MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

CERTIFICATE

This is to certify that the Laboratory Manual/Journal for the lab titled **INSTRUMENTATION LABORATORY (ICE-2263)** submitted by Mr./Ms.________________________________ (Reg. No :________________) of fourth semester, Electronics and Instrumentation engineering for the academic year , as per laboratory course requirements, which has been evaluated and duly certified.

Place: Manipal
Date: **Lab In-Charge**

CONTENTS

Evaluation Plan:

Continuous Evaluation : **60%** (Preparation, Lab performance, Journal, Regularity)

End Semester Lab Test : **40%**

EXPERIMENT NO.1	Date:

Distance Measurement

Objective: To design a signal conditioning circuit for measurement of distance using IR sensor and acquire the same to NI-LabVIEW using NI-DAQ.

Apparatus required:

1 IR sensor
2 Resistances
3 Amplifier (741)
4 DC power supply
5 DMM
6 NI-Elvis

Circuit Diagram

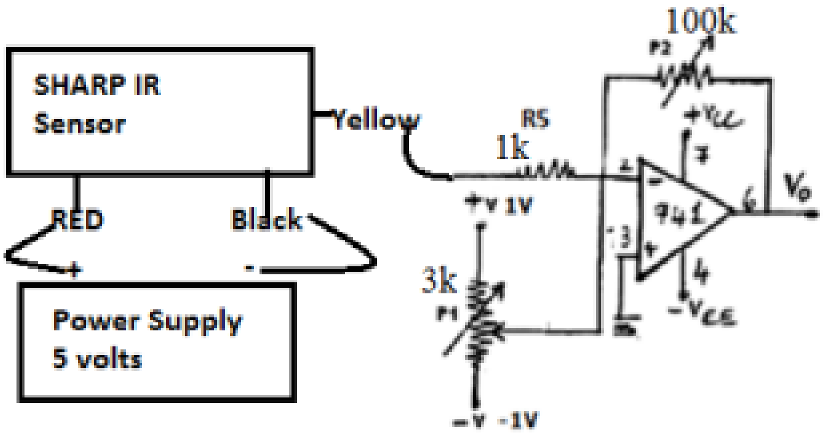


Fig. 1: Signal condition circuit

Instructions:

1. Rig up the circuit as shown in the Fig.1
2. Give supply voltage of 5V to IR sensor, whose output is in voltage (as distance increases, voltage decreases exponentially).
3. Adjust the P1 potentiometer exactly to display 1V for 100cm
4. Decrease the distance to 0 cm by moving the IR sensor mounted on setup and vary the P2 potentiometer to display 5V.
5. Repeat the above steps at least 5 to 6 times, for good calibration.
6. Acquire the output voltage to NI-LabVIEW using NI-DAQ 6002 and write a program to convert voltage to distance (cm).
7. Reduce the distance in intervals of 5cm and note down the corresponding output voltage
8. Plot a graph of distance (cm) vs Voltage output.

Observations:

Sl. No.	Distance (cm)	O/P Voltage V_o (V)
1		
2		
3		
4		
5		
6		
7		
8		
9		

Conclusion:

EXPERIMENT NO.2	Date:

Load Measurement

Objective: To design signal conditioning circuit for measurement of mass using load cell

Apparatus required:

1 Load cell

2 Resistances

3 Amplifier (741)

4 DC power supply

5 DMM

6 NI-Elvis

Circuit diagram:

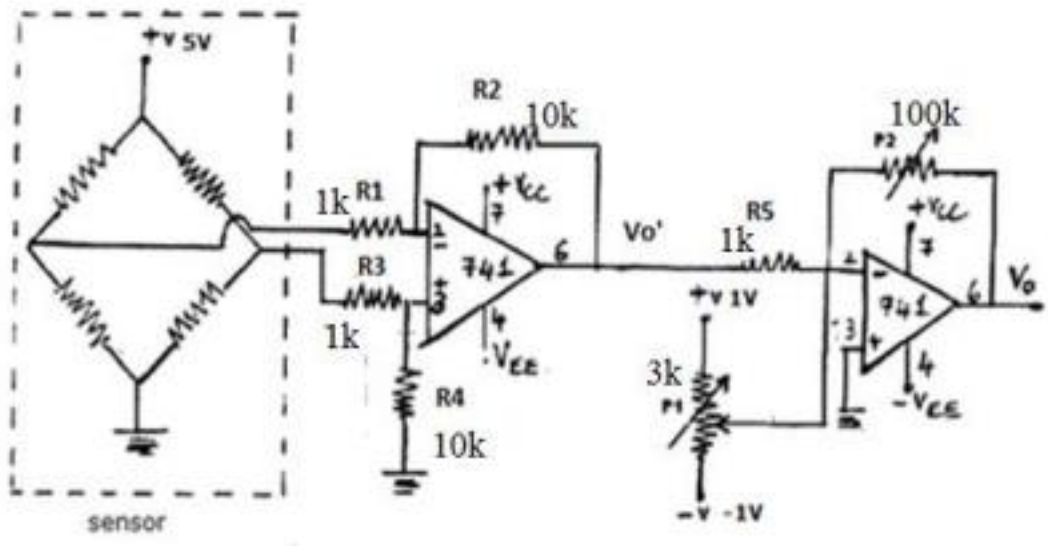


Fig.1: Signal conditioning circuit for pressure sensor

Instructions:

1. Rig up the circuit as shown in the Fig.1
2. Adjust the P1 potentiometer exactly to display 1V when load is zero.
3. Start applying load to maximum level and vary the P2 potentiometer to display 5V.
4. Repeat the above steps at least 5 to 6 times, for good calibration.
5. Increase the weights (mass) from zero to maximum in desired intervals to measure the corresponding voltage after the calibration.
6. Plot a graph of mass applied vs Voltage output.

Observations:

Sl. No.	Actual weight (kg)	O/P Voltage V_o (V)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Conclusions:

EXPERIMENT NO.3	Date:

Thickness Measurement using LVDT

Objective: To design a signal conditioning circuit for LVDT to measure thickness of a given number of cardboard sheets.

Apparatus required:

1. LVDT
2. Resistances
3. Amplifier (IC-741)
4. D C Power supply
5. DMM
6. Diodes
7. Capacitors
8. Cardboard sheets
9. NI-Elvis

Circuit diagram:

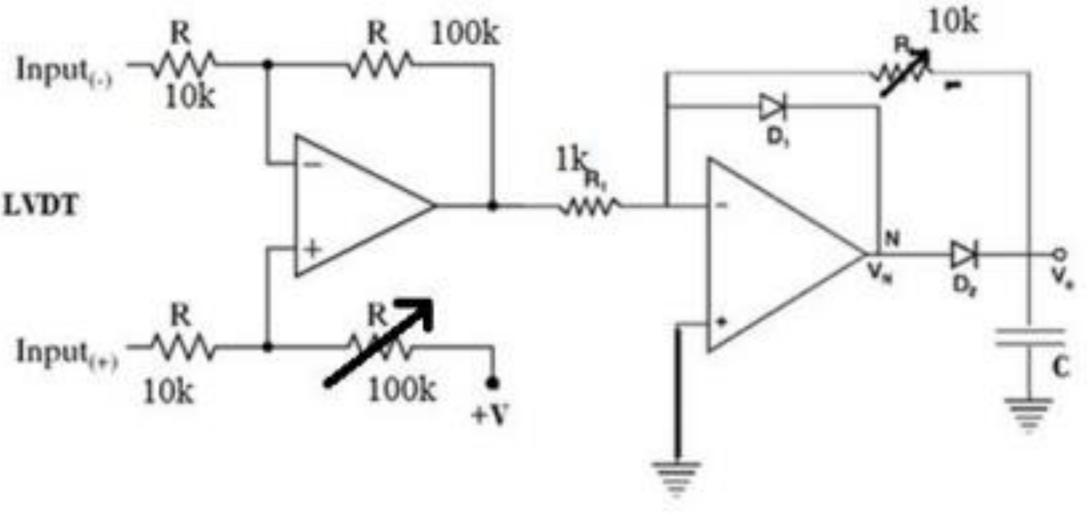


Fig.1: Signal conditioning circuit for LVDT

Instructions:

1. Count the number of cardboard sheets given and manually measure the thickness of one sheet (equal thickness sheets will be given)
2. Rig up the circuit as shown in the Fig.1.
3. Adjust the MIN (pot at noninverting terminal of 1^{st} OpAmp) potentiometer exactly to display 1V when thickness is zero. (Zero sheet)
4. Place maximum number sheets given to change the position of the core and then vary the MAX (pot at output) potentiometer to display 5V.
5. Repeat the above steps at least 5 to 6 times, for good calibration.
6. Place the sheets one by one up to maximum number of sheets to measure the corresponding voltage.

Observations:

Thickness of individual sheet: ___________

Maximum number of sheets: ____________

Sl. No.	Number of cardboard sheets	Actual thickness (mm)	O/P Voltage V_o (V)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Conclusions:

EXPERIMENT NO.4	Date:

Flow Rate Measurement using Head Type Flow Sensors

A. Flow Measurement by Orifice sensor

Aim:

To measure the flow using Orifice meter.

Apparatus required:

- Orifice flow station

Instructions:

1. Connect to pressure sensor.
2. Select the sensor type from selecting rotary 6- position switch at connect location 5.
3. Observe that the measurement assembly is held vertically. You can increase or decrease the flow by adjusting bypassing the manual valve.
4. Flow can be measured on the rotameter directly in lph. The same liquid will flow through the orifice flow meter.
5. Connect power supply to signal conditioning panel. Keep the manual valve at close position.
6. Read the lph reading on the rotameter. If flow through the rotameter is zero, the set output to 0V using zero adjust pot. Now keep the manual valve at open fully open position, if it is 200 lph then set 2.5V at output using span adjustment pot.
7. Set these voltages at your maximum lph level. Again close the valve check for your zero position voltage.
8. Repeat the span zero adjustment procedure for correct measurement range.
9. Now keep the manual valve open at various position & note down the sensor voltage readings in the table below.
10. Plot the graph of Rotameter flow in lph on X-axis & orifice sensor output voltage Q and √Q on Y-axis

Observations:

Sl. No.	Rotameter reading (LPH)	Output voltage Q(Volts)	SQRT of voltages √Q
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Conclusions:

B. Signal conditioning and Calibration of Venturi flow meter

Objective: To design the signal conditioning circuit for calibrating the venturi flow meter output

Apparatus required:

1 Pressure sensor, venturi flow sensor

2 Resistances

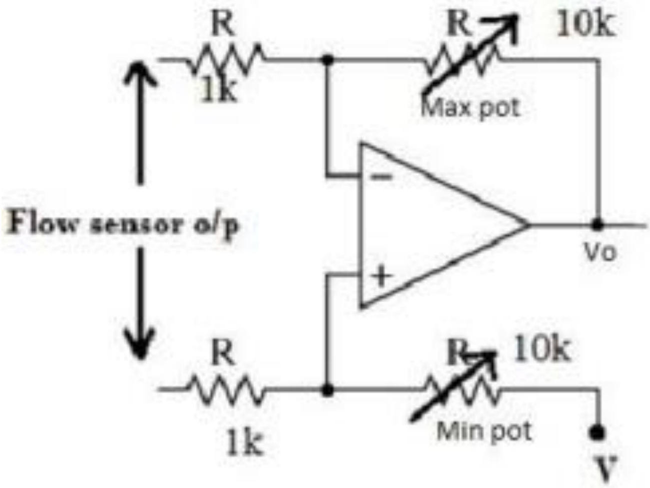
3 Amplifier (741)

4 DC power supply

5 NI-Elvis

6 DMM

Circuit diagram:



Instructions:

1. Rig up the circuit as shown in the figure
2. Adjust the output to the 1 volts by setting the min pot. for 0 LPH
3. Increase the flow rate to maximum.
4. Adjust the max pot. to indicate max voltage (5V).
5. Repeat the steps 2 to 5 above, at least 5 to 6 times, for good calibration.
6. Tabulate the output voltage for corresponding flowrate in intervals of 20LPH.
7. Plot a graph of actual flow vs Voltage output.

Observations:

Sl. No .	Actual flow (LPH)	O/P Voltage V_o (V)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Conclusions:

EXPERIMENT NO.5	Date:

TEMPERATURE MEASUREMENT USING THERMISTOR

Aim: To design a signal conditioning and calibration circuit for temperature measurement using thermistor.

Apparatus required:

1 Resistances
2 Amplifier (IC-741)
3 DC power supply
4 DMM
5 Connecting wires, breadboard
6 NI-Elvis

Circuit diagram:

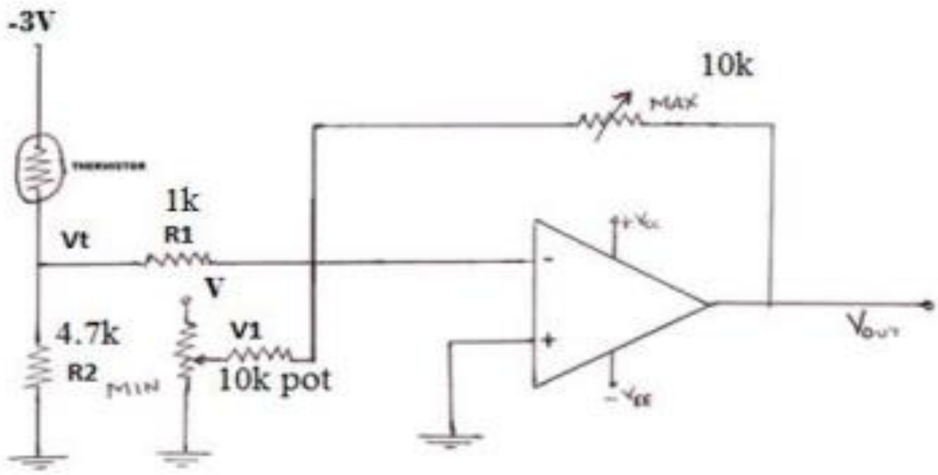


Fig.1. Connection diagram

Instructions:

1.Rig up the circuit as shown in the Fig.1, set the gain of the calibration amplifier to unity, and switch on the power supplies.
2. Initially keep the thermistor & thermometer at room temperature, and measure the O/P voltage of the electronic indicator.
3. Adjust the output to the 1 V by setting the MIN.POT.
4. Insert the thermistor in the boiling water bath (or oven) at and measure the O/P voltage.
5. Adjust the MAX.POT to indicate the 5 V.
6. Repeat the above steps at least 5 to 6 times, for good calibration.
7. Cool the water bath (or oven) in steps of 10° and note down the readings in a tabular column.
8. Note down the final resistance value of Min Pot and Max Pot after final calibration.
9. Plot a graph of Temperature indicated Vs Voltage output.

Observations:

Resistance of thermistor at room temperature: _________

Resistance of thermistor at 100°C: ___________

Resistance Value of Min pot and Max.pot after calibration: ________ & __________

Observations:

Sl. No.	**Actual temp (^{o}C)**	**O/P Voltage V_o (V)**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Conclusions:

EXPERIMENT NO.6	Date:

Liquid Level Measurement

A. Measurement of Level Using Ultrasonic Transducer

Aim:

To measure the liquid level in the process tank using Ultrasonic Transducer.

Apparatus required:

1 VLMT-04 Unit.
2 Patch Chord.
3 DMM

Instructions:

1. Switch ON the Trainer.
2. The Pump inlet valve (HV1) should be fully open and the process tank outlet valve HV2 should be fully closed.
3. Connect the multimeter across (4-20) mA.
4. Vary the pump speed using variable speed knob, set the level at 0mm. 5. Note the transmitter output in (4-20) mA terminals.
6. Gradually increase the water level by using variable speed knob and note down the water level and transmitter output.
7. Plot the Graph between level (cm) and transmitter output (mA) along x-axis and y axis respectively and obtain the static characteristics of the instrument.

Tabular column:

Sl.No	Level in (cm)	Transmitter output (mA)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Conclusions:

B. Study Of Float Type Level Transmitter

Aim:

To measure the liquid level in the process tank using float type level transmitter.

Apparatus required:

1 VLMT-05 Unit.
2 Patch Chord.
3 DMM

Instructions:

1. Switch ON the Trainer.
2. The Pump inlet valve (HV1) should be fully open and the process tank outlet valve HV2 should be fully closed.
3. Connect the multimeter across (L1 and L2) in (DC - mA) mode.
4. Vary the pump speed using variable speed knob, set the level at 0mm.
5. Note the transmitter output in Ll,- L2 terminals.
6. Gradually increase the water level by using variable speed knob and note down the water level and transmitter output.
7. Plot the graph between level (cm) and transmitter output (mA) along x and y-axis respectively and obtain the static characteristics of the instrument.

Tabular column:

Sl.No	Level in (cm)	Transmitter output (mA)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Conclusion:

C. Signal conditioning of capacitance level sensor

Objective: To design a signal conditioning circuit for measurement of liquid level using capacitance level sensors.

Apparatus required:

1 CLS
2 Resistances
3 Amplifier (741)
4 DC power supply
5 DMM
6 NI-Elvis

Circuit diagram:

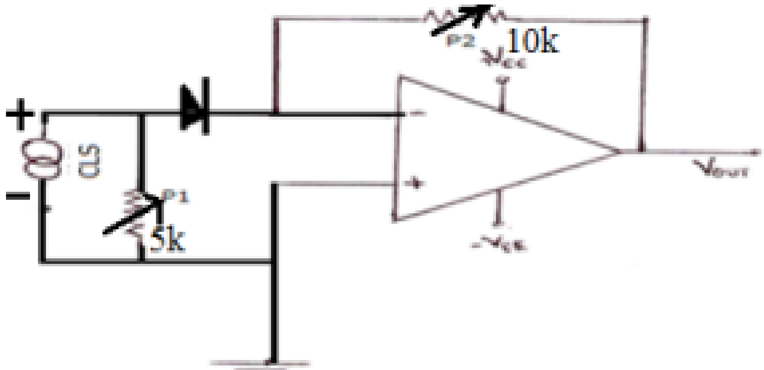


Fig. 1 Connection diagram

$$Vout = I_L P_2$$

Instructions:

1. Rig up the circuit as shown in the Fig.1
2. Check that level sensor (CLS) must display 4mA for 0 cm and 20mA for maximum level before calibrating to voltage.
3. Adjust the P1 potentiometer exactly to display 1V when no liquid in container.
4. 4. Increase the liquid level to maximum level and vary the P2 potentiometer to display 5V.
5. Repeat the above steps at least 5 to 6 times, for good calibration.
6. Increase the liquid level in intervals of 5cm and note down the corresponding output voltage.
7. Plot a graph of liquid level vs Voltage output.

Observations:

Sl. No.	Actual level (cm)	O/P Voltage V_{out} (V)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Conclusions:

EXPERIMENT NO.7	Date:

Pressure Measurement

Objective: To design a signal conditioning circuit for measurement of pressure using pressure gauge and acquire the same to NI-LabVIEW using NI-DAQ.

Apparatus required:

1 Pressure gauge
2 Resistances
3 Amplifier (741)
4 DC power supply
5 DMM
6 NI-Elvis

Circuit diagram

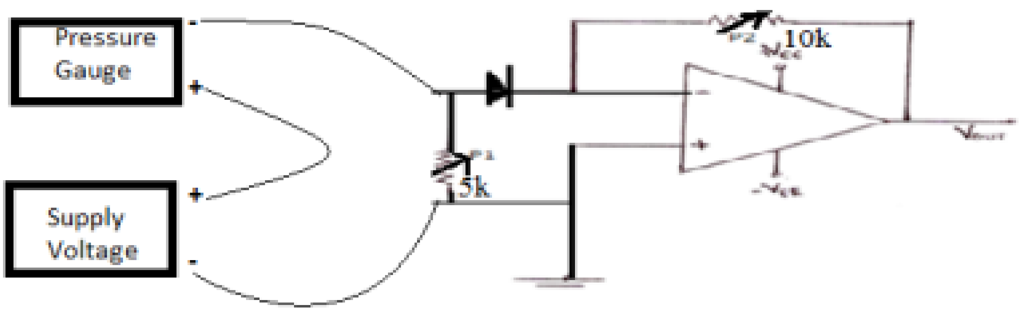


Fig. 1: Signal condition circuit

Instructions:

1. Rig up the circuit as shown in the Fig.1
2. Give supply voltage of 12V to pressure gauge, whose output is in current which is connected across diode and ground. Pressure gauge (Bar) gets input from pressure pump (0-100 psi).
3. Adjust the P1 potentiometer exactly to display 1V for 0 PSI pressure pump input
4. Increase the pressure to 50 psi using pump and vary the P2 potentiometer to display 5V.
5. Repeat the above steps at least 5 to 6 times, for good calibration.
6. Acquire the output voltage to NI-LabVIEW using NI-DAQ 6002 and write a program to convert voltage to pressure (Bar).
7. Increase the pressure in intervals of 5psi and note down the corresponding output voltage
8. Plot a graph of pressure (psi) vs Voltage output.

Observations:

Sl. No.	Pressure (psi)	O/P Voltage V_o (V)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Conclusion

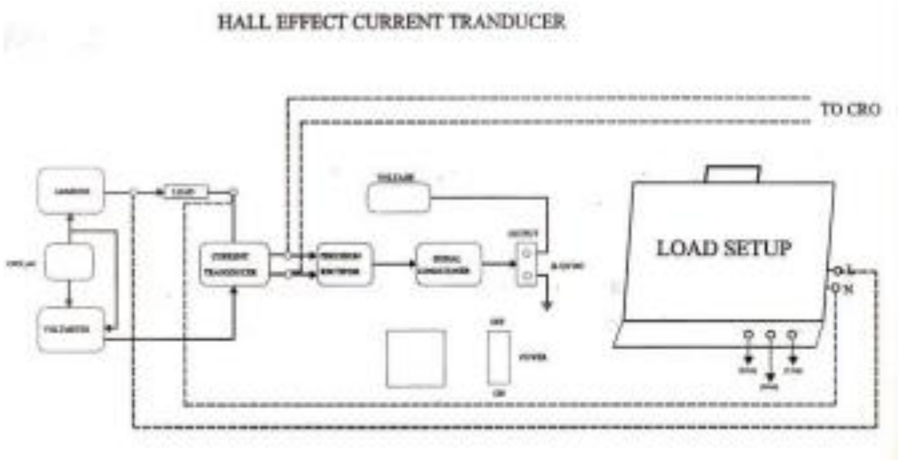
EXPERIMENT NO.8	**Date:**

Hall Effect Current Transducer

Objective: To study the performance and characteristics of Hall Effect current transducer.

Apparatus:

1. VHECT – 01 Unit
2. Patch chords
3. Digital Multimeter



Experimental procedure

1. Make the connection as per the circuit diagram
2. Vary the current (0-2.5) Amps using switches like (0.5A, 0.5A, 1.5A) in the load setup, the corresponding output voltage are noted.
3. Draw the graph between load current and output voltage.

Tabular column:

SL. No	Load Current (A)	DC Output (V)

Conclusion