I

Name _____

Roll No. _____ Year 20____20____

Exam Seat No. _____

ELECTRICAL & ELECTRONICS GROUP | SEMESTER - IV | DIPLOMA IN ENGINEERING AND TECHNOLOGY

A LABORATORY MANUAL

FOR

INDUSTRIAL MEASUREMENTS (22420)

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

(Autonomous) (ISO 9001 : 2015) (ISO / IEC 27001 : 2013)

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the changing technological and environmental challenges.

QUALITY POLICY

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES

MSBTE believes in the followings:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual for

Industrial Measurements

(22420)

Semester– (IV)

(EE, EP, EU, IE)

Maharashtra State
Board of Technical Education, Mumbai
(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education,
(Autonomous) (ISO 9001 : 2015) (ISO/IEC 27001 : 2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai - 400051.
(Printed on November 2018)

Maharashtra State
Board of Technical Education

Certificate

This is to certify that Mr. / Ms…… Roll No…….of Fourth Semester of Diploma in ……. of Institute ……..... (Code……..) has completed the term work satisfactorily in course **Industrial Measurements (22420)** for the Academic Year 20…….to 20…..... as prescribed in the curriculum.

Place : ……. Enrollment No. :……

Date : …..... Exam Seat No. :…….....

Course Teacher **Head of the Department** **Principal**

Seal of Institution

Preface

The primary focus of any engineering laboratory/ field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'I' Scheme curricula for engineering diploma programmes with outcome-base education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a ***'vehicle'*** to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'I' scheme laboratory manual development team designed the practical to ***focus*** on the ***outcomes***, rather than the traditional age old practice of conducting practical to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

The electrical diploma holder has to work in industry as technical person in middle level management. He has to work as production, maintenance, testing engineer in various industries like power generation, transmission, distribution, traction etc. and has to deal with different electrical measurement. He/she also has to deal with advanced, automated and sophisticated equipment that are used in modern techniques. While performing above task he has to measure different electrical and electronic parameters with testing, therefore he/she must require the skills for these measurements and broad idea of different meters and equipment. Equipment may contain digital and microcontroller based embedded systems, for which the basic knowledge of this subjects is required.

Although all care has been taken to check for mistakes in this laboratory manual, yet it is impossible to claim perfection especially as this is the first edition. Any such errors and suggestions for improvement can be brought to our notice and are highly welcome.

Programme Outcomes (POs) to be achieved through Practical of this Course

Following programme outcomes are expected to be achieved out of the ten programme outcomes and Electrical Engineering/ Industrial Electronics programme specific outcomes through the practical of the course on Industrial Measurement

PO1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical Engineering/ Industrial Electronics problems.

PO2. **Discipline knowledge:** Apply Electrical Engineering/ Industrial Electronics knowledge to solve broad-based Electrical Engineering/ Industrial Electronics related problems.

PO3. **Experiments and practice:** Experiments and practice: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/ Industrial Electronics problems.

PO4. **Engineering tools:** Apply relevant Electrical Engineering/ Industrial Electronics technologies and tools with an understanding of the limitations

PO5. **The Engineer and Society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in field of Electrical Engineering/ Industrial Electronics.

PO6. **Environment and Sustainability:** Apply Electrical Engineering/ Industrial Electronics solutions also for sustainable development practices in societal and environmental contexts.

PO7. **Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of Electrical Engineering/ Industrial Electronics.

PO8. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

PO9. **Communication:** Communicate effectively in oral and written form.

PO10. **Life-long learning:** Engage in independent and life-long learning activities in the context of technological changes also in the Electrical Engineering/ Industrial Electronics and allied industry.

Program Specific Outcomes (PSO) (What s/he will be able to do in the Electrical Engineering/ Industrial Electronics specific industry soon after the diploma programme).

PSO1. Electrical Engineering/ Industrial Electronics System: Maintain various types of Electrical Engineering/ Industrial Electronics systems.

PSO2. Transducer Application and Calibration: Use Transducer for Electrical Engineering/ Industrial Electronics related System.

Practical- Course Outcome matrix

Course Outcomes (COs):-

a) Select the relevant transducers for measuring various parameters.
b) Maintain the different types of pressure transducers.
c) Maintain the different types of flow transducers.
d) Maintain the different types of level transducers.
e) Maintain the different types of temperature transducers.

S. No.	Practical Outcome	CO a.	CO b.	CO c.	CO d.	CO e.
1	Linear Displacement Measurement Using Potentiometer	✓	-	-	-	-
2	Angular Displacement Measurement Using Potentiometer	✓	-	-	-	-
3	Displacement Measurement Using LVDT	✓	-	✓	-	-
4	Weights Measurement Using Strain Gauge	✓	✓	-	-	-
5	Pressure Measurement Using Bourdon Tube	✓	✓	-	-	-
6	Pressure Gauge Calibration Using Dead Weight Tester	✓	✓	-	-	-
7	Assemble / Dismantle Digital Pressure Measurement System	✓	✓	-	-	-
8	Flow Measurement Using Orifice Plate	✓	-	✓	-	-
9	Flow Measurement Using Venturi Tube	✓	-	✓	-	-
10	Flow Measurement Using Rotameter	✓	-	✓	-	-
11	Level Measurement Using Capacitance Type Transducer	✓	-	-	✓	-
12	Level Measurement Using Air Purge Method	✓	-	-	✓	-
13	Measurement Of Temperature Using RTD	✓	-	-	-	✓
14	Measurement Of Temperature Using Thermocouple	✓	-	-	-	✓
15	Calibration Of RTD	✓	-	-	-	✓
16	Calibration Of Thermocouple	✓	-	-	-	✓

List of Industry Relevant Skills

The following industry relevant skills of the competency '**Maintain electronic automated system in process and manufacturing industries**' are expected to be developed in students by undertaking the practical of this laboratory manual.

1. Identify various transducers.
2. Use transducer to measure various physical quantities.
3. Measure the displacement using different transducers.
4. Measure the flow using different transducers
5. Measure the pressure using different transducers
6. Measure the temperature using different transducers
7. Measure the Level using different transducers
8. Use venture tube to measure flow of fluid
9. Calibrate the thermocouple
10. Calibrate RTD based temperature measuring system.

Guidelines to Teachers

1. Teacher need to ensure that a dated log book for the whole semester, apart from the laboratory manual is maintained by every student which s/he has to submit for assessment to the teacher in the next practical session.
2. There will be two sheets of blank pages after every practical for the student to report other matters (if any), which is not mentioned in the printed practical.
3. For difficult practical if required, teacher could provide the demonstration of the practical emphasizing of the skills which the student should achieve.
4. Teachers should give opportunity to students for hands-on after the demonstration.
5. Assess the skill achievement of the students and COs of each unit.
6. One or two questions ought to be added in each practical for different batches. For this teachers can maintain various practical related question banks for each course.
7. If some repetitive information like data sheet, use of software tools etc. has to be provided for effective attainment of practical outcomes, they can be incorporated in Appendix.
8. For effective implementation and attainment of practical outcomes, teacher ought to ensure that in the beginning itself of each practical, students must read through the complete write-up of that practical sheet.
9. During practical, ensure that each student gets chance and takes active part in taking observations/ readings and performing practical.
10. Teacher ought to assess the performance of students continuously according to the MSBTE guidelines.

Instructions for Students

1. For incidental writing on the day of each practical session every student should maintain a dated log book for the whole semester, apart from this laboratory manual which s/he has to submit for assessment to the teacher in the next practical session.
2. For effective implementation and attainment of practical outcomes, in the beginning itself of each practical, students need to read through the complete write-up including the practical related questions and assessment scheme of that practical sheet.
3. Student ought to refer the data books, safety norms, technical manuals, etc.
4. Student should not hesitate to ask any difficulties they face during the conduct of practical.
5. Select the proper ICs, power supply as per the specifications/ratings given.

Content Page

List of Practical and Progressive Assessment Sheet

S. No.	Title of the practical	Page No.	Date of performance	Date of submission	Assessment marks(25)	Dated sign. of Teacher	Remarks (if any)
1	2	3	4	5	6	7	8
1.	Linear Displacement Measurement Using Potentiometer	1					
2.	Angular Displacement Measurement Using Potentiometer	8					
3.	Displacement Measurement Using LVDT	15					
4.	Weights Measurement Using Strain Gauge	23					
5.	Pressure Measurement Using Bourdon Tube	30					
6.	Pressure Gauge Calibration Using Dead Weight Tester	38					
7.	Assemble / Dismantle Digital Pressure Measurement System	46					
8.	Flow Measurement Using Orifice Plate	53					
9.	Flow Measurement Using Venturi Tube	61					
10.	Flow Measurement Using Rotameter	69					
11.	Level Measurement Using Capacitance Type Transducer	76					
12.	Level Measurement Using Air Purge Method	83					
13.	Measurement of Temperature Using RTD	89					
14.	Measurement of Temperature Using Thermocouple	97					
15.	Calibration of RTD	104					
16.	Calibration of Thermocouple	111					
Total							

Note:

- ***Column 6th to be transferred to pro-forma of CIAAN-2017***

Practical No. 1: Linear displacement measurement using potentiometer

I Practical Significance

Potentiometers are rarely used to directly control significant amounts of power (more than a watt or so). Instead they are used to adjust the level of analog signals (for example volume controls on audio equipment), and as control inputs for electronic circuits. User-actuated potentiometers are widely used as user controls, and may control a very wide variety of equipment functions. Potentiometers are widely use in consumer electronics. This practical help you to measure the linear displacement using potentiometer.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcome

a) Select the relevant transducers for measuring various parameters.

IV Practical Outcome

a) Use the potentiometer to measure the linear displacement

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry Maintain different transducers used for measurement of various parameters.

a) Use multimeters
b) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Linear Potentiometer: The potentiometer is an electrical device comprising a resistor with a sliding third contact, often termed a wiper, which allows the voltage to be varied depending upon where the slider is positioned along the length of the resistor. Potentiometer are found in many electrical and electronic applications and in many different forms, sizes and power ratings. For instance, in a relatively high power application a wire wound potentiometer may be used to provide a variable D.C. (or A.C.) power supply delivering many amperes at some voltage less than the supply voltage. In an electronic system a low power rated carbon track potentiometer may be

used to preset the voltage on a circuit board to achieve the desired level of response. Manual adjustment of the wiper along the length of the fixed resistance produces a variable voltage at the wiper. The magnitude of this output voltage is directly proportional to its relative position along the length of the resistor. If the potentiometer wiper is appropriately connected to a moving system then any movement in that system will cause the wiper to move and so change the output voltage. This signal provides a direct measurement of position or change in position.

VIII Experimental Set-up

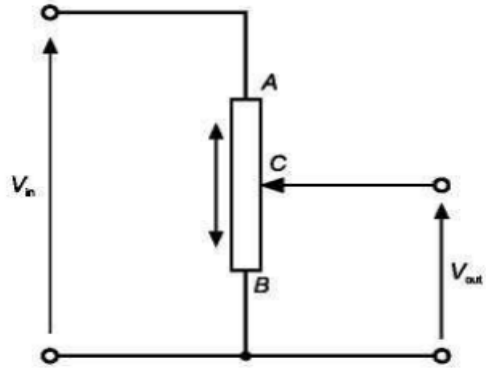

Figure: Linear Potentiometer experimental setup

The output voltage is governed by the position of the wiper (C) which may lie anywhere between the two ends, A and B, of the resistance. For the general case the output voltage is given by the expression,

$$V_{out} = V_{in} \frac{CB}{AB}$$

Where: CB is the linear distance from B to C;
AB is the maximum linear distance from B to A.

Hence when the potentiometer wiper is in position B the output voltage will be zero and when in position A will be maximum, the full supply voltage (Vin).
In any intermediate position the voltage at the wiper will be some value between 0 and Vin as given by the above potentiometer equation.

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**Linear potentiometer**	Displacement range 0-400cm	01	
2	**Power supply**	DC regulated power supply 0-30V DC	01	
3	**DMM**	0-200V DC	01	

X Procedure

1. Identify the component of given setup.
2. Connect potentiometer setup as in diagram.
3. Switch on the power supply
4. Manually displace the wiper of potentiometer by 50 cm
5. Record the output resistance using DMM.
6. Record the output voltage V_{out} using DMM in observation table.
7. Repeat the steps 4 to 6 for 5 times with an interval of 50 cm displacement.
8. Plot the graph of displacement Vs output voltage

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed (Use blank sheet provided if space not sufficient)

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

.....

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.....

.....

XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Displacement (cm)	Output Voltage (Volt)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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.....
.....
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XVIII Conclusions (if any) (Actions/decisions to be taken based interpretation of results)

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XIX Practical Related Questions

Note*: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the output voltage when the wiper is at 0 cm.
2. State the maximum linear range of potentiometer.
3. State the input voltage applied to potentiometer.
4. State the output voltage obtained at 200 cm.

[Space to Write Answers]

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.....
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XX References / Suggestions for further Reading

Sr.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	DhanpatRai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of potentiometer	10%
2	Connection of complete measurement system.	20%
3	Applying input (linear displacement) to potentiometer	10%
4	Observation of output voltages.	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……

2……

3……

4……

5……

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 2: Angular displacement measurement using potentiometer

I Practical Significance

In the industry environment Electrical Engineering/Industrial Electronics diploma graduate are expected to handle various transducers for measurement of process parameters such as temperature, pressure, level, flow, displacement etc. The angular displacement is one of important physical quantity has to measure in various application. Therefore this practical will help to measure angular displacement using potentiometer.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Select the relevant transducers for measuring various parameters.

IV Practical Outcome

a) Use the potentiometer to measure the angular displacement

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain different transducers used for measurement of various parameters.

a) Use multimeters
b) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Angular Potentiometer :

The most commonly used of all the "Position Sensors", is the potentiometer because it is an inexpensive and easy to use position sensor. It has a wiper contact linked to a mechanical shaft that can be either angular (rotational) in its movement, and which causes the resistance value between the wiper/slider and the two end connections to change giving an electrical signal output that has a proportional relationship between the actual wiper position on the resistive track and its resistance value. In other words, resistance is proportional to position.

Potentiometers come in a wide range of designs and sizes such as the commonly available round rotational type. When used as a position sensor the moveable object is connected directly to the rotational shaft of the potentiometer.

A DC reference voltage is applied across the two outer fixed connections forming the resistive element. The output voltage signal is taken from the wiper terminal of the sliding contact as shown below.

This configuration produces a potential or voltage divider type circuit output which is proportional to the shaft position. Then for example, if you apply a voltage of say 10v across the resistive element of the potentiometer the maximum output voltage would be equal to the supply voltage at 10 volts, with the minimum output voltage equal to 0 volts. Then the potentiometer wiper will vary the output signal from 0 to 10 volts, with 5 volts indicating that the wiper or slider is at its half-way or center position

The output signal (Vout) from the potentiometer is taken from the center wiper connection as it moves along the resistive track, and is proportional to the angular position of the shaft.

VIII Experimental Set-up

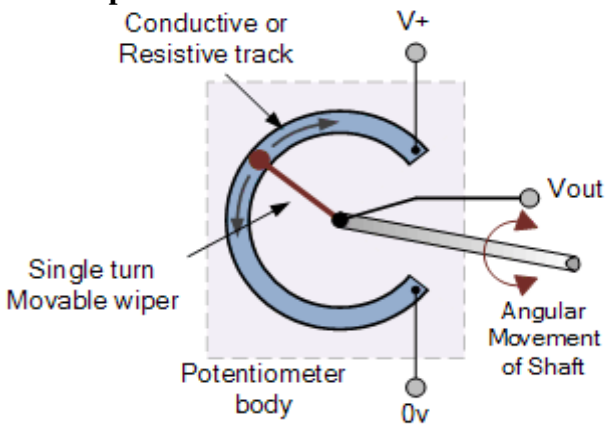

Figure: Angular Potentiometer experimental setup

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**Angular potentiometer**	Displacement range $0\text{-}300^0$, single turn	01	
2	**Power supply**	DC regulated power supply 0-30 V DC	01	
3	**DMM**	0-200V DC	01	

X Procedure

1. Identify the component of given setup.
2. Connect potentiometer setup as in diagram.
3. Switch on the power supply
4. Manually displace the wiper of potentiometer by 30^0 displacement.
5. Record the output resistance using DMM.
6. Record the output voltage V_{out} using DMM in observation table.
7. Repeat the steps 4 to 6 for 5 times with an interval of 30^0 displacement.
8. Plot the graph of displacement Vs output voltage

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed (To be written by students) (Use blank sheet provided if space not sufficient)

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

.....

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Displacement (Angle in degrees)	Output Voltage (Volt)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) ((Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note*: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the output voltage when the wiper is at 0^0
2. State the maximum angular range of potentiometer.
3. State the input voltage applied to potentiometer
4. State the output voltage obtained at 300^0

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	Dhanpat Rai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup potentiometer	10%
2	Connection of complete measurement system.	20%
3	Applying input (angular displacement) to potentiometer	10%
4	Observation of output voltages.	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

3……..

4……..

5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 3: Displacement measurement using LVDT

I Practical Significance

LVDT is passive transducer based on mutual inductance principle. It is used to measure linear displacement. It is used as secondary transducer for measurement pressure using bourdon tube. This practical help you to measure displacement using LVDT.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Select the relevant transducers for measuring various parameters.

IV Practical Outcome

a) Use LVDT to measure displacement.

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain different transducers used for measurement of various parameters.

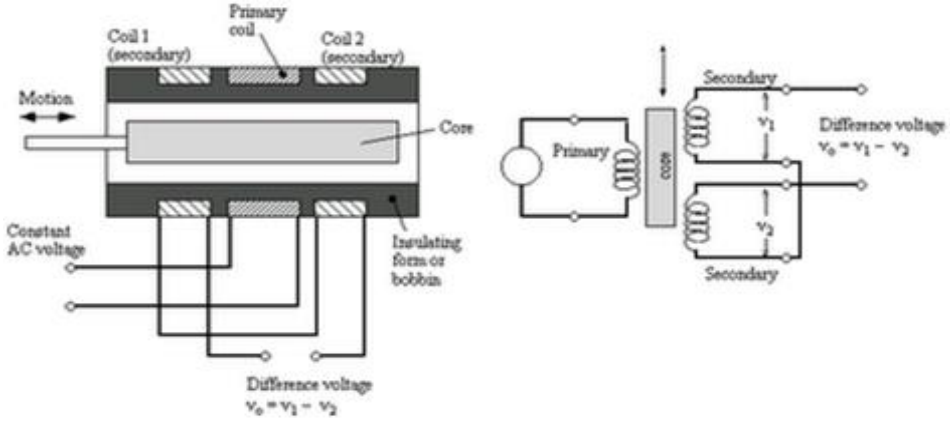
a) Use C.R.O
b) Use multimeters
c) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

LVDT "Linear Variable Differential Transformer" is most widely used inductive transducer to translate linear motion into electrical signals.



Construction of LVDT : LVDT consists of a cylindrical former where it is surrounded by one primary winding in centre of the former and the two secondary windings connected in series opposition. The number of turns in both the secondary winding are equal, but are series opposite to each other.

Working of LVDT (Linear Variable Differential Transformer): The Linear Variable Differential Transformer works on the principle of electromagnetic induction. When we give supply to the primary winding of the LVDT, a current starts flowing through the primary winding. Due to magnetic property of current, the magnetic lines of force starts flowing around the primary coil, thus a magnetic field is set up around the primary winding. As in general transformers, due to magnetic effect of primary winding, an e.m.f. is also set up in secondary winding when the magnetic lines of force of primary winding cuts (come across contact) the iron rod and secondary winding. This e.m.f. causes a current to flow in secondary winding and this whole process is known as mutual inductance.

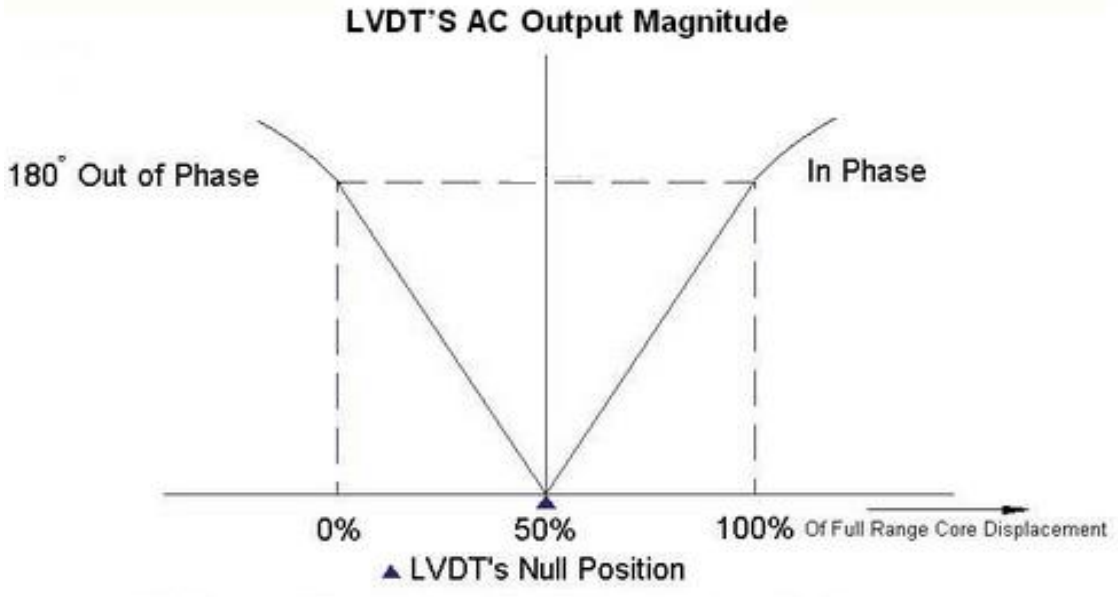
Case 1 (When the rod is placed in Center i.e. Area of contact of iron rod is same with both secondary coils):

When the iron rod is placed in center of both secondary coils then the area of contact of iron rod between two secondary windings is equal, then the equal amount of e.m.f. is developed in the both coils.

Case 2(When the Rod is moved towards the right to the coil S2): When the rod is moves to the right side towards the secondary coil 2 then the area of contact of rod is larger with secondary coil S2 as compared to coil S1. Therefore, more amount of magnetic field cuts the coil S2 and thus more e.m.f. will be induced in the secondary coil S2.

Case 3(When Iron Rod is moved towards the left, to coil S1): When the iron rod is moved towards the coil S1 that is to left side then the contact area of secondary coil S1 will be larger than coil S2. Thus more e.m.f. will be induced in secondary coil S2.

Characteristics of LVDT



AC Output of Conventional LVDT Versus Core Displacement

VIII Experimental Set-up

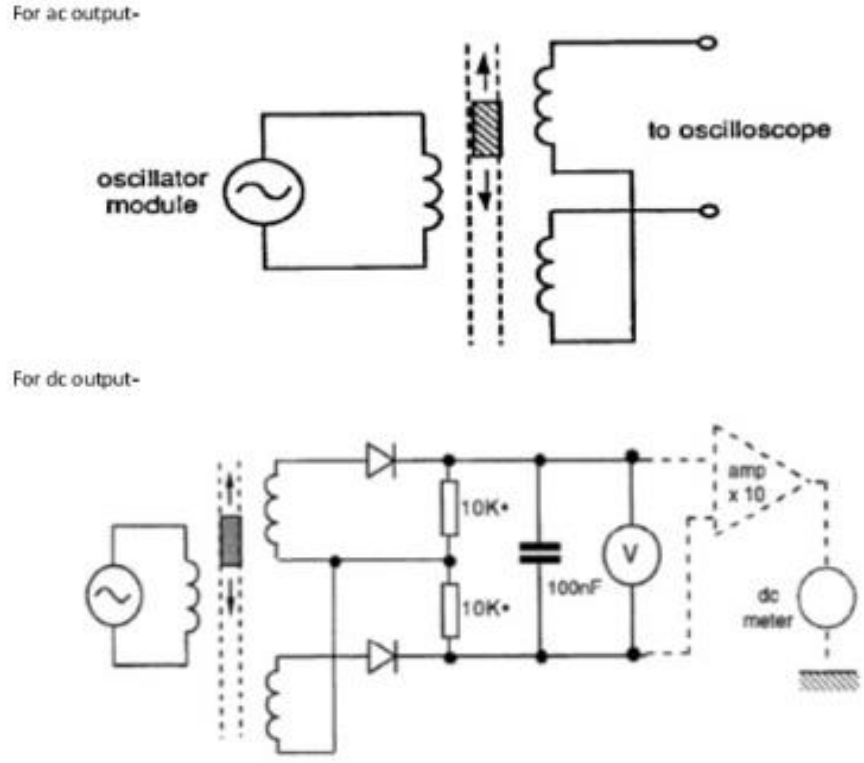


Figure: LVDT experimental setup

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**LVDT trainer kit-**	Displacement range +/- 20 mm. Accuracy of +/- 2% Primary Excitation 4 KHZ and 1 Volt, RMS Output : Digital display of +/- 20mm	01	

X Procedure

1. Identify the component of given setup diagram.
2. Connect LVDT setup as in diagram.
3. Switch on the power supply.
4. Manually displace the core of LVDT by 1mm.
5. Record the digital display indication w.r.t displacement.
6. Record the output voltage V1 using DMM in observation table.
7. Cross check output voltage V1 using C.R.O.
8. Repeat the steps 4 to 7 for 5 times with an interval of 1mm placement on both side of center position of core.
9. Plot the graph of displacement vs output voltage.

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed ((Use blank sheet provided if space not sufficient**)**

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Displacement	Indication on digital display	Output voltage
1			
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3			
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8			
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XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) ((Actions/decisions to be taken based on the interpretation of results)

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. State the output voltage when the core is at center position
2. State the maximum linear range of LVDT.
3. State the input voltage is applied to primary winding of LVDT.
4. State the output voltage is obtained at secondary winding of LVDT.

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	Dhanpat Rai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of LVDT.	10%
2	Connection of complete measurement system.	20%
3	Applying input (displacement) to LVDT.	10%
4	Observation of output voltages.	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

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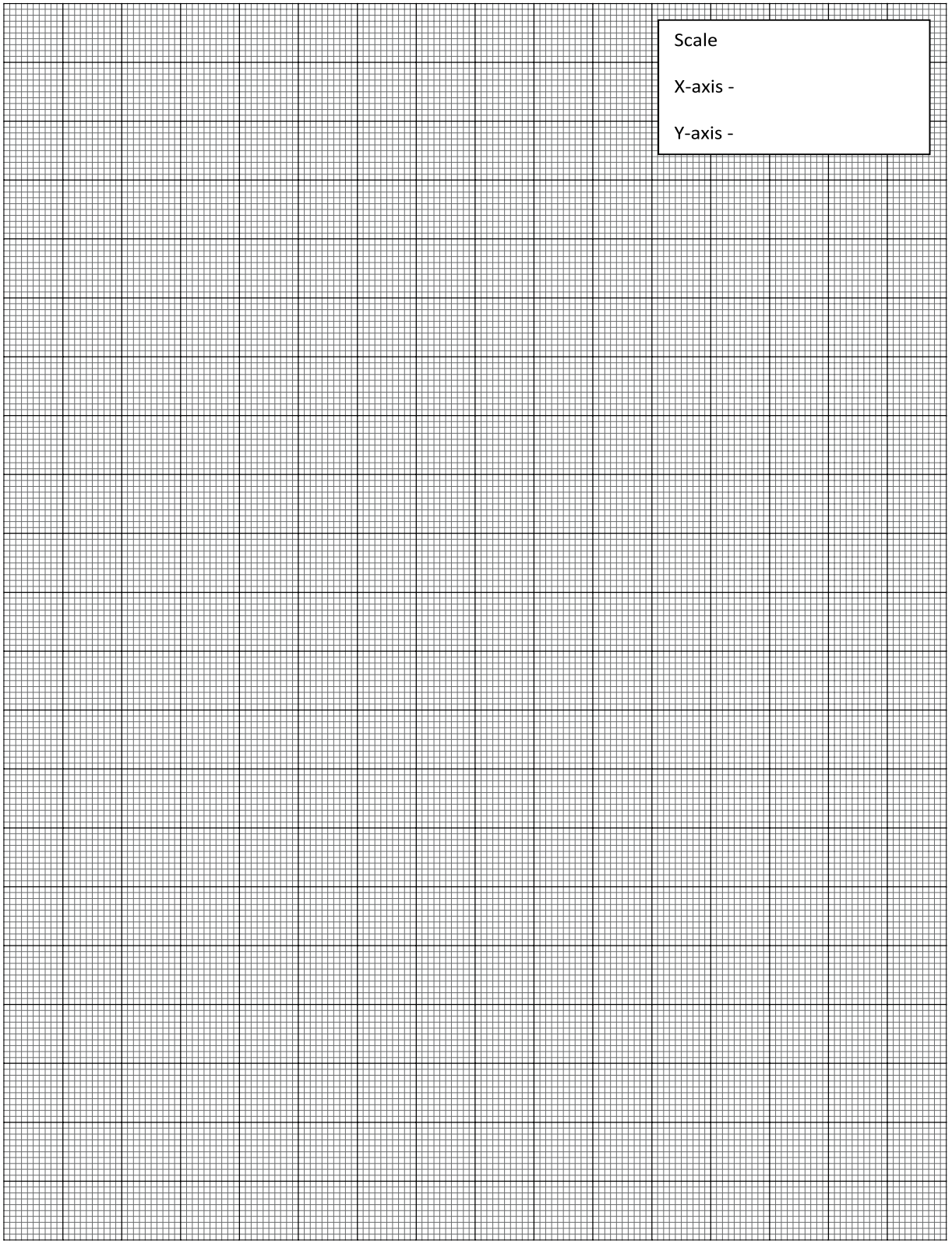
Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 4: Weights measurement using strain gauge

I Practical Significance

A Strain Gauge is passive transducer which resistance change as per applied pressure. The strain gauge is used as Load Cell in weighing machine. In this practical student will able measure the pressure (weight) applied on strain gauge.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.

2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Select the relevant transducers for measuring various parameters.

IV Practical Outcome

a) Use the strain gauge to measure weights.

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain different transducers used for measurement of various parameters.
a) Use multimeters
b) Connection skills

VI Relevant Affective domain

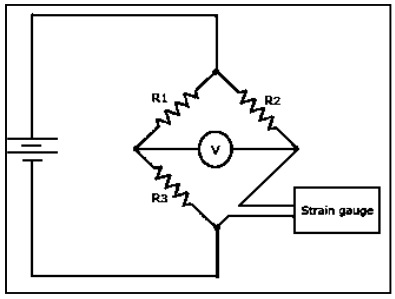
a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Strain gauge is a resistive transducer whose resistance changes when subjected to stress (due to change in length, area and resistivity).When gauge is subjected to positive stress its length increases while its area cross section decreases since resistance of conductor is directly proportional to length and inversely proportional to area of cross section, resistance to gauge increases this change in resistance is measured by wheat stone bridge.

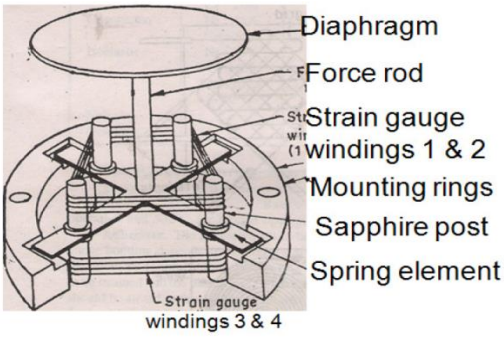
Gauge factor: Sensitivity or gauge factor is defined as ratio of unit change in resistance to unit change in length

$$G.F = \frac{\Delta R/R}{\Delta L/L}$$

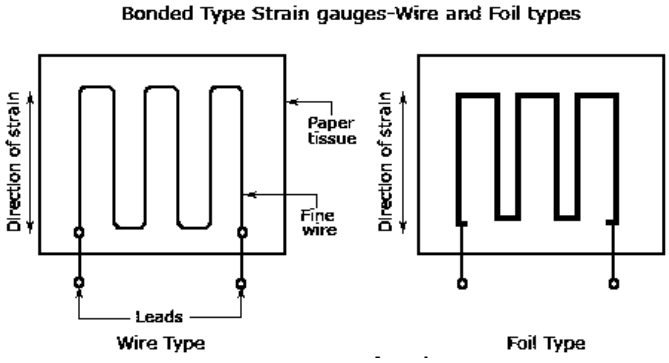


Types of strain gauges

a. Unbonded



b. Bonded



VIII Experimental Set-up

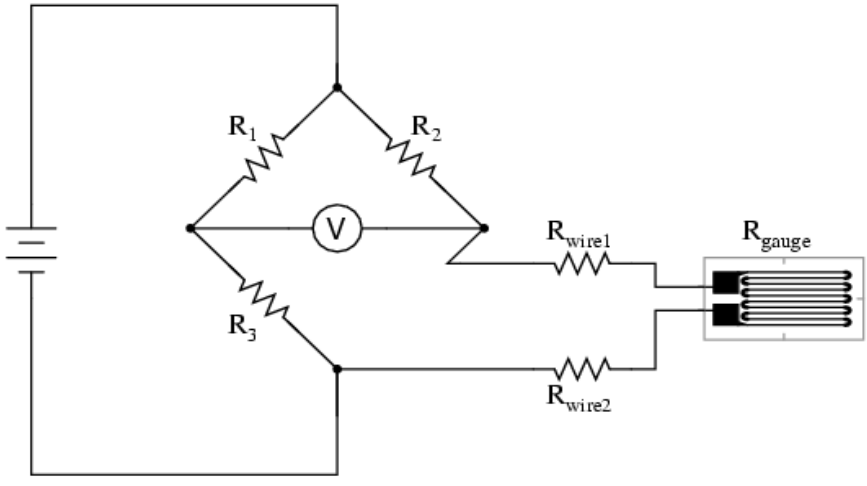


Figure: Strain Gauge experimental setup

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**Strain gauge trainer kit**	Strain gages of 350 ohms, Accuracy: +/- 1% Power Supply 230 Vac, maximum of 5-kg load, Digital indication	01	

X Procedure

1. Identify the component of given setup diagram
2. Connect stain gauge setup as in diagram.
3. Switch on the power supply
4. Provide weight of 1kg on strain gauge platform
5. Increase the weights in steps of 1kg
6. Record the output on digital display
7. Record the output voltage V_1 using DMM in observation table.
8. Repeat the steps 5 to 6 for 5 times with an interval
9. Plot the graph of weights Vs output voltage

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed (Use blank sheet provided if space not sufficient)

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations (Use blank sheet provided if space not sufficient)

Sr. No.	Weights kg	Indication on Digital display	Output voltage V1
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) ((Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. State the output voltage when no weight is applied on the platform.
2. State the maximum range of strain gauge.
3. State the type of strain gauge used in practical.
4. State the type of material used in strain gauge in practical setup.

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	DhanpatRai and Sons, N. Delhi 2010; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of strain gauge.	10%
2	Connection of complete measurement system.	20%
3	Applying input (weights) to strain gauge .	10%
4	Observation of output voltages.	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……

2……..

3……..

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5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 5: Pressure measurement using bourdon tube

I Practical Significance

In the industry environment Electrical Engineering/Industrial Electronics diploma graduate are expected to handle various transducers for measurement of process parameters such as temperature, pressure, level, flow, displacement etc. The pressure measurement can be done directly or indirectly. The bourdon tube is one of the transducer is used to measure pressure Therefore this practical will help you to measure the pressure using bourdon tube.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Select the relevant transducers for measuring various parameters.

IV Practical Outcome

a) Use Bourdon tube pressure gauge to measure pressure.

V Competency and Practical Skills

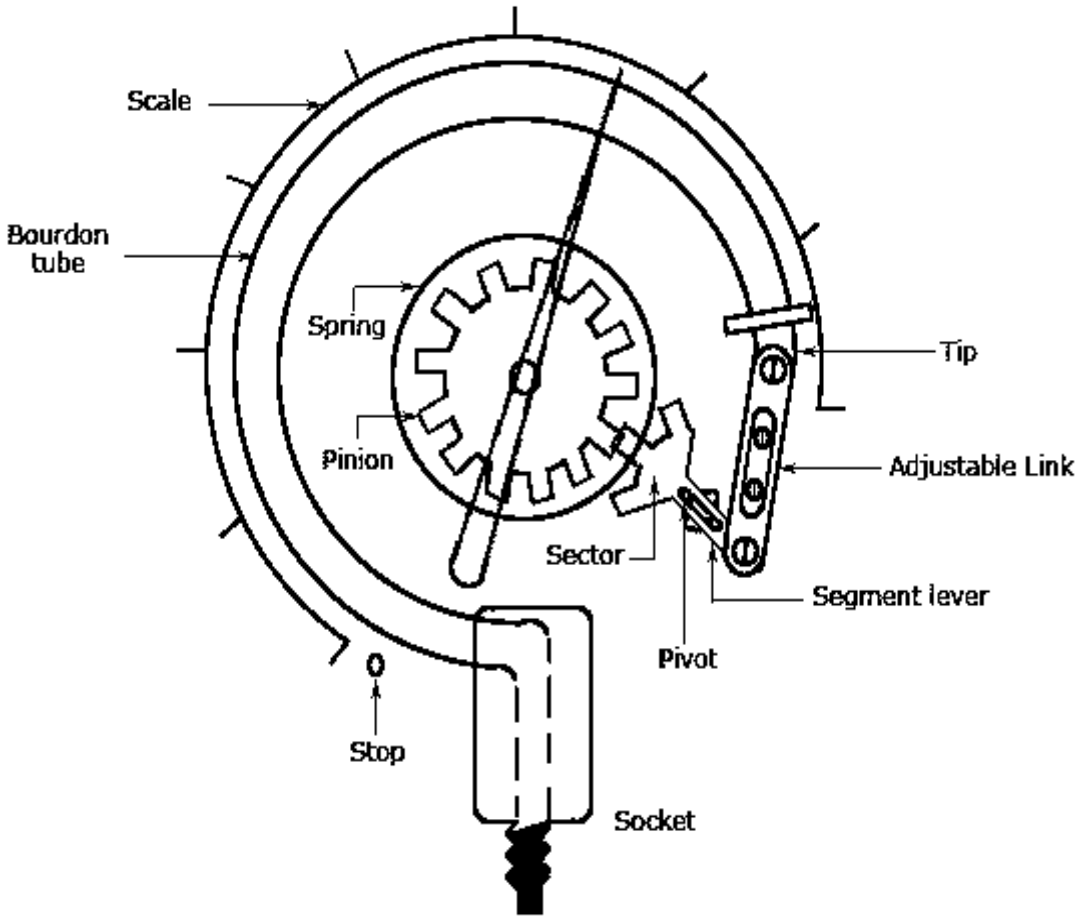
This practical is expected to develop the following skills for the industry
Maintain different transducers used for measurement of various parameters.
a) Use multimeters
b) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Bourdon Tube is known for its very high range of differential pressure measurement in the range of almost 100,000 psi (700 MPa). It is an elastic type pressure transducer. A C type bourdon tube consist of long thin wall cylinder of non-circular cross section, sealed at one end and made up of material such as phosphorous bronze, steel, beryllium copper, and attach by light line mechanism which operates the pointer. The other end of the tube is fixed and is open for application of pressure which is to be measured. The tube is soldered to a socket at the base through which pressure connection is to be made.



Bourdon Tube Pressure Gauge

Working

As the fluid pressure enters the bourdon tube, it tries to be reformed and because of a free tip available, this action causes the tip to travel in free space and the tube unwinds. The simultaneous actions of bending and tension due to the internal pressure make a non-linear movement of the free tip. This travel is suitable guided and amplified for the measurement of the internal pressure. But the main requirement of the device is that whenever the same pressure is applied, the movement of the tip should be the same and on withdrawal of the pressure the tip should return to the initial point.

VIII Experimental Set-up

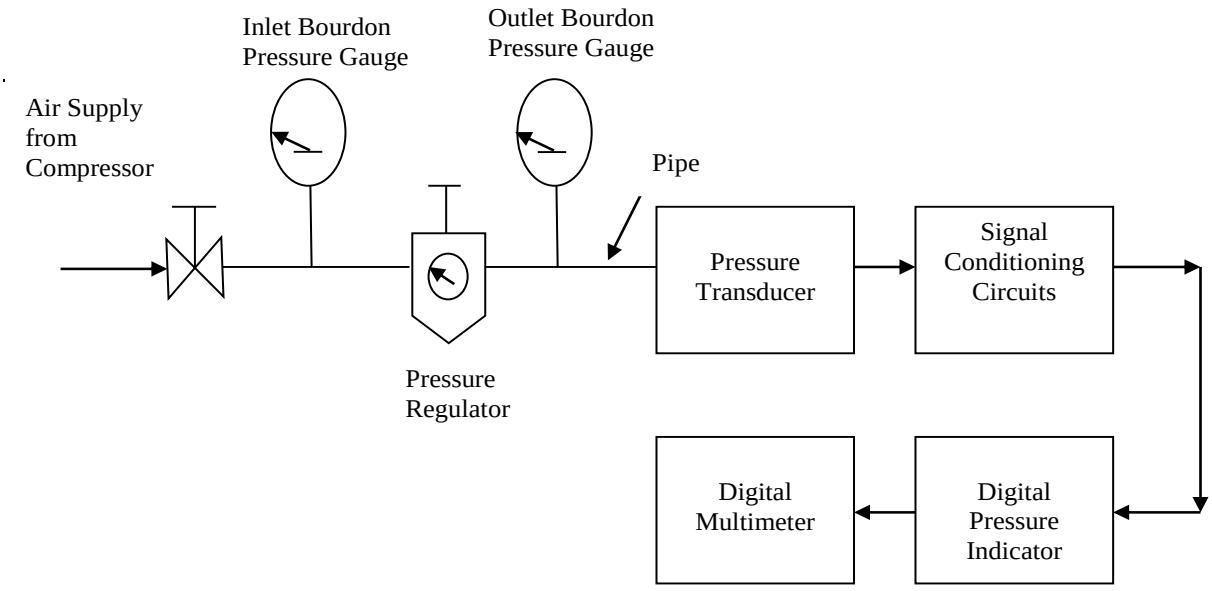


Figure: Pressure measurement setup

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**Bourdon tube pressure gauge**	Input pressure range 0 – 50 psi. Accuracy of +/- 2%. Dial gauge indication in the range 0 to 50 psi and Digital display.	01	

X Procedure

1. Identify the component of given setup diagram
2. Connect pressure measurement setup as in diagram.
3. Switch on the power supply
4. Provide pressure of 5 psi with compressor.
5. Increase the pressure in steps of 5 psi
6. Record the output pressure on dial gauge
7. Record the output pressure on digital display
8. Repeat the steps 4 to 7 for 5 times.

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed (Use blank sheet provided if space not sufficient**)**

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XIII Resources used

Sr. No	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Pressure on dial gauge	Pressure Indication on Digital Display
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) ((Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. State the output pressure when no pressure is applied from compressor.
2. State the maximum range of pressure measurement.
3. State the type of bourdon tube used in practical.
4. State the type of material used in bourdon tube.

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	DhanpatRai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of pressure measurement.	10%
2	Connection of complete measurement system.	20%
3	Applying input (pressure) to bourdontube.	10%
4	Observation of output pressure.	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

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5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 6: Pressure gauge calibration using dead weight tester

I Practical Significance

In the industry environment Electrical Engineering/Industrial Electronics diploma graduate are expected to handle various transducers for measurement of process parameters such as temperature, pressure, level, flow, displacement etc. The dead weight tester apparatus is used for measurement of high steady pressure as well as calibration purpose for known pressure quantity. Therefore this practical will help you to calibrate given pressure using dead weight tester.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Maintain the different types of pressure transducers

IV Practical Outcome

a) Calibrate the bourdon tube pressure gauge using dead weight tester.

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain different transducers used for measurement of various parameters.

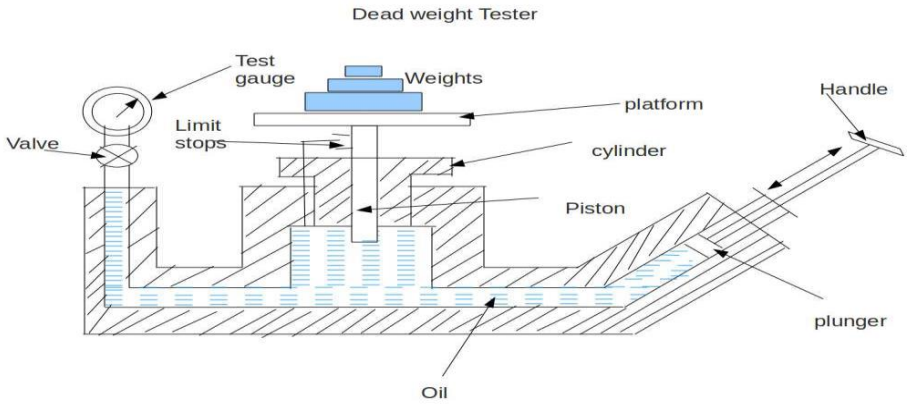
a) Use Deadweight tester
b) Pressure Gauge
c) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Dead Weight Tester is used for measurement of high steady pressure, and for checking bourdon type of gauge. In the practical form, it is often used as a standard of pressure measurement. In this type of instrument the force produce on the piston on known area is measured directly by weight it will support



Operation

The dead weight tester is basically a pressure producing and pressure measuring device. It is used to calibrate pressure gauges. The following procedure is adopted for calibrating pressure gauges. Calibration of pressure gauge means introducing an accurately known sample of pressure to the gauge under test and then observing the response of the gauge. In order to create this accurately known pressure, the following steps are followed. The valve of the apparatus is closed.

A known weight is placed on the platform. Now by operating the plunger, fluid pressure is applied to the other side of the piston until enough force is developed to lift the piston-weight combination. When this happens, the piston weight combination floats freely within the cylinder between limit stops.
In this condition of equilibrium, the pressure force of fluid is balanced against the gravitational force of the weights plus the friction drag.

Therefore, $PA = Mg + F$
Hence: $P = Mg + F / A$
where, P = pressure
M = Mass; Kg
g = Acceleration due to gravity ; m/s^2
F = Friction drag; N
A = Equivalent area of piston – cylinder combination; m^2
Thus the pressure P which is caused due to the weights placed on the platform is calculated. After calculating P, the plunger is released.

Now the pressure gauge to be calibrated is fitted at an appropriate place on the dead weight tester. The same known weight which was used to calculate P is placed on the platform. Due to the weight, the piston moves downwards and exerts a pressure P on the fluid. Now the valve in the apparatus is opened so that the fluid pressure P is transmitted to the gauge, which makes the gauge indicate a pressure value. This pressure value shown by the gauge should be equal to the known input pressure P. If the gauge indicates some other value other than P the gauge is adjusted so that it reads a value equal to P. Thus the gauge is calibrated.

VIII Experimental Set-up

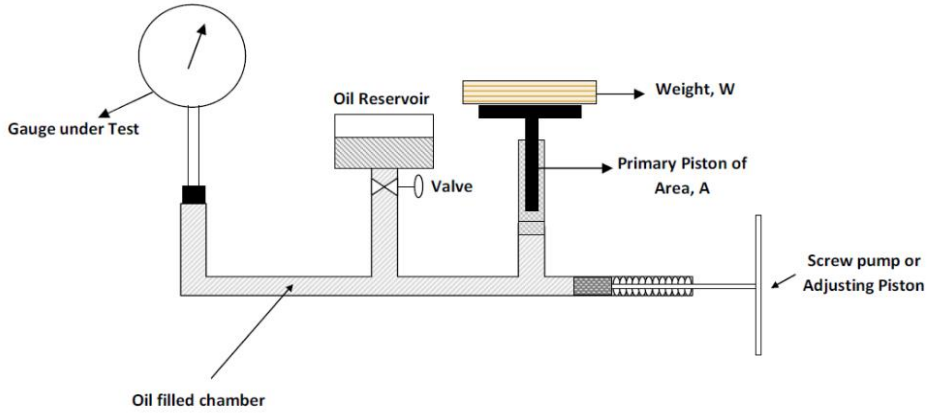


Figure: Dead Weight Tester experimental setup

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**Dead weight tester**	Input range 0-10 kg, Output on dial gauge 0 – 10kg/cm^2	01	

X Procedure

1. Identify the component of given setup diagram
2. Check the oil level in the reservoir.
3. Open check valve.
4. Rotate displacement pump clockwise and anti-clockwise two to three times for removing air bubbles.
5. Close check valve.
6. Place the standard weights 0.5kg/cm^2 on weighing platform
7. Observe the output pressure in gauge.
8. Record the pressure in observation table.
9. Increase the weights in range 0.5kg/cm^2
10. Repeat the steps 6 to 9 for 5 times.

XI Precautions to be followed

1. Ensure proper connections are made as per the setup.
2. Ensure tight fitting of bourdon gauge.

XII Actual procedure followed (To be written by students)(Use blank sheet provided if space not sufficient)

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XIII Resources used

	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Standard Weights kg/cm^2	Pressure gauge indication kg/cm^2
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) ((Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. State the output pressure when no weight is applied on the platform.
2. State the maximum pressure range of deadweight tester.
3. State the error observed.
4. State the purpose of check valve.

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	DhanpatRai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of dead weight tester.	10%
2	Connection of complete measurement system.	20%
3	Applying input (weights) to dead weight tester.	10%
4	Observation of output pressures.	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

3……..

4……..

5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 7: Assemble / dismantle digital pressure measurement system

I Practical Significance

In the industry environment Electrical Engineering/Industrial Electronics diploma graduate are expected to handle various systems. They maintain those systems as well as calibrate. While maintaining system they may dismantle and assemble the system. Therefore this practical will help you to assemble / dismantle digital pressure measurement system

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Maintain the different types of pressure transducers.

IV Practical Outcome

a) Assemble/dismantle digital pressure measurement system

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain different transducers used for measurement of various parameters.

a) Dismantle skill
b) Use multimeters
c) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Many of the processes in the modern world involve the measurement and control of pressurized liquid and gas systems. This monitoring reflects certain performance criteria that must be controlled to produce the desirable results of the process and insure its safe operation. Boilers, refineries, water systems, and compressed gas systems are but a few of the many applications for pressure gauges.

The mechanical pressure indicating instrument, or gauge, consists of an elastic pressure element; a threaded connection means called the "socket"; a sector and pinion gear mechanism called the "movement"; and the protective case, dial, and viewing lens assembly. The elastic pressure element is the member that actually displaces or moves due to the influence of pressure. When properly designed, this pressure element is both highly accurate and repeatable. The pressure element is connected to the geared "movement" mechanism, which in turn rotates a pointer

throughout a graduated dial. It is the pointer's position relative to the graduations that the viewer uses to determine the pressure indication.

VIII Experimental Set-up

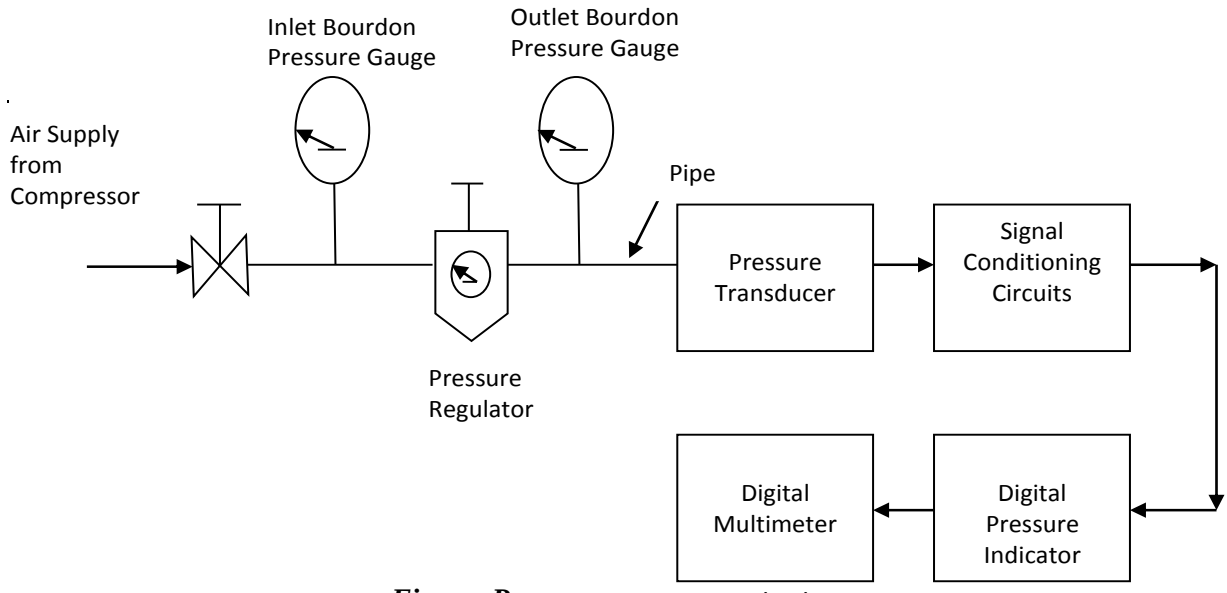

Figure: Pressure measurement setup

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**Bourdon tube pressure gauge**	Input pressure range 0 – 50 psi. Accuracy of +/- 2%. Dial gauge indication in the range 0 to 50 psi. and digital display	01	

X Procedure

Dismantle

1. Identify the component of given setup diagram
2. Switch off the power supply of compressor
3. Close manual valve at outlet
4. Switch off power supply of setup
5. Disconnect all pipes in line
6. Clean all pipe, pressure gauge, pressure regulator.
7. Disconnect power wires, signal wires

Assemble

1. Identify the component of given setup diagram
2. Connect all signal wires
3. Place pressure gauge and pressure regulator in setup
4. Connect all pipes in line as in the setup
5. Ensure all connection as per setup arrangement
6. Switch on the power supply of setup

7. Switch on the compressor supply
8. Open manual valve for operation purpose
9. Observe 2 to 3 readings.

XI Precautions to be followed

1. Observe the parts carefully.
2. Maintain the parts till they are assembled.

XII Actual procedure followed (Use blank sheet provided if space not sufficient**)**

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XIII Resources used

Sr. No	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

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XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions (if any) (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. Name the different tools used for dismantle
2. Name the different components dismantle in the setup.
3. State the min and max output pressure after assemble

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	Dhanpat Rai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of pressure measurement.	10%
2	Dismantle of complete measurement system.	20%
3	Assemble of complete measurement system	10%
4	Observation of output voltages.	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

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Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 8: Flow measurement using orifice plate

I Practical Significance

Flow measurement is one of important process in industry. Orifice meter have been in use for fluid flow measurement. It is essentially a cylindrical tube that contains a plate with a thin hole in the middle of it. The thin hole essentially forces the fluid to flow faster through the hole in order to maintain flow rate. Therefore this practical will help you to measure flow using the Orifice plate.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Maintain the different types of flow transducers.

IV Practical Outcome

a) Use orifice meter for flow measurement.

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain the different types of flow transducers.

a) Use U tube manometer
b) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Orifice plate is the simplest and cheapest form of primary elements and used more frequently than all others types. An orifice plate is inserted in the line and the differential pressure across it is measured.

There are different types of orifice plates used as per applications.

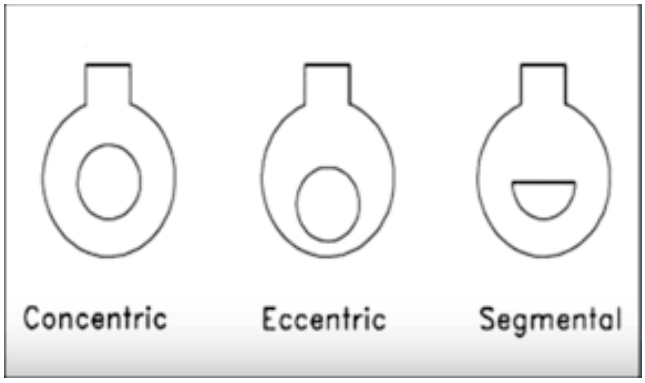
a. Concentric Orifice plate: It is most widely used. It is usually made up of material such as stainless steel, nickel, monel, phosphor bronze etc. to withstand corrosive effects of the fluid .Its thickness varies from1/8" to ½" depending upon pipeline size and flow velocity. It has circular hole in the middle and is installed in the pipe line with the hole concentric to pipe line.

b. Eccentric Orifice Plate: Is orifice which bore position is offset from center line of the pipe. It is used in service if there is secondary fluid phase (gas contains liquid or liquid contains gas) in which the application of vent hole or drain hole on the concentric orifice plate may adversely affect the accuracy in case the vent

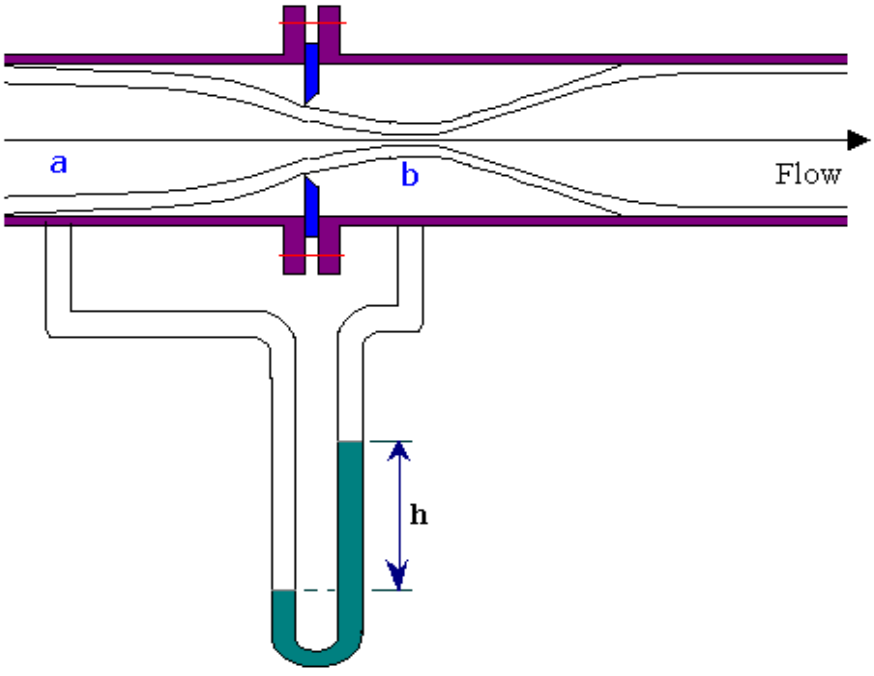
or drain hole size requires large area to cater the secondary phase. Eccentric Orifice Plate is also used in service where severe entrainment may occur such as in dirty gas or liquid, which in this case the solid or slurries could plug the vent or drain hole.

c. **Segmental Orifice plate**: It has a hole that is not circular but rather a segment of a concentric circle. It is used to measure the flow of light slurries and fluids with high concentration of solids. It eliminates the hold back foreign matter and provides more complete drainage than the eccentric orifice plates. It is more expensive and has slightly greater uncertainty.

d. **Quadrant Orifice plate:** The upstream side of the bore is shaped like a flow nozzle while the downstream side acts as a sharp edge orifice plate. They are recommended for measurement of viscous fluids which have pipe Reynolds numbers bellow 10000.



VIII Experimental Set-up



Flow rate Calculation Equation

$$V = K\sqrt{\frac{2gh}{\rho}}$$

$$Q = KA\sqrt{\frac{2gh}{\rho}}$$

$$W = KA\sqrt{\frac{2gh}{\rho}}$$

where, V = velocity of flowing fluid
Q = volume flow rate
W = mass flow rate
A = cross-sectional area of pipe through which fluid is flowing
h = differential head (pressure) across the restriction element
g = acceleration due to gravity
ρ = density of the flowing liquid

$$K = \frac{C}{\sqrt{1-\beta^4}} = \text{a constant}$$

where C = discharge coefficient
β = diameter ratio

$$\beta = \frac{d\ (\text{diameter of restriction element})}{D\ (\text{inside diameter of the pipe})}$$

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**Orifice meter measurement setup**	1''line size, concentric type, MOC-SS, U tube manometer 400 mm height, Range 0-1000LPH	01	

X Procedure

1. Identify the component of given setup diagram
2. Connect Orifice meter measurement setup as in diagram.
3. Fill the sump tank with water.
4. Switch on the power supply.
5. Start the pump and ensure flow rate through pipe line
6. Measure differential pressure across the orifice using U tube manometer.
7. Calculate flow rate for obtained differential pressure.
8. Change valve position for increasing flow rate in pipe line.
9. Record the differential pressure, flow rate in observation table.
10. Repeat the steps 6 to 9 for 5 to 6 readings.
11. Plot the graph of differential pressure vs. flow rate.

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed (Use blank sheet provided if space not sufficient**)**

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Flow rate indicated	Calculated flow rate
1		
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8		
9		
10		
11		

XVI Results

1. Name of identified transducer a) ……
   a. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. Name the device used for differential pressure measurement.
2. State the maximum range of flow rate measurement.
3. State the type of orifice plate used in practical.
4. State the type of material used in orifice plate in practical setup.

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	DhanpatRai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of orifice plate	10%
2	Connection of complete measurement system.	20%
3	Applying flow rate to orifice plate	10%
4	Observation of output differential pressure	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

3……..

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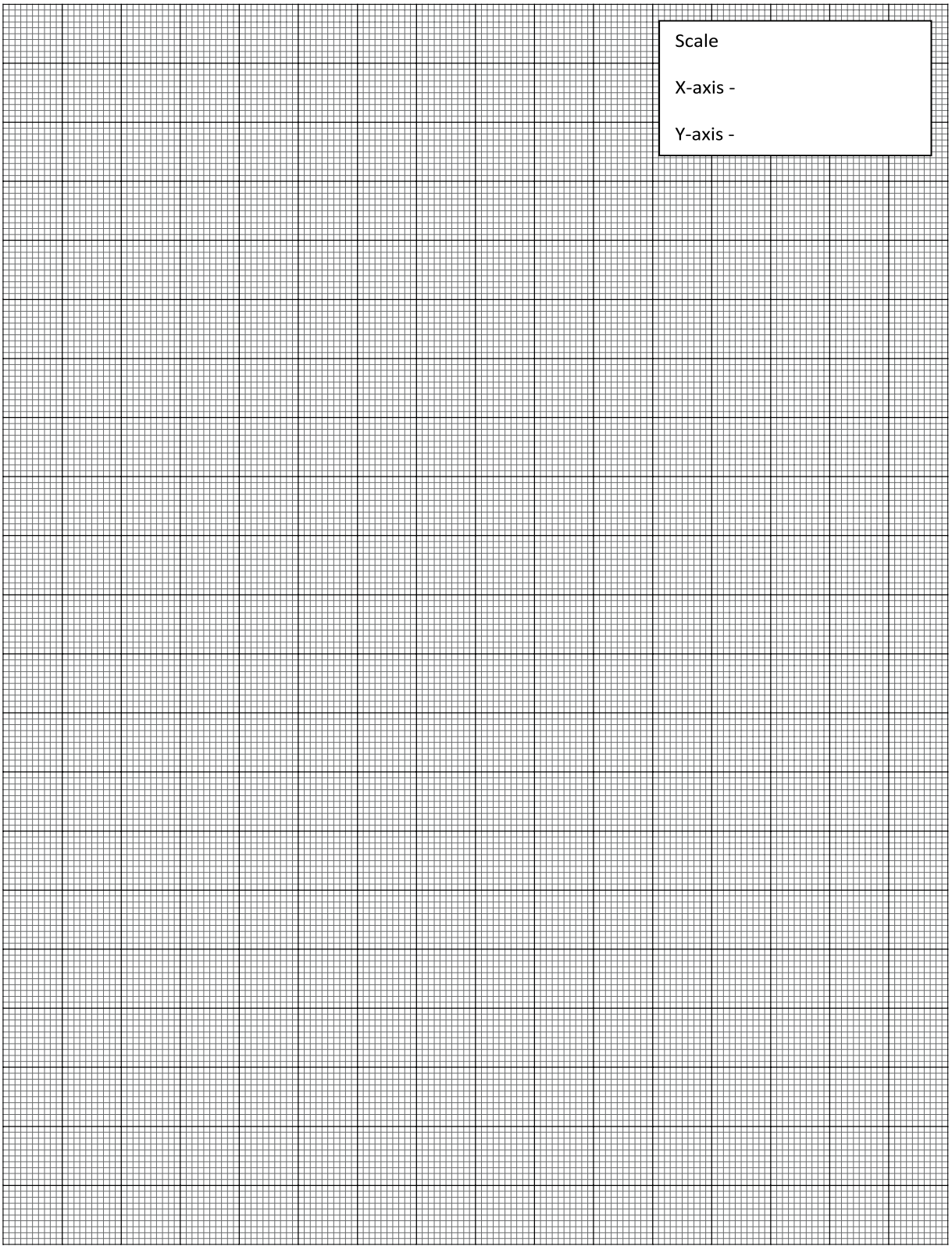
5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 9: Flow measurement using venturi tube

I Practical Significance

In the industry environment Electrical Engineering/Industrial Electronics diploma graduate are expected to handle various transducers for measurement of process parameters such as temperature, pressure, level, flow, displacement etc. The flow measurement is one of the important processes in industry. Different transducers are used in industry for flow measurement venturi tube one of it. Therefore this practical will help you to measure the flow using venturi tube.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Maintain the different types of flow transducers.

IV Practical Outcome

a) Use venturi meter for flow measurement.

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain the different types of flow transducers.

a) Use U tube manometer
b) Connection skills

VI Relevant Affective domain

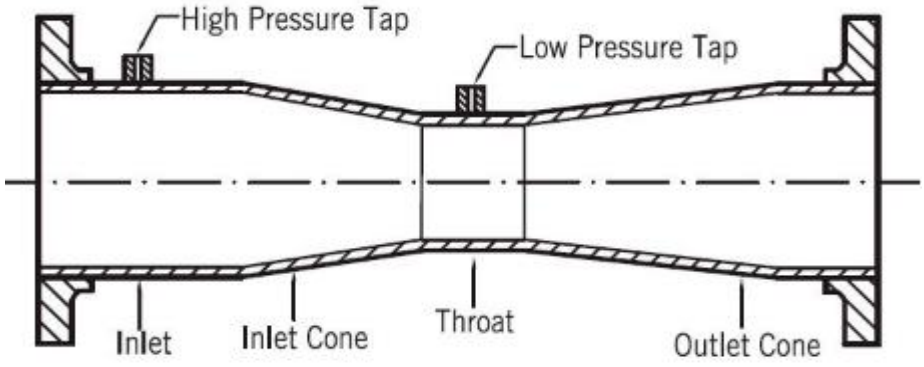
a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Venturi Tubes: It is used where permanent pressure loss is of prime importance and good pressure recovery and maximum accuracy is desired in the measurement of high viscous fluids. It can handle slurry and dirty liquids that build up around other primary elements if the pressure taps are protected from plugging. They are usually made up of material such as cast iron and steel. They are available in the sizes from 100mm to 800mm

They are build in several form such as

1. Long form
2. Short form where venture outlet cone is shorten.
3. Eccentric form
4. Rectangular form



A venturimeter is a device used for measuring the rate of flow of a fluid flowing through a pipe.

The main parts of a venturimeter are:

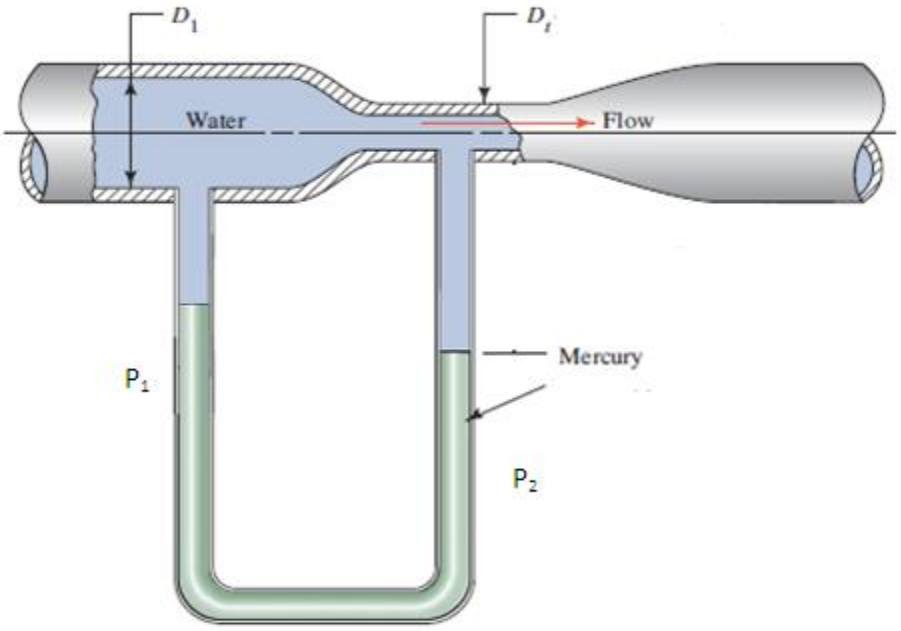
1. A short converging part: It is that portion of the venturi where the fluid gets converges.
2. Throat: It is the portion that lies in between the converging and diverging part of the venturi. The cross section of the throat is much less than the cross section of the converging and diverging parts. As the fluid enters in the throat, its velocity increases and pressure decreases.
3. Diverging part: It is the portion of the venturimeter (venturi) where the fluid gets diverges.

Working

The venturimeter is used to measure the rate of flow of a fluid flowing through the pipes.

- As the water enters at the inlet section i.e. in the converging part it converges and reaches to the throat.
- The throat has the uniform cross section area and least cross section area in the venturimeter. As the water enters in the throat its velocity gets increases and due to increase in the velocity the pressure drops to the minimum.
- Now there is a pressure difference of the fluid at the two sections. At the section 1(i.e. at the inlet) the pressure of the fluid is maximum and the velocity is minimum. And at the section 2 (at the throat) the velocity of the fluid is maximum and the pressure is minimum.
- The pressure difference at the two section can be seen in the manometer attached at both the section.
- This pressure difference is used to calculate the rate flow of a fluid flowing through a pipe.

VIII Experimental Set-up



Flow rate Calculation Equation

$$V = K\sqrt{\frac{2gh}{\rho}}$$

$$Q = KA\sqrt{\frac{2gh}{\rho}}$$

$$W = KA\sqrt{\frac{2gh}{\rho}}$$

where, V = velocity of flowing fluid
Q = volume flow rate
W = mass flow rate
A = cross-sectional area of pipe through which fluid is flowing
h = differential head (pressure) across the restriction element
g = acceleration due to gravity
ρ = density of the flowing liquid

$$K = \frac{C}{\sqrt{1-\beta^4}} = \text{a constant}$$

where C = discharge coefficient
β = diameter ratio

$$\beta = \frac{d\ (\text{diameter of restriction element})}{D\ (\text{inside diameter of the pipe})}$$

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**Venturi flow measurement setup:**	1''line size, MOC-SS, U tube manometer 400 mm height, Range 0-1000LPH,	01	

X Procedure

1. Identify the component of given setup diagram
2. Connect Venturi meter measurement setup as in diagram.
3. Fill the sump tank with water.
4. Switch on the power supply.
5. Start the pump and ensure flow rate through pipe line
6. Measure differential pressure across the venturi using U tube manometer.
7. Calculate flow rate for obtained differential pressure.
8. Change valve position for increasing flow rate in pipe line.
9. Record the differential pressure, flow rate in observation table.
10. Repeat the steps 6 to 9 for 5 to 6 readings.
11. Plot the graph of differential pressure vs. flow rate.

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed (Use blank sheet provided if space not sufficient)

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XIII Resources used

Sr. No	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
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3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Flow rate on indicator	Calculated Flow rate
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8		
9		
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XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results**)**

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XVIII Conclusions (if any) (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

***Note**: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. Name the device used for differential pressure measurement.
2. State the maximum range of flow rate measurement.
3. State the type of Venturi used in practical.
4. State the type of material used in Venturi in practical setup.

[Space to Write Answers]

XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	DhanpatRai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of venturi setup	10%
2	Connection of complete measurement system.	20%
3	Applying input flow rate to venturi	10%
4	Observation of output differential pressure	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

3……..

4……..

5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 10: Flow measurement using rotameter

I Practical Significance

Rotameter is one of important instrument used by industry. The Rotameter have been in use for fluid flow measurement. It belongs to a class of variable area flow meters. This variable area principle consists of three basic elements: A uniformly tapered flow tube, a float, and a measurement scale. Therefore this practical will help you to measure the flow using Rotameter.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Maintain the different types of flow transducers.

IV Practical Outcome

a) Use Rotameter for flow measurement.

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain the different types of flow transducers.

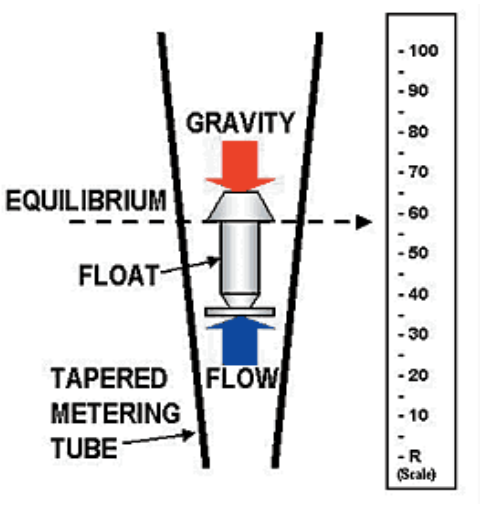
a) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Rotameter: It is a variable area flow meter used for flow measurement. It consist of vertical tapered tube with a float which is free to move up and down within the tube. The free area between float and inside wall of the tube forms an annular orifice. The tube is mounted vertically with the small end at the bottom. The fluid to be measured enters the tube from the bottom and passes upwards around the float and exit at the top.



Operating Principle

Its operating principle is based on a float of given density's establishing an equilibrium position where, with a given flow rate, the upward force of the flowing fluid equals the downward force of gravity.

Rotameters are the most widely used type of variable-area (VA) flow meter. In these devices, the falling and rising action of a float in a tapered tube provides a measure of flow rate as shown in Figure. Rotameter are known as gravity-type flow meters because they are based on the opposition between the downward force of gravity and the upward force of the flowing fluid. When the flow is constant, the float stays in one position that can be related to the volumetric flow rate. That position is indicated on a graduated scale. It can be used to measure the flow rates of most liquids, gases, and steam. The materials of construction include stainless steel, glass, metal, and plastic.

The tapered tube's gradually increasing diameter provides a related increase in the annular area around the float, and is designed in accordance with the basic equation for volumetric flow rate:

$$Q = kA\sqrt{gh}$$

where:

- Q = volumetric flow rate, e.g., gallons per minute
- k = a constant
- A = annular area between the float and the tube wall
- g = force of gravity
- h = pressure drop (head) across the float

With h being constant in a VA meter, we have A as a direct function of flow rate Q.

VIII Experimental Set-up

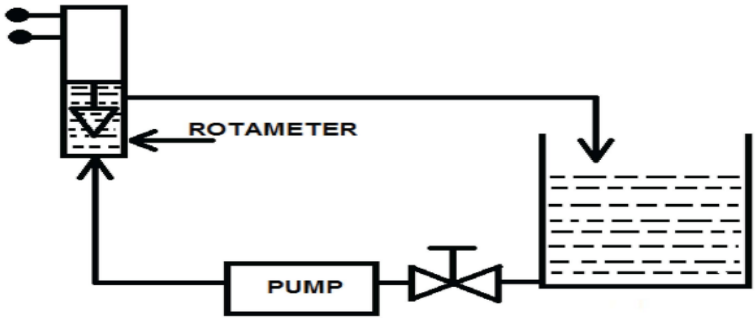


Fig. 1. Flow Measurement Setup

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**Rotameter flow measurement setup**	Range 0-1000 LPH, Glass tube body, Bob Material-SS, connection 1'', Mounting inlet bottom top outlet.	01	

X Procedure

1. Identify the component of given setup diagram
2. Connect Rotameter measurement setup as in diagram.
3. Fill the sump tank with water.
4. Switch on the power supply.
5. Start the pump and ensure flow rate through pipe line
6. Measure flow rate indication on the Rotameter.
7. Change valve position for increasing flow rate in pipe line.
8. Record flow rate in observation table.
9. Repeat the steps 6 to 8 for 5 to 6 readings.

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed (Use blank sheet provided if space not sufficient)

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Flow rate on indicator	Calculated flow rate
1		
2		
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7		
8		
9		
10		

XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) ((Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. State mounting position of Rotameter device used for flow measurement.
2. State the maximum range of flow rate measurement.
3. State the type of flow measurement used in practical.
4. State the type of material used in Rotameter in practical setup.

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	DhanpatRai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of rotameter setup	10%
2	Connection of complete measurement system.	20%
3	Applying input flow rate to rotameter	10%
4	Observation of output differential pressure	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

3……..

4……..

5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 11: Level measurement using capacitance type transducer

I Practical Significance

In the industry environment Electrical Engineering/Industrial Electronics diploma graduate are expected to handle various transducers for measurement of process parameters such as temperature, pressure, level, flow, displacement etc. Level measurement is one of the important processes in industry. Level can be measure using different transducer, Capacitance transducer is one of them. Therefore this practical will help you to measure the level using capacitance transducer.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Maintain the different types of level transducers.

IV Practical Outcome

a) Use capacitance transducer to measure level

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain the different types of level transducers.
b) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Capacitance Level Measurement: It is an example of indirect measurement of level. Capacitance level sensors are used for wide variety of solids, aqueous and organic liquids, and slurries .The sensors can be designed to sense material with dielectric constants as low as 1.1 (coke and fly ash) and as high as 88 (water) or more. Sludges and slurries such as dehydrated cake and sewage slurry (dielectric constant approx. 50) and liquid chemicals such as quicklime (dielectric constant approx. 90) can also be sensed. Dual probe capacitance level sensors can also be used to sense the interface between two immiscible liquids with substantially different dielectric constants.

Working Principle: The principle of capacitive level measurement is based on change of capacitance. An insulated electrode acts as one plate of capacitor and the tank wall (or reference electrode in a non-metallic vessel) acts as the other plate. The capacitance depends on the fluid level. An empty tank has a lower capacitance while a filled tank has a higher capacitance. A simple capacitor consists of two electrode plate separated by a small thickness of an insulator such as solid, liquid, gas, or vacuum.

This insulator is also called as dielectric. Value of C depends on dielectric used, area of the plate and also distance between the plates.

$$C = E (K A/d)$$

Where:
C = capacitance in pico farads (pF)
E = a constant known as the absolute permittivity of free space
K = relative dielectric constant of the insulating material
A = effective area of the conductors
d = distance between the conductors
This change in capacitance can be measured using AC bridge.

VIII Experimental Set-up

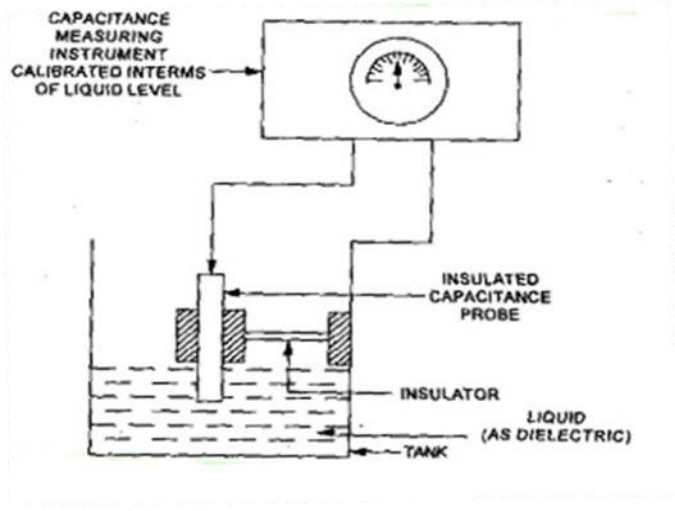

Fig. Level Measurement Setup

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**Capacitance level measurement**	Input range 0-500 mm, power supply 230 V ac , 2 wire capacitance type, top mounted, Digital display indication of 0 – 500mm.	01	

X Procedure

1. Identify the component of given set up diagram.
2. Connect level measurement setup as in diagram.
3. Switch on the power supply.
4. Measure the output when the tank is empty
5. Fill the tank in the range of 20% of maximum range.
6. Note down the level of the tank in mm. with the help of scale.
7. Record input and output for level measurement in observation table.
8. Repeat the steps 5 to 7 for 5 readings.

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed(Use blank sheet provided if space not sufficient**)**

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XIII Resources used

	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Level on scale	Level on indicator
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

XVI Results

1. Name of identified transducer a) ……
2. Names of identified partsa) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note*: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the output of level in terms of capacitance when tank is empty and filled.
2. State the maximum range of level measurement.
3. State the type of capacitance level measurement used in practical.
4. State the type of material used in capacitance level measurement in practical setup.

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	DhanpatRai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup capacitance level meas.	10%
2	Connection of complete measurement system.	20%
3	Applying input change to capacitance level measurements	10%
4	Observation of output voltage.	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

3……..

4……..

5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 12: Level measurement using air purge method

I Practical Significance

In the industry environment Electrical Engineering/Industrial Electronics diploma graduate are expected to handle various transducers for measurement of process parameters such as temperature, pressure, level, flow, displacement etc. Level measurement is one of the important processes in industry. Level can be measure using different transducer, Air purge method is one of them. Therefore this practical will help you to measure the level using Air purge method.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Maintain the different types of level transducers.

IV Practical Outcome

a) Use air purge method to measure level

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry

Maintain the different types of level transducers.

a) Use of pressure indicator
b) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Air purge (bubbler tube) is one of the most popular hydrostatic pressure types of liquid measuring system which is suitable for any liquid. An air purge system consists of a hollow tube inserted in the liquid of the tank. Two connections are made with the bubbler tube, one to the regulated air supply and the other to a pressure gauge, calibrated in terms of liquid level. A bubbler is connected in the air supply line which serves simply as a visual check to the flow of the supply air. A level recorder may be connected with the pressure gauge to keep the continuous record of liquid level. When there is no liquid in the tank or the liquid in the tank is below the bottom end of the bubbler tube and the pressure gauge indicates zero. In other words, if there is no back pressure because the air escapes to the atmosphere. As the liquid level in the tank increases, the air flow is restricted by the depth of liquid and the air pressure acting against liquid head appears as back pressure to the pressure gauge. This back pressure

causes the pointer to move on a scale, calibrated in terms of liquid level. The full range of head pressure can be registered as level by keeping the air pressure fed to the tube, slightly above the maximum head in the tank. The range of the device is determined by the length of the tube. Because air is continuously bubbling from the bottom of the tube, the tank liquid does not enter the bubbler tube and hence the tube is said to be purging. The common purging fluid is air, but, if air reacts with the tank fluid or is absorbed, different gases (N_2) are chosen depending on the liquid properties.

VIII Experimental Set-up

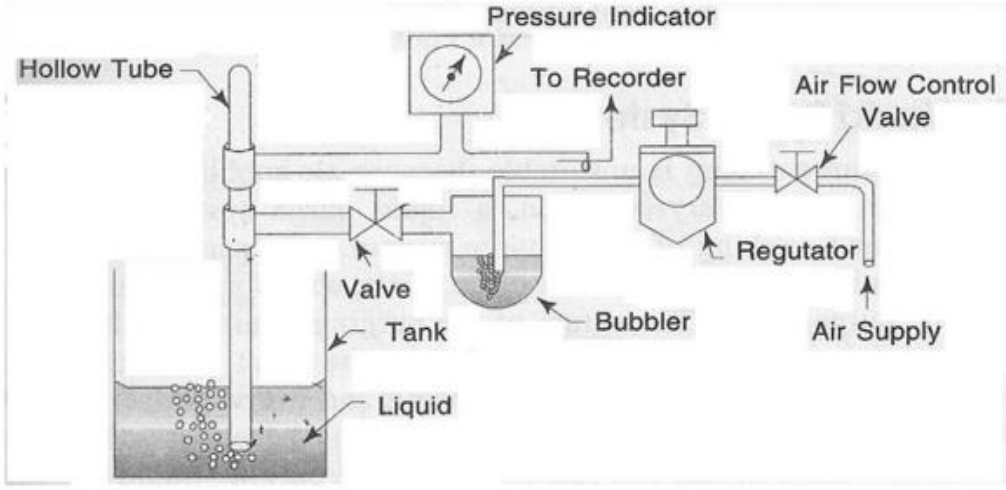

Fig. Level Measurement Setup

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**Air purge level measurement:**	**Air purge level measurement:** Level tank, height 0-500mm ,air pressure regulator ¼" valve ,air compressor with ¼" connection and pressure gauge power supply 230 Vac, Level indication.	01	

X Procedure

1. Identify the component of given setup diagram.
2. Connect set up level measurement as in diagram.
3. Switch on the power supply.
4. Measure the output pressure when the tank is empty
5. Fill the tank in the range of 20% of maximum range.
6. Note down the level of the tank in mm. with the help of scale.
7. Record input and output for level measurement in observation table.
8. Repeat the steps 5 to 7 for 5 readings.

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed (Use blank sheet provided if space not sufficient**)**

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Level on scale	Back Pressure	Level on indicator
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) ((Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. State the need of bubbler in practical setup.
2. State the maximum range of level measurement.
3. State the pressure indication when tank is empty.
4. State the different purging fluids used for level measurement.

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	DhanpatRai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of Air purge level	10%
2	Connection of complete measurement system.	20%
3	Applying input change to air purge system	10%
4	Observation of output pressure indication.	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

3……..

4……..

5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 13: Measurement of temperature using RTD

I Practical Significance

In the industry environment Electrical Engineering/Industrial Electronics diploma graduate are expected to handle various transducers for measurement of process parameters such as temperature, pressure, level, flow, displacement etc. RTD (Resistance Temperature Detector) is most linear passive temperature transducer. Pt-100 is most common low cost RTD. It is made up of platinum and it have 100 Ohm resistance at 0^o temperature. This practical will help you to use to measure the temperature using RTD for given liquid

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Maintain the different types of temperature transducers.

IV Practical Outcome

a) Use RTD to measure temperature

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain the different types of temperature transducers.

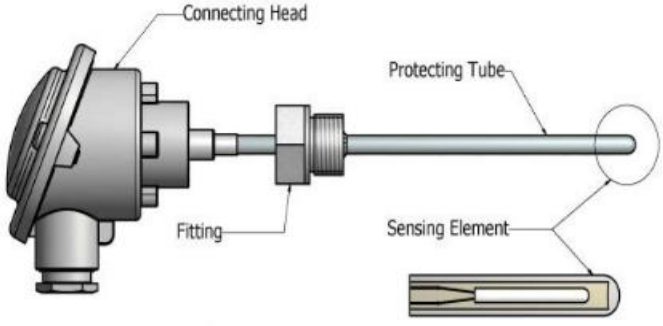
a) Use of multimeter
b) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Resistance Temperature Detector (RTD): The resistance of certain metals changes with a temperature change. With the increase of temperature electrical resistance of certain metal increase in direct proportion to the rise of temperature.

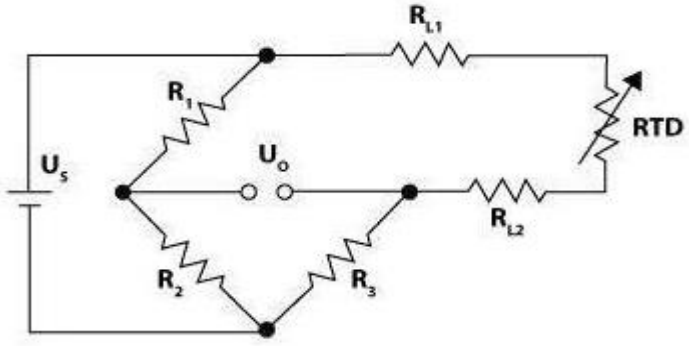


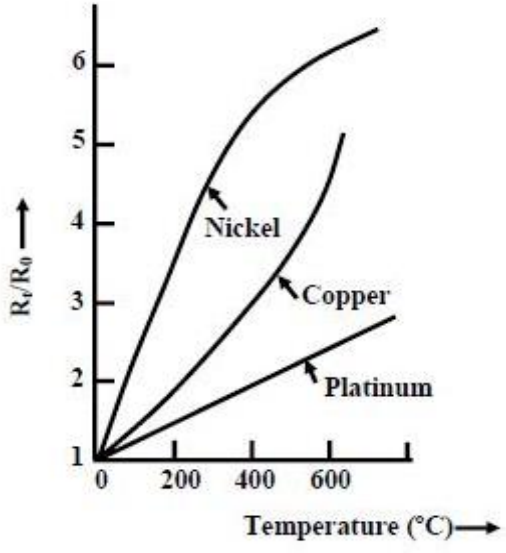
In **RTD** devices; Copper, Nickel and Platinum are widely used metals. These three metals are having different resistance variations with respective to the temperature variations. That is called resistance-temperature characteristics. Platinum has the temperature range of 650oC, and then the Copper and Nickel have 120oC and 300oC respectively. The figure shows the resistance-temperature characteristics curve of the three different metals. For Platinum, its resistance changes by approximately 0.4 ohms per degree Celsius of temperature.

The construction is typically such that the wire is wound on a form (in a coil) on notched mica cross frame to achieve small size, improving the thermal conductivity to decrease the response time and a high rate of heat transfer is obtained. In the industrial RTD's, the coil is protected by a stainless steel sheath or a protective tube.

In RTD, the change in resistance value is very small with respect to the temperature. So, the RTD value is measured by using a bridge circuit. By supplying the constant electric current to the bridge circuit and measuring the resulting voltage drop across the resistor, the RTD resistance can be calculated. Thereby, the temperature can be also determined. This temperature is determined by converting the RTD resistance value using a calibration expression.

$$R_t = R_0[1+ \alpha (t - t_0)]$$





VIII Experimental Set-up

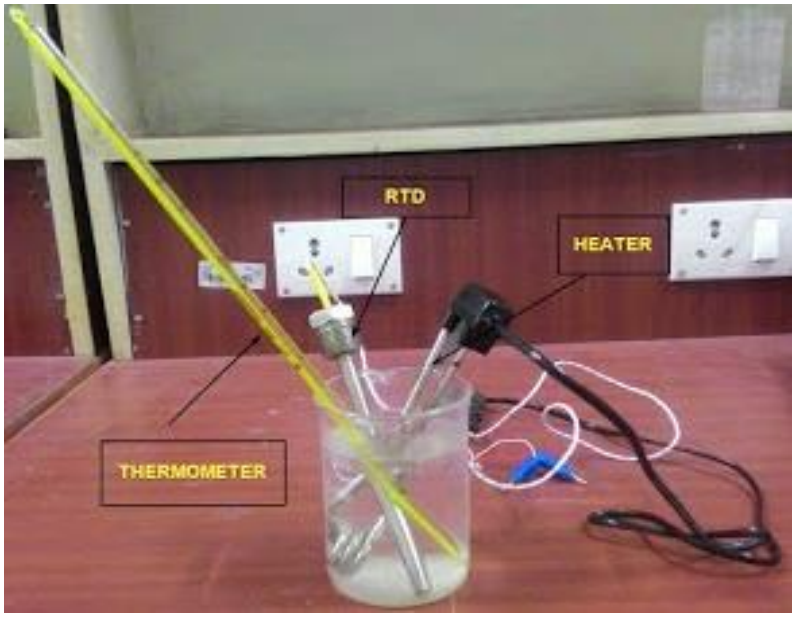


Fig.1. Temperature Measurement Setup

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	**RTD**	Pt100	01	
2	**Temp Bath**	2 KW, 230V AC	01	
3	**Digital Temperature indication**	0^0C to 200^0C, accuracy of +/- 1%	01	
4	**Mercury Thermometer**	0 to 300^0C	01	
5	**Digital Multimeter**	0-200Ω	01	

X Procedure

1. Identify the component of given setup diagram.
2. Connect set up for temperature measurement with RTD.
3. Place the RTD, thermometer, immersion heater in temperature bath.
4. Record the room temp. with mercury thermometer
5. Record the output resistance with multimeter for room temperature.
6. Switch on the power supply of heater.
7. Note down the temperature for every 5 degree temperature rise.
8. Record the temperature using mercury thermometer.
9. Record the output resistance using multimeter.
10. Complete the observation table.
11. Repeat the steps 7 to 10 for 10 readings.
12. Plot the temperature Vs resistance grap

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed (Use blank sheet provided if space not sufficient**)**

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XIII Resources used

	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Temperature ^{0}C	Resistance (Ω)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. State the output resistance when two terminals are short of RTD.
2. State the output when the element become open of RTD.
3. State the output resistance at room temperature.
4. State the different materials used for RTD
5. State the meaning of pt100.

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	DhanpatRai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of RTD	10%
2	Connection of complete measurement system.	20%
3	Apply increase intemperature to RTD	10%
4	Observation of output Resistance	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

3……..

4……..

5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 14: Measurement of temperature using thermocouple

I Practical Significance

In the industry environment Electrical Engineering/Industrial Electronics diploma graduate are expected to handle various transducers for measurement of process parameters such as temperature, pressure, level, flow, displacement etc. Thermocouple is most useful active temperature transducer. It work based on See beck and Peltier effect. Since it is active transducer designing of signal conditioner is easy. This is mostly used to measure the temperature above 300^{o} C. This practical will help you to use to measure temperature using thermocouple for given liquid.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Maintain the different types of temperature transducers.

IV Practical Outcome

a) Use Thermocouple to measure temperature

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain the different types of temperature transducers.

a) Use of multimeter
b) Connection skills

VI Relevant Affective domain

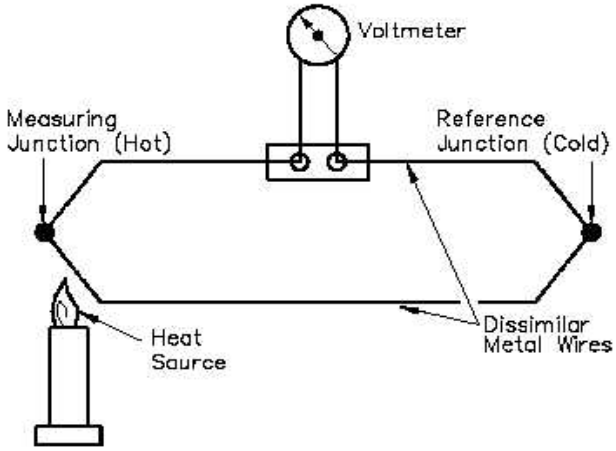
a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Thermocouple: A thermocouple is a device made by two different wires joined at one end, called junction end or measuring end. The two wires are called thermo elements or legs of the thermocouple: the two thermo elements are distinguished as positive and negative ones. The other end of the thermocouple is called reference end The junction end is immersed in the environment whose temperature T2 has to be measured, which can be for instance the temperature of a furnace at about 500°C, while the reference end is held at a different temperature T1, e.g. at ambient temperature.

Thermocouples will cause an electric current to flow in the attached circuit when subjected to changes in temperature. The amount of current that will be produced is dependent on the temperature difference between the measurement and

reference junction; the characteristics of the two metals used; and the characteristics of the attached circuit.



Heating the measuring as shown in above figure Simple Thermocouple Circuit junction on the thermocouple produces a voltage which is greater than the voltage across the reference junction. The difference between the two voltages is proportional to t h e d Difference in temperature and can be measured on the voltmeter(in milli volts).

VIII Experimental Set-up

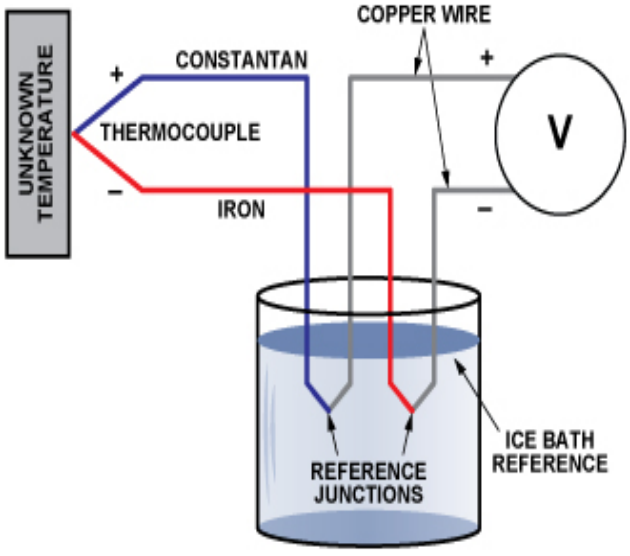


Fig. 1. Temperature Measurement Setup

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	Thermocouple	Thermocouple K Type: Temp range 0-200^{0}C	01	
2	Temp Bath	2 KW, 230V AC	01	
3	Digital Temperature indication	0^{0}C to 200^{0}C, accuracy of +/- 1%	01	

4	Digital Multimeter	0-200mV	01	
5	Mercury Thermometer	0 to 300^0C	01	
6	Compensating cable	2 wire, 0.5mm^2	01	

X Procedure

1. Identify the component of given setup diagram.
2. Connect set up for temperature measurement with thermocouple.
3. Place the thermocouple, thermometer, immersion heater in temperature bath.
4. Record the room temp. with mercury thermometer
5. Record the output voltage with multimeter for room temperature.
6. Switch on the power supply of heater.
7. Note down the temperature for every 10 degree temperature rise.
8. Record the temperature using mercury thermometer.
9. Record the output voltage using multimeter.
10. Complete the observation table.
11. Repeat the steps 7 to 10 for 10 readings.
12. Plot the temperature Vs voltage graph

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed (To be written by students)(Use blank sheet provided if space not sufficient)

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XIII Resources used

	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Temperature^{0}C	Voltage (mV)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) ((Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. State the output voltage when two terminals are short of thermocouple.
2. State the output when one of the elements becomes open.
3. State the output voltage at room temperature.
4. State the different types of thermocouple.

[Space to Write Answers]

XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	DhanpatRai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of thermocouple setup	10%
2	Connection of complete measurement system.	20%
3	Apply increase in temperature to thermocouple	10%
4	Observation of output voltage	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

3……..

4……..

5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 15: Calibration of RTD

I Practical Significance

In the industry environment Electrical Engineering/Industrial Electronics diploma graduate are expected to handle various transducers for measurement of process parameters such as temperature, pressure, level, flow, displacement etc. Calibration is one of important process in measuring instrument. Calibration of transducer as well as system is essential. Calibration of RTD with standard temperature measurement system can be done. Therefore this practical will help you to calibrate the given RTD temperature measuring instrument.

II Relevant Program Outcomes (POs)

1. **Discipline knowledge**: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.
2. **Experiments and practice**: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Maintain the different types of temperature transducers.

IV Practical Outcome

a) Calibrate RTD temperature measuring instruments

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry
Maintain the different types of temperature transducers.

a) Use of multimeter
b) Connection skills

VI Relevant Affective domain

a) Follow safety practices.
b) Maintain cleanliness of transducer setup.

VII Minimum Theoretical Background

Calibration: It is the comparison of specific values of input and output of the system corresponding to reference standard. It offers guarantee that instrument works as per specification of manufacturer. It removes errors in measurement system and gives accuracy of instrument as per specification

VIII Experimental Set-up

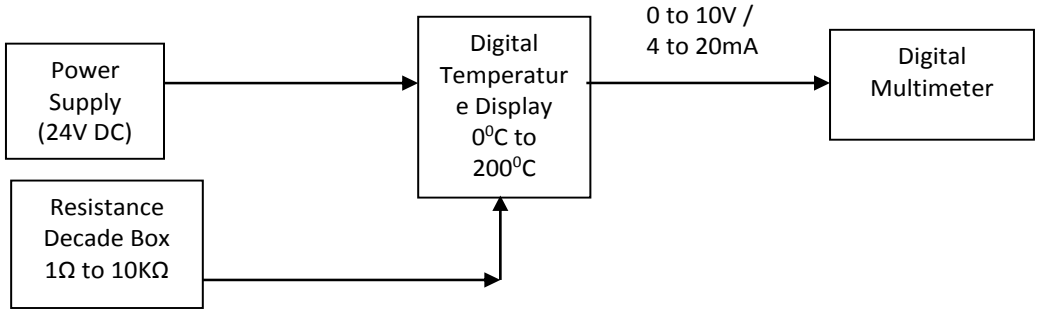

Fig. 1. Calibration of Temperature measurement system

IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	RTD	PT 100	01	
2	Temp Bath	2 KW, 230V AC	01	
3	Digital Temperature indication	0^0C to 200^0C, accuracy of +/- 1%	01	
4	Mercury Thermometer	0 to 300^0C	01	
5	Digital Multimeter	0-200Ω	01	
6	Decade Box	1Ω to 10KΩ	01	

X Procedure

1. Identify the component of given setup diagram.
2. Connect temperature calibration setup for RTD.
3. Switch on the power supply.
4. Provide 100Ω resistance from decade box to temperature indicator.
5. Record the temperature indication and output voltage.
6. If any deviation from 0^0C adjust zero of temperature indicator
7. Provide maximum 175Ω resistance from decade box to temperature indicator(175Ω corresponding to 200^0C from std RTD(Pt 100) chart)
8. Record the temperature indication and output voltage.
9. If any deviation from 200^0C adjust span of temperature indicator
10. Repeat step 7 to 9 for every 25%, 50% and 75% temperature rise with respect to max temp (200^0C).

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed(Use blank sheet provided if space not sufficient**)**

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XIII Resources used

	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Temperature	Resistance	Temperature Indicator	Output voltage	Deviation in temperature

XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. State the need for zero adjustment.
2. State the need for span adjustment
3. State the output resistance at 200^0C.
4. State the output resistance values at temperature 00C, 500C, 1000C, 1500C from Std Pt 100 chart.

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Electrical and Electronic Measurements and Instrumentation	Sawhney, A.K.	Dhanpat Rai and Sons, N. Delhi 201; ISBN:9788177001006
2	Industrial Instrumentation and Control	Singh, S.K.	McGraw Hill Publishing; N. Delhi 2010; ISBN:9780070678200

XXI Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Identify the practical setup of RTD	10%
2	Connection of complete measurement system.	20%
3	Apply increase in resistance to temperature indicator	10%
4	Observation of output temperature and voltage.	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
2	Submission of report in time.	10%
Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

3……..

4……..

5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 16: Calibration of thermocouple

I Practical Significance

In the industry environment Electrical Engineering/Industrial Electronics diploma graduate are expected to handle various transducers for measurement of process parameters such as temperature, pressure, level, flow, displacement etc. Calibration is one of important process in measuring instrument. Calibration of transducer as well as system is essential. Calibration of thermocouple with standard temperature measurement system can be done. Therefore this practical will help you to calibrate the given thermocouple.

II Relevant Program Outcomes (POs)

PO 2. Discipline knowledge: Apply Electrical Engineering/Industrial Electronics knowledge to solve broad-based Electrical Engineering/Industrial Electronics related problems.

PO 3. Experiments and practice: Plan to perform experiments and practices to use the results to solve broad-based Electrical Engineering/Industrial Electronics problems.

III Relevant Course Outcomes

a) Maintain the different types of temperature transducers.

IV Practical Outcome

a) Calibrate Thermocouple temperature measuring instruments

V Competency and Practical Skills

This practical is expected to develop the following skills for the industry

Maintain the different types of temperature transducers.

a) Use of multimeter
b) Use of milli volt source
c) Connection skills

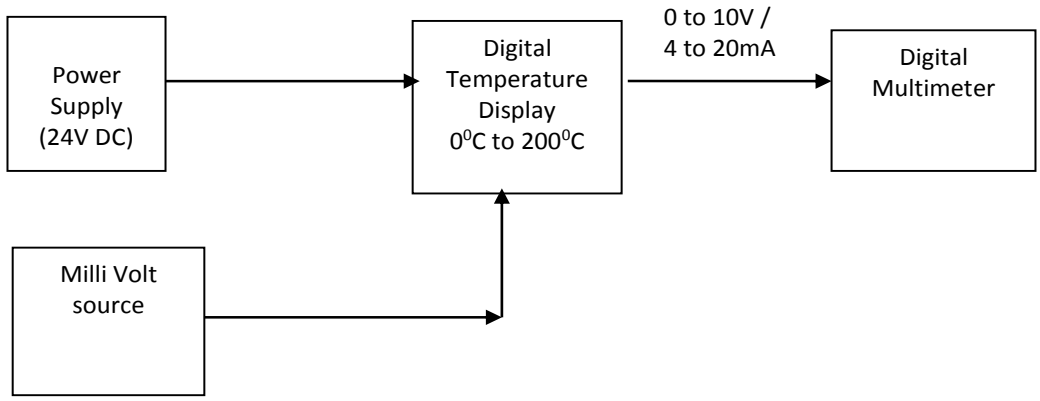
VI Relevant Affective domain

a) Follow safety practices.
b) Maintain tools and equipment.

VII Minimum Theoretical Background

Calibration: It is the comparison of specific values of input and output of the system corresponding to reference standard. It offers guarantee that instrument works as per specification of manufacturer. It removes errors in measurement system and gives accuracy of instrument as per specification

VIII Experimental Set-up



IX Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	Thermocouple	K type	01	
2	Temp Bath	2 KW, 230V AC	01	
3	Digital Temperature indication	0^0C to 200^0C, accuracy of +/- 1%	01	
4	Mercury Thermometer	0 to 300^0C	01	
5	Digital Multimeter	0-200mV	01	
6	Milli volt source	0-100mV	01	

X Procedure

1. Identify the component of given setup diagram.
2. Connect temperature calibration setup for thermocouple.
3. Switch on the power supply.
4. Provide 0 mV voltage from milli volt source to temperature indicator.
5. Record the temperature indication and output voltage.
6. If any deviation from 0^0C adjust zero of temperature indicator
7. Provide maximum 10.78mV from milli volt source to temperature indicator(10.78mV corresponding to 200^0C from Std thermocouple chart)
8. Record the temperature indication and output voltage.
9. If any deviation from 200^0C adjust span of temperature indicator
10. Repeat step 7 to 9 for every 25%, 50% and 75% temperature rise with respect to max temp (200^0C).

XI Precautions to be followed

1. Ensure that proper connections are made as per the setup.
2. Ensure proper setting of devices used.
3. Ensure the power switch is in off condition initially.

XII Actual procedure followed(Use blank sheet provided if space not sufficient)

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XIII Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV Precautions followed

.....

.....

.....

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XV Observations and Calculations(Use blank sheet provided if space not sufficient)

Sr. No.	Temperature	Milli volt	Temperature Indicator	Output voltage	Deviation in temperature

XVI Results

1. Name of identified transducer a) ……
2. Names of identified parts a) …… b) …… c) …… d) ……

XVII Interpretation of results(Give meaning of the above obtained results)

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XVIII Conclusions (if any) (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note*: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the need for zero adjustment.
2. State the need for span adjustment
3. State the output milli volt at 200^0C.
4. State the output milli volt values at temperature 0^0C,50^0C,100^0C,150^0C from Std thermocouple (type used in practical setup)chart.

[Space to Write Answers]

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3	Apply increase milli volt inputs to temperature indicator	10%
4	Observation of output temperature and voltage	10%
5	Working in team.	10%
Product related:10 Marks		**40%**
1	Answers to practical related questions.	30%
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Total: 25 Marks		**100%**

Name of Student Team Members

1……..

2……..

3……..

4……..

5……..

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

List Of Laboratory Manuals Developed by MSBTE

First Semester:

1	Fundamentals of ICT	22001
2	English	22101
3	English Work Book	22101W
4	Basic Science (Chemistry)	22102
5	Basic Science (Physics)	22102

Second Semester:

1	Bussiness Communication Using Computers	22009
2	Computer Peripherals & Hardware Maintenace	22013
3	Web Page Design with HTML	22014
4	Applied Science (Chemistry)	22202
5	Applied Science (Physics)	22202
6	Applied Machines	22203
7	Basic Surveying	22205
8	Applied Science (Chemistry)	22211
9	Applied Science (Physics)	22211
10	Fundamental of Electrical Engineering	22212
11	Elements of Electronics Engineering	22213
12	Elements of Electrical Engineering	22215
13	Basic Electronics	22216
14	C Language programming	22218
15	Basic Electronics	22225
16	Programming in C	22226
17	Fundamental of Chemical Engineering	22231

Third Semester:

1	Applied Multimedia Techniques	22024
2	Advanced Serveying	22301
3	Highway Engineering	22302
4	Mechanics of Structures	22303
5	Building Construction	22304
6	Concrete Technology	22305
7	Strength Of Materials	22306
8	Automobile Engines	22308
9	Automobile Transmission System	22309
10	Mechanical Operations	22313
11	Technology Of Inorganic Chemicals	22314
12	Object Oriented Programming Using C++	22316
13	Data Structure Using 'C'	22317
14	Computer Graphics	22318
15	Database Management System	22319
16	Digital Techniques	22320
17	Principles Of Database	22321
18	Digital Techniques & Microprocessor	22323
19	Electrical Circuits	22324
20	Electrical & Electronic Measurment	22325
21	Fundamental Of Power Electronics	22326
22	Electrical Materials & Wiring Practice	22328
23	Applied Electronics	22329
24	Electrical Circuits & Networks	22330
25	Electronic Measurments & Instrumentation	22333
26	Principles Of Electronics Communication	22334
27	Thermal Engineering	22337
28	Engineering Matrology	22342
29	Mechanical Engineering Materials	22343
30	Theory Of Machines	22344

Fourth Semester:

1	Hydraulics	22401
2	Geo Technical Engineering	22404
3	Chemical Process Instrumentation & Control	22407
4	Fluid Flow Operation	22409
5	Technology Of Organic Chemical	22410
6	Java Programming	22412
7	GUI Application Development Using VB.net	22034
8	Microprocessor	22415
9	Database Managment	22416
10	Electric Motors And Transformers	22418
11	Industrial Measurement	22420
12	Digital Electronic And Microcontroller Application	22421
13	Linear Integrated Circuits	22423
14	Microcontroller & Applications	22426
15	Basic Power Electronics	22427
16	Digital Communication Systems	22428
17	Mechanical Engineering Measurments	22443
18	Fluid Mechanics and Machinery	22445
19	Fundamentals Of Mechatronics	22048
20	Micro Project & Industrial Training Assessment Manual	22049

Fifth Semester:

1	Network Management & Administration	17061
2	Solid Modeling	17063
3	CNC Machines	17064
4	Behavioral Science(Hand Book)	17075
5	Behavioral Science (Assignment Book)	17075
6	Windows Programming using VC++	17076
7	Estimation and Costing	17501
8	Public Health Engineering	17503
9	Concrete Technology	17504
10	Design of Steel Structures	17505
11	Switchgear and Protection	17508
12	Microprocessor & Application	17509
13	A.C. Machines	17511
14	Operating System	17512
15	Java Programming	17515
16	System Programming	17517
17	Communication Technology	17519
18	Hydraulic & Pneumatics	17522
19	Advanced Automobile Engines	17523
20	Basic Electrical & Electronics	17524
21	Measurement and Control	17528
22	Power Engineering	17529
23	Metrology & Quality Control	17530
24	Computer Hardware & Networking	17533
25	Microcontroller	17534
26	Digital Communication	17535
27	Control System & PLC	17536
28	Audio Video Engineering	17537
29	Control System	17538
30	Industrial Electronics and applications	17541
31	Heat Transfer Operations	17560
32	Chemical Process Instrumentation & control	17561

Sixth Semester:

1	Solid Modeling	17063
2	Highway Engineering	17602
3	Contracts & Accounts	17603
4	Design of R.C.C. Structures	17604
5	Industrial Fluid Power	17608
6	Design of Machine Elements	17610
7	Automotive Electrical and Electronic Systems	17617
8	Vehicle Systems Maintenance	17618
9	Software Testing	17624
10	Advanced Java Programming	17625
11	Mobile Computing	17632
12	System Programing	17634
13	Testing & Maintenance of Electrical Equipments	17637
14	Power Electronics	17638
15	Illumination Engineering	17639
16	Power System Operation & Control	17643
17	Environmental Technology	17646
18	Mass Transfer Operation	17648
19	Advanced Communication System	17656
20	Mobile Communication	17657
21	Embedded System	17658
22	Process Control System	17663
23	Industrial Automation	17664
24	Industrial Drives	17667
25	Video Engineering	17668
26	Optical Fiber & Mobile Communication	17669
27	Therapeutic Equipment	17671
28	Intensive Care Equipment	17672
29	Medical Imaging Equipment	17673

Pharmacy Lab Manual

First Year:

1	Pharmaceutics - I	0805
2	Pharmaceutical Chemistry - I	0806
3	Pharmacognosy	0807
4	Biochemistry and Clinical Pathology	0808
5	Human Anatomy and Physiology	0809

Second Year:

1	Pharmaceutics - II	0811
2	Pharmaceutical Chemistry - II	0812
3	Pharmacology & Toxicology	0813
4	Hospital and Clinical Pharmacy	0816

HEAD OFFICE

Secretary,
Maharashtra State Board of Technical Education
49, Kherwadi, Bandra (East), Mumbai - 400 051
Maharashtra (INDIA)
Tel: (022)26471255 (5 -lines)
Fax: 022 - 26473980
Email: -secretary@msbte.com
Web -www.msbte.org.in

REGIONAL OFFICES:

MUMBAI

Deputy Secretary (T),
Mumbai Sub-region,
2nd Floor, Govt. Polytechnic Building,
49, Kherwadi, Bandra (East)
Mumbai - 400 051
Phone: 022-26473253 / 54
Fax: 022-26478795
Email: rbtemumbai@msbte.com

PUNE

Deputy Secretary (T),
M.S. Board of Technical Education,
Regional Office,
412-E, Bahirat Patil Chowk,
Shivaji Nagar, Pune
Phone: 020-25656994 / 25660319
Fax: 020-25656994
Email: rbtepn@msbte.com

NAGPUR

Deputy Secretary (T),
M.S. Board of Technical Education
Regional Office,
Mangalwari Bazar, Sadar, Nagpur - 440 001
Phone: 0712-2564836 / 2562223
Fax: 0712-2560350
Email: rbteng@msbte.com

AURANGABAD

Deputy Secretary (T),
M.S. Board of Technical Education,
Regional Office,
Osmanpura, Aurangabad -431 001.
Phone: 0240-2334025 / 2331273
Fax: 0240-2349669
Email: rbteau@msbte.com