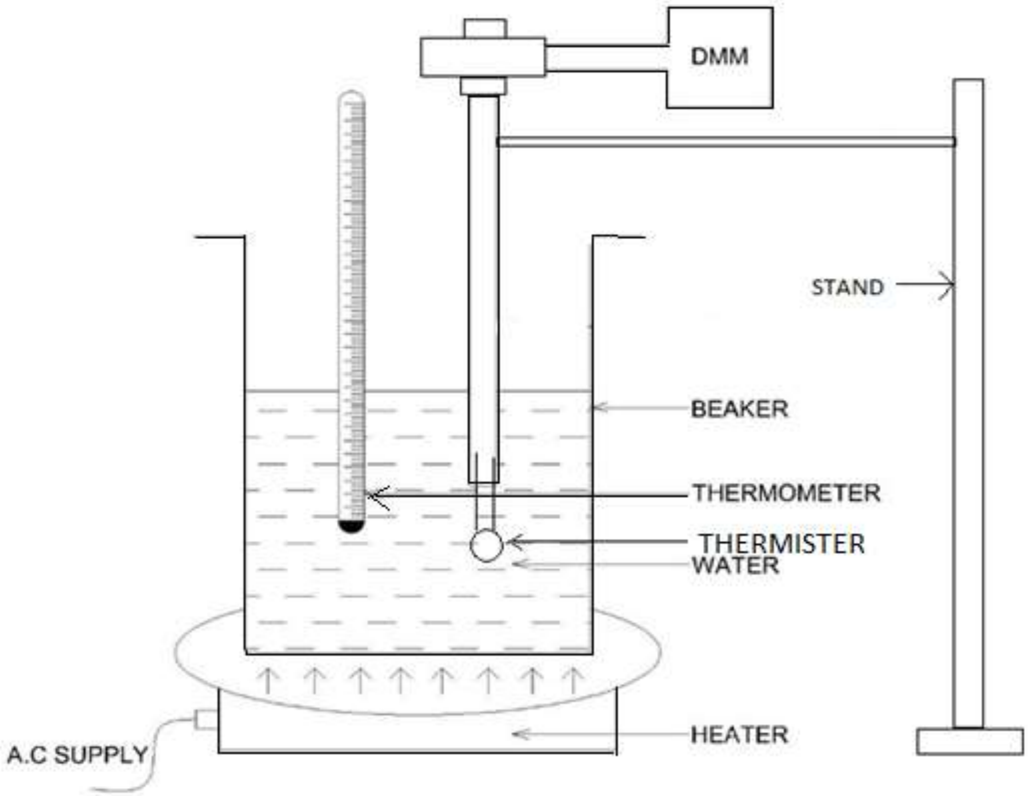
3. Thermistor is connected to digital multi-meter and kept in resistance mode.

4. Initially at 30^{o}C temperature resistance.

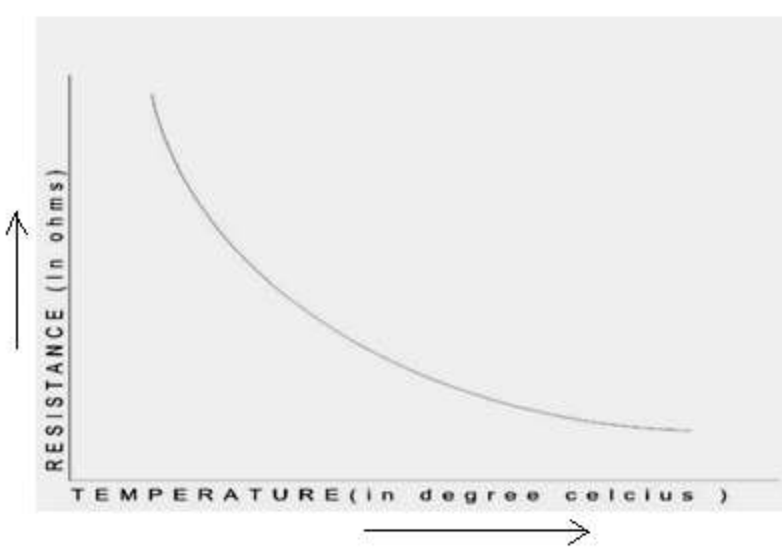
5. For every 5^{o}C increase, resistance is noted.

6. After taking reading till 80^{o}C water is cooled.

d) EXPERIMENTAL SETUP:



e) MODEL GRAPH:



F) TABULATION:

1. HEATING

S.no	Temperature (°c)	Resistance (kΩ)

2. COOLING

S.no	Temperature (°c)	Resistance (kΩ)

RESULT:

Thus the characteristics of thermistor were studied and verified, and the graph was plotted.

Prelab questions

1. What device is similar to an RTD but has a negative temperature coefficient?
2. What are the materials used for Thermistor?
3. What is NTC?
4. What is the resistance range of thermistor?
5. What are the types of thermistor?

Post-lab questions

1. What is temperature rating of thermistor?
2. What are the ranges of output for a thermistor?
3. What are the applications of thermistor?

Exercise Number: 4

Title of the Experiment: **CHARACTERISTICS OF RTD**
Date of the Exercise:

OBJECTIVE (AIM) OF THE EXPERIMENT

To verify the characteristics of RTD (Resistance Temperature Detector) using wheat stone bridge.

FACILITIES REQUIRED AND PROCEDURE

a) FACILITIES REQUIRED TO DO THE EXPERIMENT:

S.NO	Apparatus	Range	Quantity
1	RTD	-	1
2	Thermometer	-	1
3	Digital meter	-	1
4	Heater	-	1
5	Resistor	100Ω	3
6	Vessel	-	1

b) THEORY:

RTD’s are Sensors used to measure temperature by correlating the resistance of the RTD element .Platinum is the most widely used RTD element due to its accuracy ,stability and wide temperature range. RTD’s are characterized by linear positive change in resistance with respect to temperature. They exhibit the most linear signal with respect to temperature of any electronic sensing device.

c) **PROCEDURE:**

1. Connections are made as per circuit diagram.

2. The RPS is set to 5V.

3. The RTD is placed in a vessel containing water which is kept on a heater.

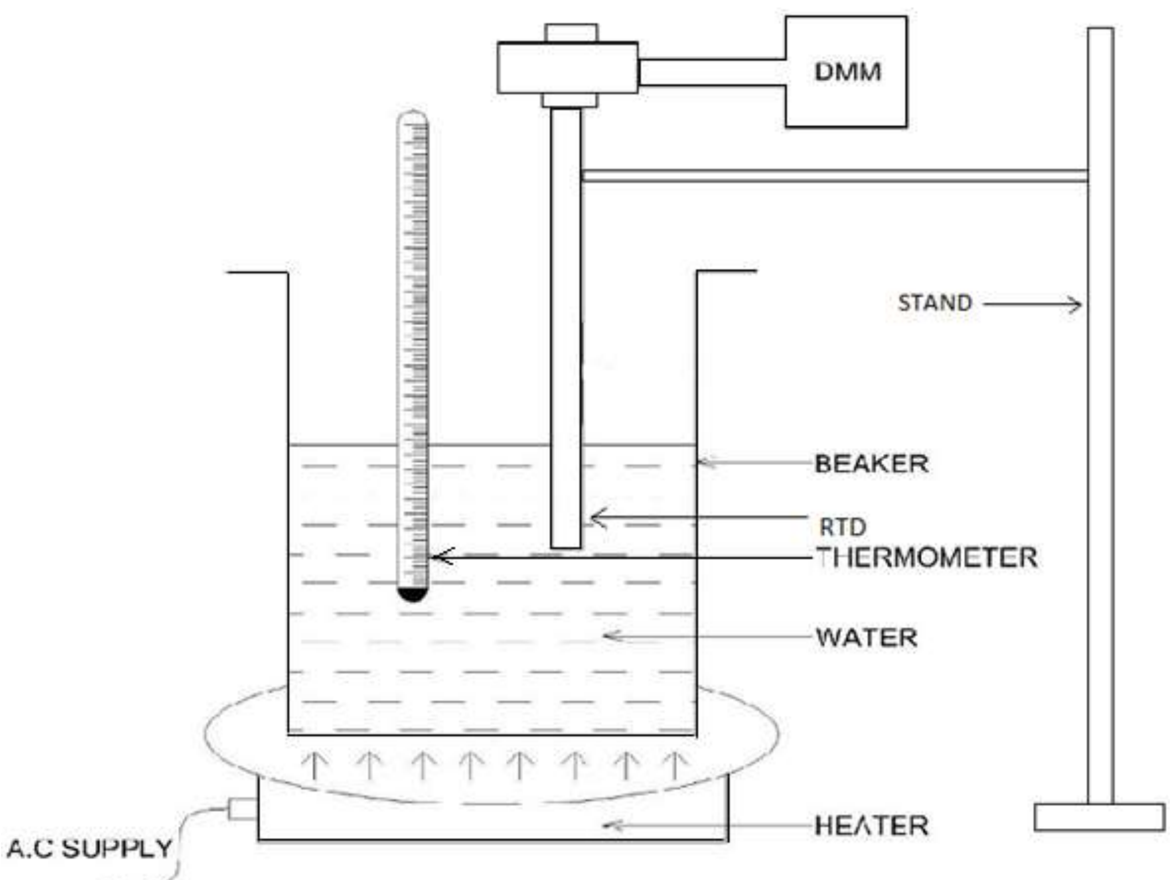
4. The heater is switched on and the water is heated to 35 oC

5. The multimeter is placed and the voltage generated is noted down for every 5 oC rise in temperature.

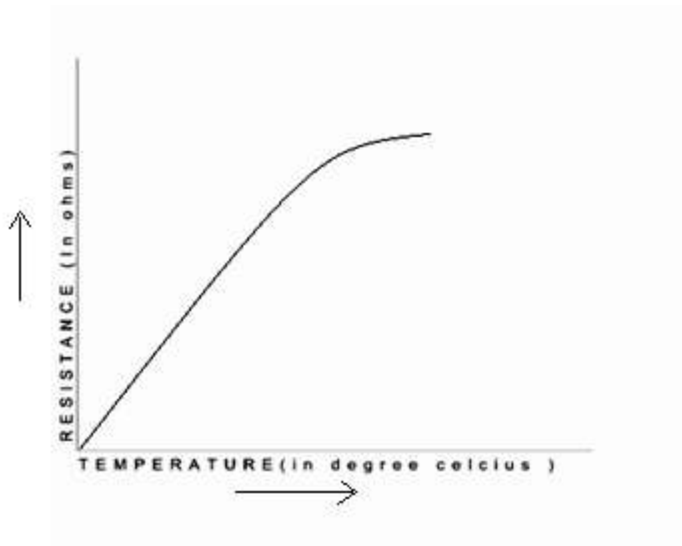
6. For different values of voltage the resistance value of RTD is determined.

7. Graph is plotted between the resistance of RTD and temperature.

d) **EXPERIMENTAL SETUP**



e) MODEL GRAPH:



f) TABULATION:

1. HEATING

S.NO	TEMPERATURE(ºC)	RESISTANCE(Ω)

2. COOLING

S.NO	TEMPERATURE(ºC)	RESISTANCE(Ω)

RESULT: Thus the characteristics of RTD were verified using Wheatstone bridge.

Prelab questions

1. What device is similar to an RTD but has a negative temperature coefficient?
2. What are the materials used for RTD?
3. What is NTC and PTC?
4. What is the resistance at room temperature for RTD
5. What are the applications of RTD?

Post-lab questions

1. What is temperature rating of RTD?
2. What the ranges of output resistance?
3. What are the applications of RTD

Exercise Number: 5

Title of the Experiment: **CHARACTERISTICS OF THERMOCOUPLE**
Date of the Exercise:

OBJECTIVE (AIM) OF THE EXPERIMENT:

To verify the characteristics of Thermocouple.

FACILITIES REQUIRED AND PROCEDURE:

a) FACILITIES REQUIRED TO DO THE EXPERIMENT:

S.NO	Apparatus	Quantity
1	Thermocouple	1
2	Thermometer	1
3	Electric heater	1
4	Digital multi-meter	1
5	Beaker	1

b) THEORY:

When the two different metals are placed in one junction the voltage is generated on that junction it's nearly proportional to the temperature. The Junction is called 'Thermocouple'. It is used to transfer the heat energy into the electrical energy. The emf is produced by the electrical current. The thermal energy is measured by the PMMC meter.

c) PROCEDURE:

1. Connect the multi-meter to the Thermocouple as shown in the diagram.

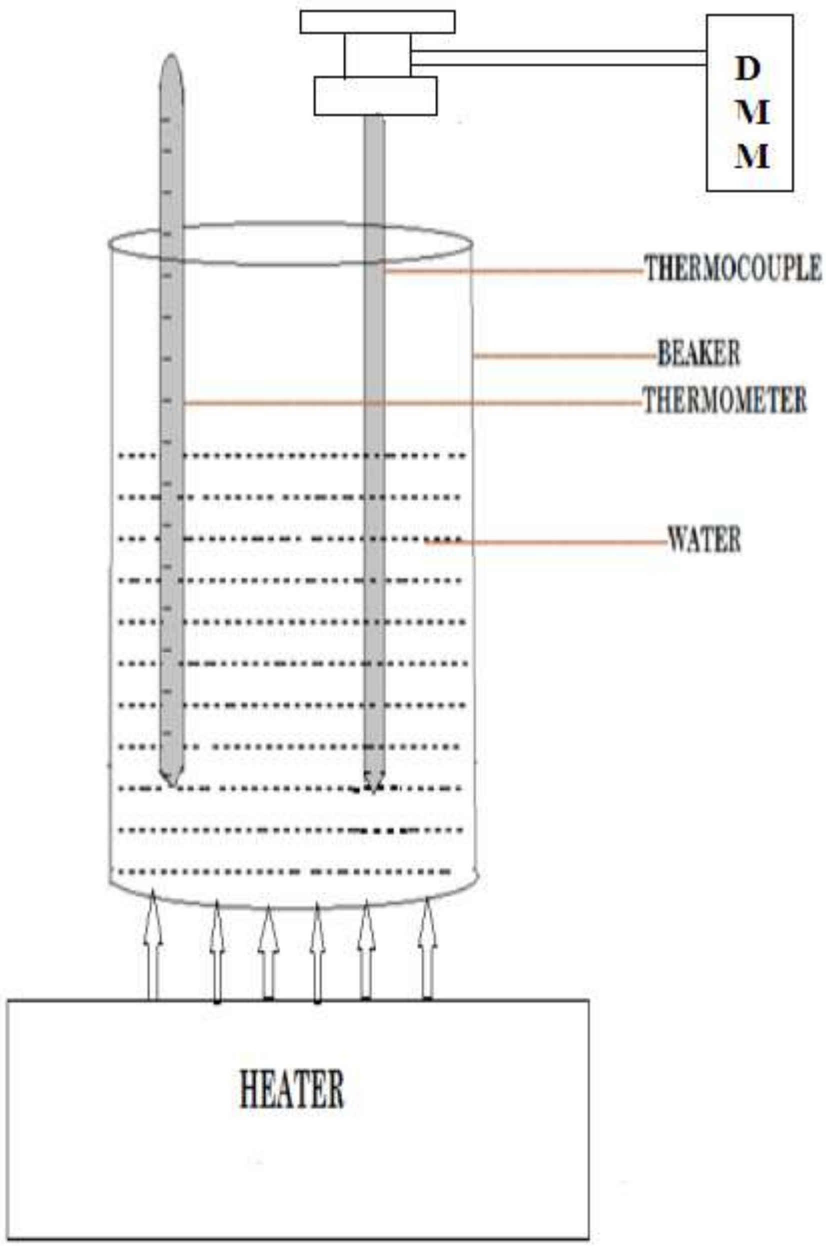
2. Heat the water up to90˚ C.

3. The emf is noted down after a certain interval such as 5 ˚**C.**

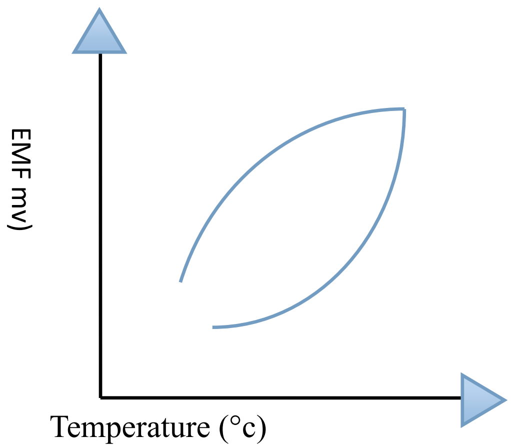
4. Graph is plotted between emf and Thermocouple.

5. Calculate time constant from the graph.

d) EXPERIMENTAL SETUP:



e) Model graph:



f) TABULATION:

Heating

S.NO	Temperature (°c)	Voltage(mV)

Cooling:

S.NO	Temperature (°c)	Voltage(mV)

Result :

Thus the Characteristics of Thermocouple was verified successfully.

Prelab questions

1. What is active transducer?
2. What are the materials used for Thermocouple?
3. What is the output from Thermocouple?

Post-lab questions

1. Why thermocouple is active transducer?
2. What are the ranges of output from thermocouple?
3. What are the applications of thermocouple?

Exercise Number:6

Title of the Experiment: **LOADING EFFECT OF POTENTIOMETER**

Date of the Exercise:

OBJECTIVE (AIM) OF THE EXPERIMENT

To verify the loading effect of the given Potentiometer

FACILITIES REQUIRED AND PROCEDURE

a) FACILITIES REQUIRED TO DO THE EXPERIMENT:

S.NO	APPARATUS	RANGE	QUANTITY
1	Potentiometer	400Ω/1A	2
2	RPS	(0-30)V	1
3	Voltmeter	(0-30)V	1
4	Connecting wires	-	-

b) THEORY:

A potentiometer is a device which converts change in resistance into electrical output. It contains variable resistor which is controlled by a moving part called wiper. One can alter the output by changing the number of turns of wire or by changing the length. The output voltage depends on the input voltage and the ratio of the input and output voltage. The potentiometer also acts as a voltage divider.

c) PROCEDURE:

1. Connections are given as per the circuit diagram.

2. RPS is switched ON and 10 V is supplied to the potentiometer.

3. The wiper position of potentiometer is varied in steps of 2 cm and corresponding voltmeter readings are noted down.

4. The load rheostat is connected across the potentiometer.

Formula:

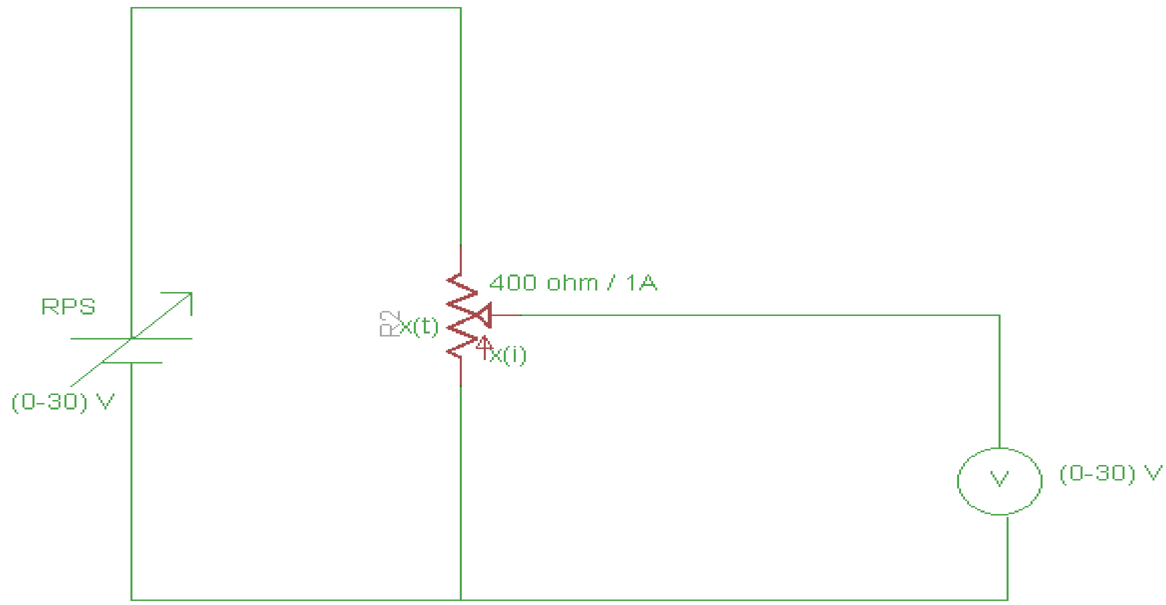
$$\%Error = \frac{K^2(1-K)}{[K(1-K)Rp/Rm + 1]} \times 100$$

$$\%\ Error = \frac{E\ (no\ load) - E\ (load)}{E\ (no\ load)} \times 100$$

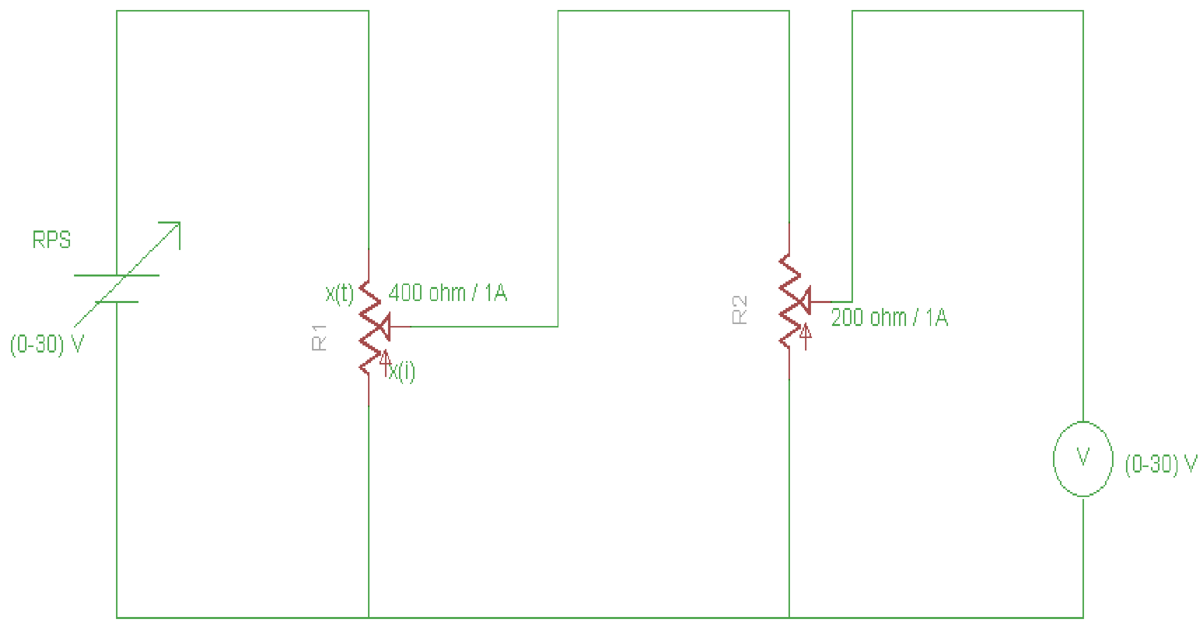
Where, K = x (i) / x(t)

d) CIRCUIT DIAGRAM:

without Load:

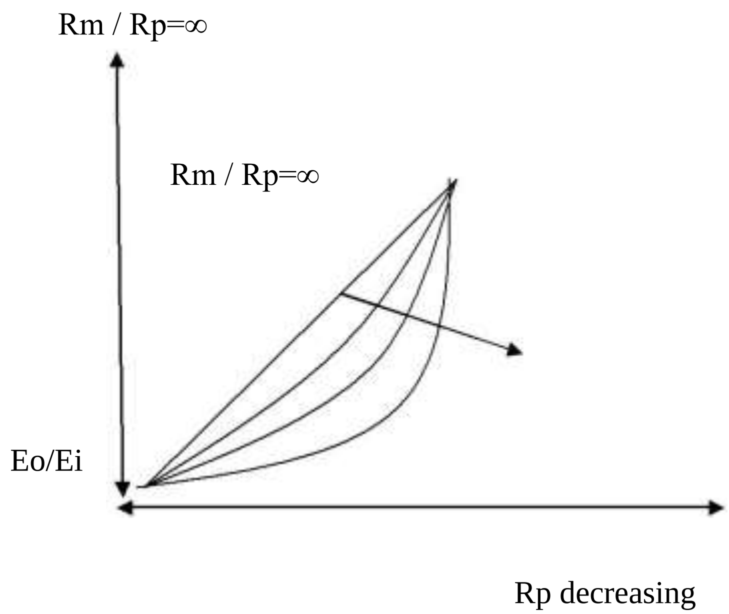


With load:



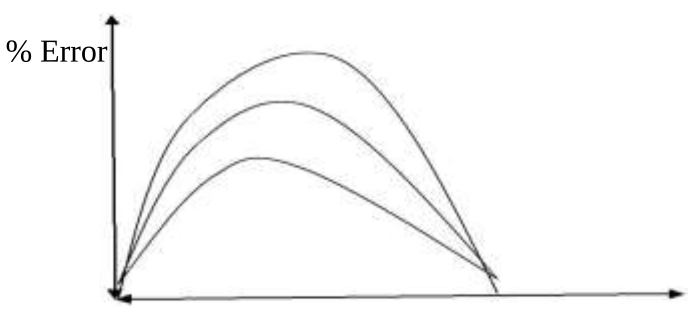
e) MODEL GRAPH:

Without Load:



x(i) / x(t)

with Load:



x(i) / x(t)

f) TABULATION:

(a) Without load:Ei = 15V , X_O= 33cm,R_m=∞,R_p=400Ω

S.NO	E_I(VOLTS)	E_O(VOLTS)	X_I(CMS)	$K=X_I/X_0$	E_O/E_I

(b) With Load:Ei=15V , X_O = 33 cm, R_m=400Ω,R_p=∞

S.NO	E_I(VOLTS)	E_O(VOLTS)	X_I(CMS)	$K=X_I/X_0$	E_O/E_I	%error

RESULT:

Thus, the loading effect of potentiometer was verified successfully.

Prelab questions

1. What is the principle of potentiometer?
2. What is the order of Potentiometer?
3. What is meant by non-linearity in resistance potentiometer
4. What are the materials used for Potentiometer

Post-lab questions

1. What is the range of potentiometer
2. Know the relation between resistance and sensitivity
3. Potentiometer is a passive transducer why?
4. What type of motion is used in sliding contact of potentiometer

Exercise Number: 7

Title of the Experiment: **CHARACTERISTICS OF SYNCHROS**
Date of the Exercise:

OBJECTIVE (AIM) OF THE EXPERIMENT

To verify the characteristics of synchro's as a position as a position of voltage transmitter and as remote angle receiver.

FACILITIES REQUIRED AND PROCEDURE

a) FACILITIES REQUIRED TO DO THE EXPERIMENT:

S.NO	Apparatus	Quantity
1	Synchro's Trainer Kit	2
2	Patch Chords	1
3	DMM	1

b) THEORY:

A synchro is an electronic magnetic transducer commonly used to convert angular position of shift into an electrical signal. A synchro system is formed by interconnection of the devices called synchro -transmitter. They are also called as synchro pair. The synchro pair measures & compares two angular displacements and its output voltage is approximately linear with angular displacement of axis of both shaft. Working: Synchro-transmitter is applied as input to stator coils of electric transformer. The rotor shaft connected to the load whose position as to be maintaining of the desired value, depending on the current position has to be of rotor & applied emf on the stator. An emf is induced on rotor winding. The emf can be measured and used to drive the motor so that the position of the load is correct. The rotor of control transformer is made cylindrical so that the air gap is practically uniform. This feature of control transformer minimizes the change in the rotar impedance with the rotation of the shaft. A synchro is, in effect, a transformer whose primary-to-secondary coupling may be varied by physically changing the relative orientation of the two windings. Synchros are often used for measuring the angle of a rotating machine such as an antenna platform. In its general physical construction, it is much like an electric motor. The primary winding of the transformer, fixed to the rotor, is excited by an alternating current, which by electromagnetic induction, causes currents to flow in three Y-connected secondary windings fixed at 120 degrees to each other on the stator. The relative magnitudes of secondary currents are measured and used to determine the angle of the rotor relative to the stator, or the currents can be used to directly drive a receiver synchro that will rotate in unison with the synchro transmitter. In the latter case, the whole device may be called a selsyn.

c) PROCEDURE:

Synchro's as a position transmitter:

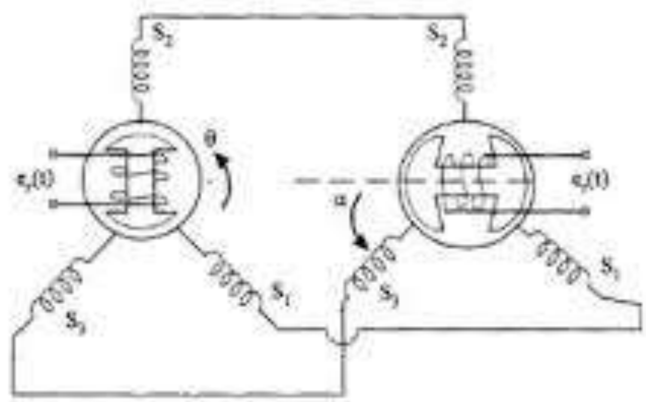
- Connections are given as per the circuit diagram.
- Initial position for performing the experiment in selected.
- Now, the rotor position is verified in steps of 30oand its corresponding voltages

  Vs1,Vs2,Vs3 etc are noted.

Synchro's torque transmission:

- The motor of angle transmitter is given an A.C supply of 50 V, 50 Hz and the supply is given to the rotor of the receiver also.
- 2. Now starting from zero the rotor is rotated up to 360o in steps of 30o and for each rotation of the receiver, the receiver movement is noted.

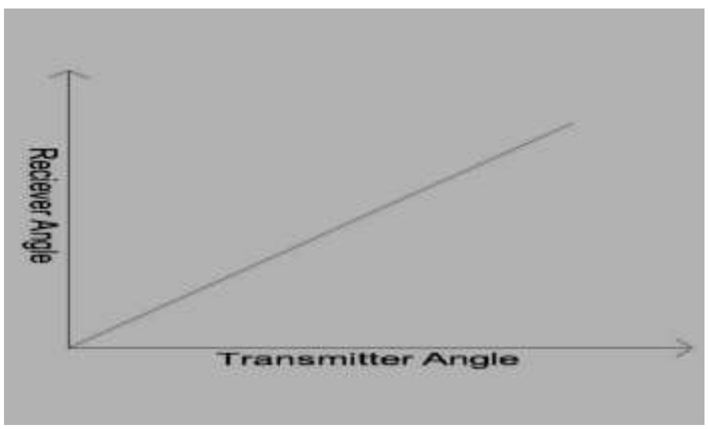
d) CIRCUIT DIAGRAM:

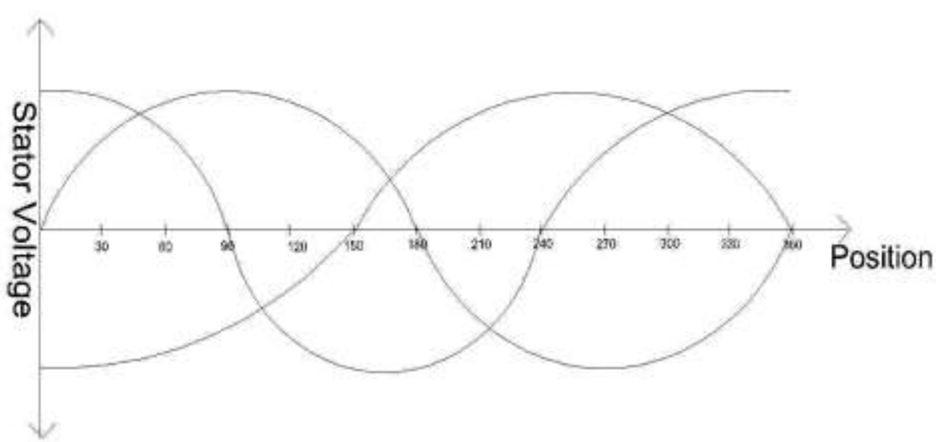


Hence

$e_r(t) \sim K_1 V_r \cos\phi \sin\omega_r t$

e) MODEL GRAPH:





f) TA

S.NO	ROTOR POSITION(IN DEG)	V_{S2S1}	V_{S1S2}	V_{S2S3}

S.NO	TRANSMITTER ANGULAR POSITION	RECEIVER ANGULAR POSITION

RESULT:

Thus, the characteristics of synchro's as a position of voltage transmitter and as a remote angle receiver were verified.

Pre lab questions:

1. What are the types of construction used in rotor of synchro transmitter?
2. List out the two modes of operation in synchro transmitter.
3. What is meant by electrical zero of synchro transformer?
4. What is meant by electrical zero of synchro transmitter?

Post lab questions:

1. How the voltages are induced in three windings of stator?
2. How many windings are there for a simple resolver?
3. Why the rotor of a sychro transformer is in cylindrical form?
4. What type of waveform is obtained at the output of synchros as a error detector?

Exercise Number: 8

Title of the Experiment: **CHARACTERISTICS OF LVDT**

Date of the Exercise:

OBJECTIVE (AIM) OF THE EXPERIMENT

To verify and study the characteristic of Linear Variable Differential Transformer.

FACILITIES REQUIRED AND PROCEDURE

a) FACILITIES REQUIRED TO DO THE EXPERIMENT:

S.NO	Apparatus	Quantity
1	**LVDT SETUP**	**1**
2	**LVDT MEASURING SYSTEM**	**1**
3	**DIGITAL MULTI-METER**	**1**

b) Formula:

%Error = ((Measured value –True value)/True value) x100%

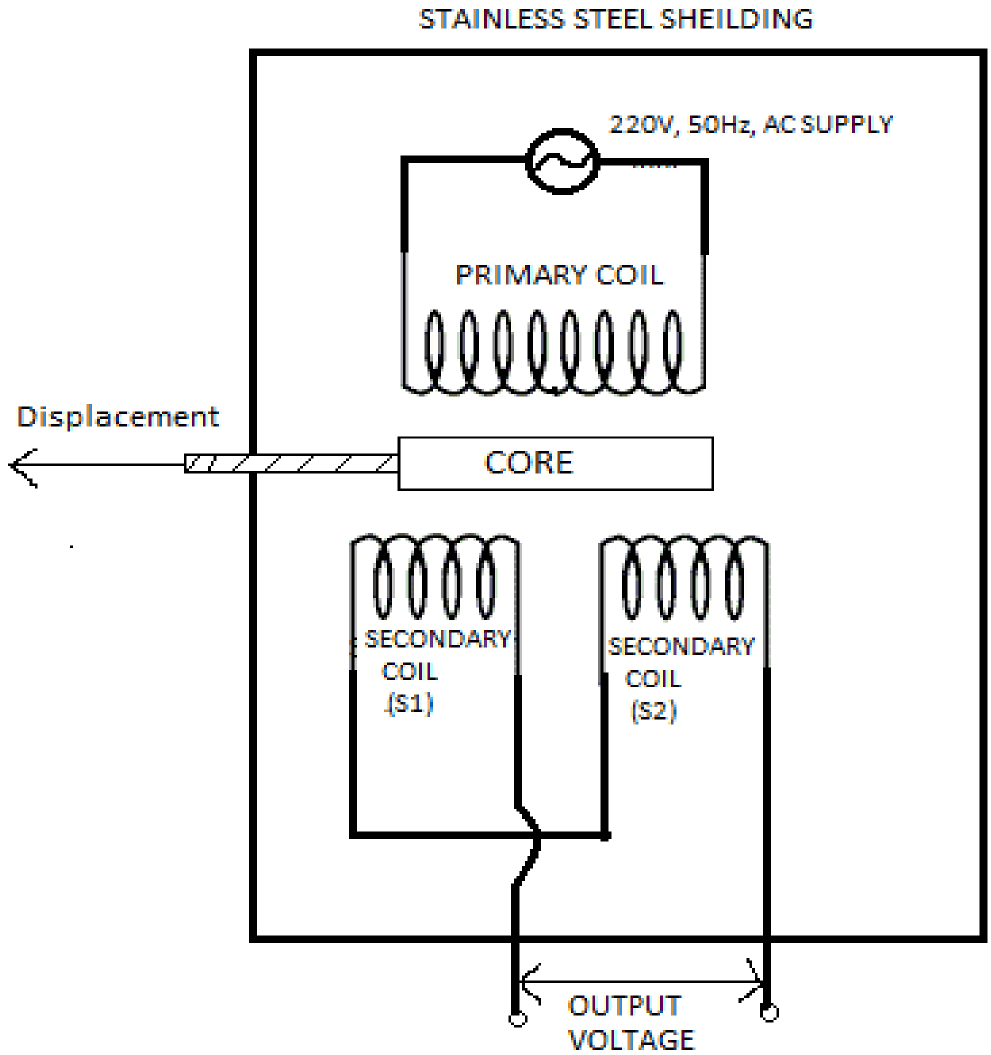
c) THEORY:

The most widely used inductive Transformer to translate the linear motion into electrical signals is the Linear Variable Differential Transformer (LVDT). The LVDT acting as primary transducers converts the displacement directly into an electrical output proportional to displacement, i.e. the Mechanical Variable (displacement) is converted into Analog Signal (Voltage) directly LVDT provides continuous reduction and shows the low hysteresis and hence, repeatability is excellent under all condition. As there are no sliding contacts, there is less friction and less noise.

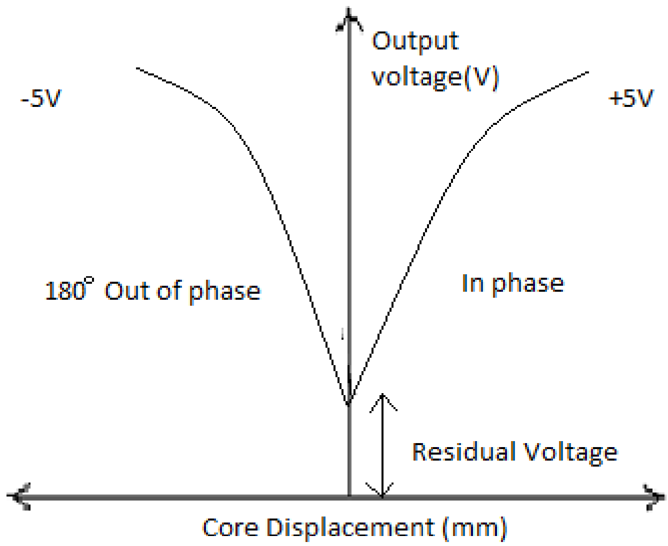
d) Procedure

- Connections are given as per the circuit diagram.
- The screw gauge is adjusted for minimal voltage.
- The core is moved in clockwise direction with the help of screw gauge.
- The output voltage for each 1 mm displacement was added and noted.
- The displacement core was brought to initial position and moved in anticlockwise direction.
- Again the output voltage for each 1 mm displacement was noted.
- A graph is plotted between displacement and output voltage (Eo).

e) CIRCUIT DIAGRAM:



f) MODEL GRAPH:



g) TABULATION:

MICROMETER DISPLACEMENT(mm)	**CORE DISPLACEMENT (mm)**	**SECONDARY OUTPUT VOLTAGE(V)**

RESULT:

Thus, the characteristics of Linear Variable Differential Transformer was studied and verified successfully.

Pre lab questions:

1. What are the materials for LVDT?
2. What is the size of air cored transducer?
3. What type of transducers are suitable for high frequencies?
4. What is the linearity range of LVDT?

Post lab questions:

1. What are the three principles of Inductive transducers
2. What is meant by residual voltage
3. List out few applications of LVDT

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Title of the Experiment: **PIEZO ELECTRIC TRANSDUCER**
Date of the Exercise:

OBJECTIVE (AIM) OF THE EXPERIMENT

Measurement of vibration parameters.

FACILITIES REQUIRED AND PROCEDURE

a) FACILITIES REQUIRED TO DO THE EXPERIMENT:

S.NO	APPARATUS	QUANTITY
1	Piezo sensor(accelerometer)	1
2	Piezo electric trainer kit	1
3	DMM	1

b) THEORY:

The vibrating probe I sstimulated by a piezo and oscillates at its mechanical resonance frequency. If the probe comes into contact with material, the oscillation is dampened and this is electronically registered and sent out as a signal.Once the probe is no longer comes in contact with material, the probe can oscillate again and a new output signal is generated.

c) PROCEDURE:

Connect vibration pickup cable to the vibration analyser sensor socket.

1. Power on: SPDT switch supplied AC mains into indicator.

2. Allow the instrument is ON position for 10 minutes for initial warmup

3. Adjust the Zero balance pot so that the display reads 000

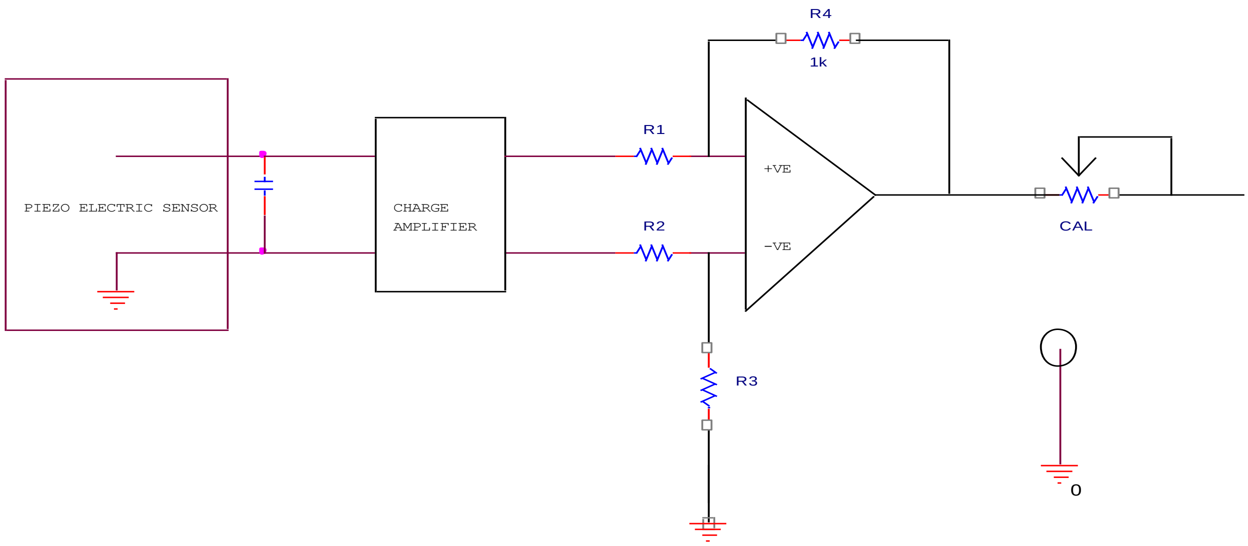
4. Gently tap the plate on which the sensor is mounted at regular interval with a small metal or wooden piece. You can notice the display increasing by varying the frequency continually. Also by taking at various forces you can notice the display value increase as the force increases.

5. Apply dynamic force on the sensor the display will show the parameter selected depending on the force applied

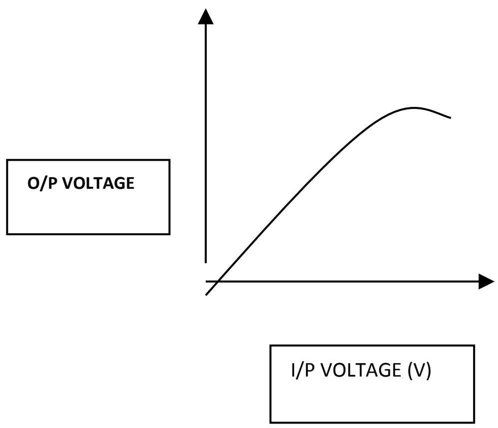
d) Tabular Column:

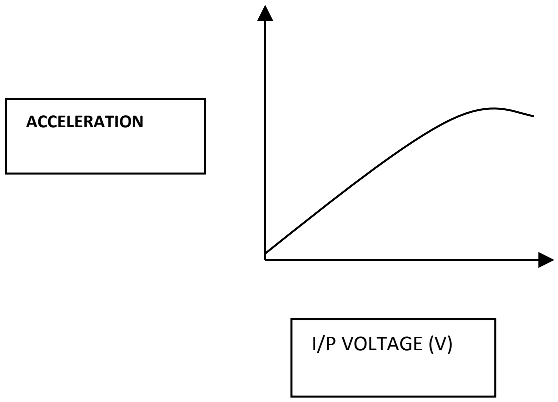
S. No	Input voltage (V)	Velocity (mm/sec)	Acceleration m/sec^2	Output voltage (V)

e) CIRCUIT DIAGRAM:



f) MODEL GRAPH:





RESULT:

Thus, the characteristics of piezoelectric transducer was studied and verified successfully.

Pre lab questions:

1. What is piezo electric effect
2. How materials are classified based on piezo electric effect
3. Piezo electric transducer is an active or passive transducer

Post lab questions:

1. Piezo electric transducer is an inverse transducer why?
2. Quartz and Rochelle salt belongs to which group of piezo electric materials
3. What is the output range of piezo electric transducer

Exercise Number:10

Title of the Experiment: **CHARACTERISTICS OF HALL EFFECT TRANSDUCER**

Date of the Exercise:

OBJECTIVE (AIM) OF THE EXPERIMENT

To get the characteristics of Hall Effect transducer.

FACILITIES REQUIRED AND PROCEDURE

a) FACILITIES REQUIRED TO DO THE EXPERIMENT:

S.NO	APPARATUAS	QUANTITY
1	Hall effect trainer kit	1
2	Rheostat	2
3	Connecting wires	-

b) THEORY:

A Hall Effect sensor is a transducer that varies its output voltage in response to a magnetic field. Hall Effect sensors are used for proximity switching, positioning, speed detection, and current sensing applications. In its simplest form, the sensor operates as an analog transducer, directly returning a voltage. With a known magnetic field, its distance from the Hall plate can be determined. Using groups of sensors, the relative position of the magnet can be deduced. Frequently, a Hall sensor is combined with circuitry that allows the device to act in a digital (on/off) mode, and may be called a switch in this configuration. Commonly seen in industrial applications such as the pneumatic cylinder

c) PROCEDURE:

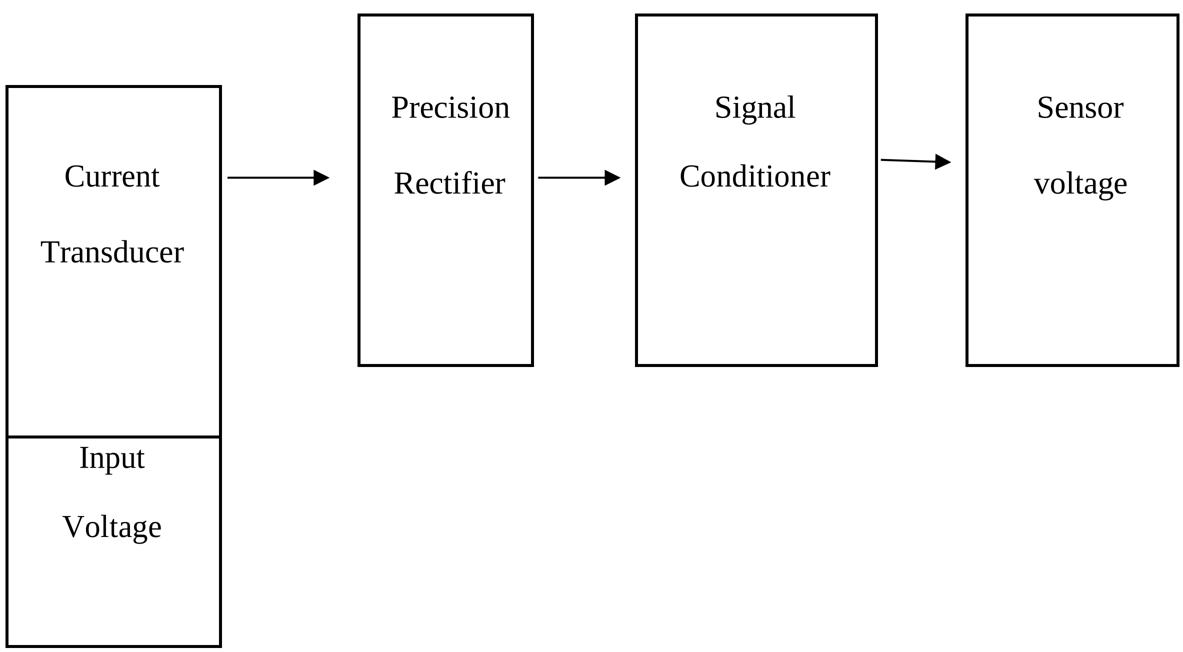
1. Switch on the 230v power supply.
2. Connect the dc input voltage to the sensor input voltage terminal on the trainer.
3. Connect the load to the corresponding terminal provided in the trainer.
4. Give some load in order to get the current in the appropriate meter.
5. Note down the sensor output voltage for the zero input voltage.
6. Now apply the input voltage to the sensor and note down the reading on the ammeter and voltmeter and put it on the tabular column.
7. Plot the graph between current and sensor output voltage

d) TABULATION:

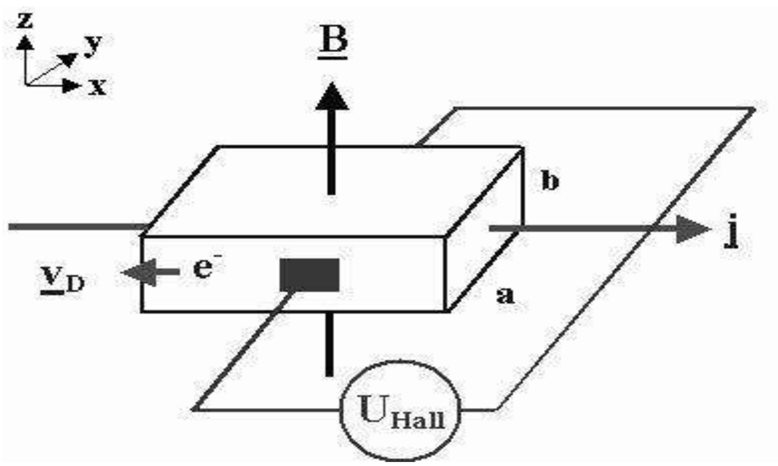
S.NO	Output current(amps)	Sensor voltage(volts)
1.		
2.		
3.		
4.		

Probe current I(mA)	Magnetic field(Tesla)	Zero Field Potential(offset voltage) V_{zero}	Hall Voltage for one side of the probe with offset voltage(V_H^+)	Hall voltage for second side without Offset voltage(V_H^-)	Hall voltage for one side without offset voltage($V^+=V^+_H-V_{ZERO}$)	Hall voltage for second side without offset voltage($V^-=V_H^- - V_{ZERO}$)	Mean Voltage ($V_H=(V^+-V^-)/2$)

e) Block Diagram

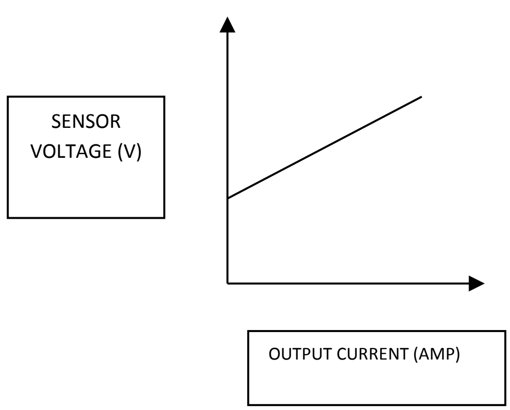


f) CIRCUIT DIAGRAM:



g) EXPERIMENTAL SETUP:

h) MODEL GRAPH:



i) **MODEL CALCULATIONS:**

RESULT:

Thus the design of RC phase shift oscillator was successfully done and the required oscillating frequency is obtained. The output waveform was thus verified and obtained.

Prelab questions

1. What are the parameters that can be measured using Hall effect transducer?
2. What is the principle of Hall effect transducer?

Post lab questions:

1. What is the output range of Hall effect Transducer?
2. What is meant by Hall effect coefficient?
3. List out the applications of Hall effect transducer.