I

Name _____

Roll No. _____ Year 20____20____

Exam Seat No. _____

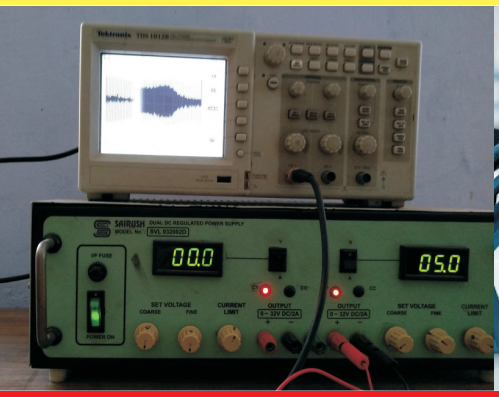
ELECTRONICS GROUP | SEMESTER - III | DIPLOMA IN ENGINEERING AND TECHNOLOGY

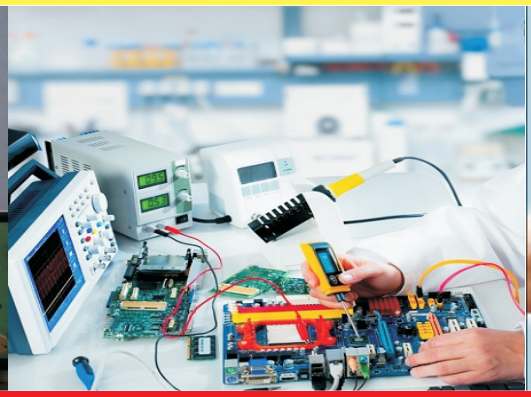
# A LABORATORY MANUAL

# FOR

# ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

# (22333)





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

# Electronics Measurements and Instrumentation

# (22333)

## Semester-III

**(EJ/ET/EN/EX/EQ)**

**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 June, 2018 )

# MAHARASHTRA STATE

# BOARD OF TECHNICAL EDUCATION

## Certificate

This is to certify that Mr. / Ms. ……..…… Roll No. ……..…., of Third Semester of Diploma in ……..…… of Institute, ……..…….……..… (Code: ……...) has completed the term work satisfactorily in course **Electronic Measurements and Instrumentation (22333)** for the academic year 20…….. to 20…….. as prescribed in the curriculum.

Place: ……  Enrollment No:.……

Date: ……  Exam. Seat No: ……

**Subject 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 practicals to ***focus*** on the ***outcomes***, rather than the traditional age old practice of conducting practicals 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.

Modern automated instrumentation system is an emerging field, used for data sensing, acquisition, transmission, analysis and control in various practical applications. Analog and digital instruments are mainly used to measure different process control parameters. The physical quantities/parameters are be converted into electrical signal with the help of various types of sensors and transducers and also used to maintain electronic control and automation system. Handling Test and Measuring Instrument is the essential activity of the diploma engineering passouts (also called technologists) when they work in any electronic automation industry.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome.

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

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

PO2. **Discipline knowledge:**Apply Electronics engineering knowledge to solve broad-based Electronics engineering related problems.

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

PO4. **Engineering tools:**Apply relevant 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 Electronics engineering.

PO6. **Environment and sustainability:**Apply Electronics engineering 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 Electronics engineering.

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 Electronics engineering and allied industry.

**Program Specific Outcomes (PSO)** :-

**PSO1. Electronics and Telecommunication Systems:** Maintain various types of Electronics systems.

**PSO2. EDA Tools Usage**: Use EDA tools to develop simple Electronics engineering related circuits.

# 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 practicals of this laboratory manual.

1. Identify various electronic instruments.
2. Use analog meters to measure voltage, current and resistance
3. Use digital meters to measure voltage, current and resistance.
4. Calibrate the analog voltmeter and analog ammeter
5. Select the relevant range of CRO for various measurement
6. Use function generator to generate different types of waveforms
7. Use bourdon tube and LVDT to measure applied pressure
8. Use venturi tube to measure flow of fluid
9. Use pH meter to measure pH
10. Test the performance of Portable Data Acquisition System.

# Practical- Course Outcome matrix

**Course Outcomes (COs)**

- **a.** Analysecharacterstics of measuring instrument.
- **b.** Calibrate different electronic instrument.
- **c.** Use the relevant instrument to measure specified parameters.
- **d.** Interpret working of various types of sensors and transducers.
- **e.** Use various types of transducers and sensors to measure quantities.
- **f.** Maintain signal conditioning and data acquisition system..

| S. No. | Practical Outcomes(PrO) | CO a. | CO b. | CO c. | CO d. | CO e | CO f |
|---|---|---|---|---|---|---|---|
| 1. | Use analog multimeter to determine accuracy, resolution and hysteresis for specified measured quantity. | √ | - | - | - | | - |
| 2. | Use analog meters to measure voltage, current and resistance | √ | - | - | - | | - |
| 3. | Use digital meters to measure voltage, current and resistance. | - | - | √ | - | | - |
| 4. | Calibrate the given analog voltmeter to maintain its accuracy. | - | √ | - | - | | - |
| 5. | Calibrate the given analog ammeter | - | √ | - | - | | - |
| 6. | Select the relevant range for various measurement by varying positions of front panel knobs on CRO. | - | - | √ | - | | - |
| 7. | Use CRO to measure amplitude and frequency of the given input signal | - | - | √- | - | | - |
| 8. | Generate Lissajous pattern on CRO to measure frequency of the given input signal | - | - | √ | - | | - |
| 9. | Generate Lissajous pattern on CRO to measure phase of the given input signal | - | - | √ | - | | - |
| 10. | Use function generator to generate different types of waveforms and observe them on DSO. | - | - | √ | - | | - |
| 11. | Use DSO to measure amplitude and frequency of the given input signal. | - | - | √ | - | | - |
| 12. | Use spectrum analyzer to measure frequency band of the given input signal | - | - | √ | - | | - |
| 13. | Test characteristics of potentiometer | - | - | - | √ | | - |
| 14. | Test relation between Linear displacement and output voltage using LVDT | - | - | - | √ | | - |
| 15. | Use strain gauge to measure applied pressure. | - | - | - | - | √ | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16. | Use RTD (PT-100) to measure temperature of the given liquid | - | - | - | - | √ | - |
| 17. | Use thermocouple to measure temperature of liquid | - | - | - | - | √ | - |
| 18. | Use bourdon tube and LVDT to measure applied pressure | - | - | - | - | √ | - |
| 19. | Use venturi tube to measure flow of fluid. | - | - | - | - | √ | - |
| 20. | Use orifice plate to measure flow of fluid. | - | - | - | - | √ | - |
| 21. | Use rotameter to measure flow of liquid. | - | - | - | - | √ | - |
| 22. | Use pH meter to measure pH value of given solution | - | - | √ | - | - | - |
| 23. | Use signal conditioner to get the required output. | - | - | - | - | - | √ |
| 24. | Use Data Acquisition System to determine electrical and physical parameters. | - | - | - | - | - | √ |
| 25. | Troubleshooting of potentiometer | - | - | - | - | - | √ |
| 26. | Troubleshooting of strain gauge. | - | - | - | - | - | √ |
| 27. | Troubleshooting of venturi tube | - | - | - | - | - | √ |
| 28. | Troubleshooting of Rotameter. | - | - | - | - | - | √ |

## Guidelines to Teachers

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain prior concepts to the students before starting of each practical
3. Involve students in performance of each practical.
4. Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
5. Teachers should give opportunity to students for hands on experience after the demonstration.
6. Teacher is expected to share the skills and competencies to be developed in the students.
7. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected the students by the industry.
8. Give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions.
9. If practical is in two parts -Part I and Part II it should be conducted in two turns.
10. Teacher is expected to refer complete curriculum document and follow guidelines for implementation
11. Assess the skill achievement of the students and COs of each unit.

## Instructions for Students

1. Listen carefully the lecture given by teacher about course, curriculum, learning structure, skills to be developed.
2. Before performing the practical student shall read lab manual of related practical to be conducted.
3. 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***.
4. Organize the work in the group and make record of all observations.
5. Students shall develop maintenance skill as expected by industries.
6. Student shall attempt to develop related hand-on skills and gain confidence.
7. Student shall develop the habits of evolving more ideas, innovations, skills etc. those included in scope of manual
8. Student shall refer technical magazines, IS codes and data books.
9. Student should develop habit to submit the practical on date and time.
10. Student should well prepare while submitting write-up of exercise.

# Content Page

List of Practicals 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) |
|---|---|---|---|---|---|---|---|
| 13. | Test characteristics of potentiometer | 77 | | | | | |
| 14. | Test relation between Linear displacement and output voltage using LVDT | 82 | | | | | |
| 15. | Use strain gauge to measure applied pressure. | 88 | | | | | |
| 16. | Use RTD (PT-100) to measure temperature of the given liquid | 93 | | | | | |
| 17. | Use thermocouple to measure temperature of liquid | 99 | | | | | |
| 18. | Use bourdon tube and LVDT to measure applied pressure | 104 | | | | | |
| 19. | Use venturi tube to measure flow of fluid. | 110 | | | | | |
| 20. | Use orifice plate to measure flow of fluid. | 116 | | | | | |
| 21. | Use rotameter to measure flow of liquid. | 122 | | | | | |
| 22. | Use pH meter to measure pH value of given solution | 127 | | | | | |
| 23. | Use multimeter/CRO to measure voltage at output of given signal conditioning circuit | 132 | | | | | |
| 24. | Test the performance of Portable Data Acquisition System | 137 | | | | | |
| 25. | Troubleshooting of potentiometer | 142 | | | | | |
| 26. | Troubleshooting of Strain gauge | 148 | | | | | |
| 27. | Troubleshooting of Venturi Tube | 153 | | | | | |
| 28. | Troubleshooting of Rotameter | 159 | | | | | |
| **Total** | | | | | | | |

- To be transferred to Proforma of CIAAN-2017.

# Practical No. 1: Determination of accuracy, resolution and hysteresis using analog meter

## I Practical Significance

Analog multimeter is one of important instrument used by industry. Analog multimeters have been in use to measure volts, ohms and amps. These multi-meters are extremely flexible. This practical will help you to analyze characteristics of analog multimeter.

## II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

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## III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use measuring instrument.
ii. Measure accurately using an analog meter.
iii. Select the instrument as per required range.

## IV Relevant Course Outcome(s)

- Analyse characteristics of measuring instrument.

## V Practical Outcome

- Use analog multimeter to determine accuracy, resolution and hysteresis for specified measured quantity.

## VI Relevant Affective domain related Outcome(s)

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

## VII Minimum Theoretical Background

The accuracy of an electronic measurement defines how close the indicated value is to the true value of the measured signal. Analog meters usually have their accuracy listed as a percentage of the full-scale reading

Relative accuracy is given by

$$A = 1 - \left| \frac{Y_n - X_n}{Y_n} \right|$$

where
$Y_n$= actual value
$X_n$ = measured value

Resolution: Smallest change in input that produces a detectable change in instrument output.

Hysteresis: Summation of all effects, under constant environmental conditions, that cause an instrument's output to assume different values at a given stimulus point when that point is approached with increasing or decreasing stimulus.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample


**Figure: Power supply and Analog multimeter**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1 | Analog multimeter | 0-600V,0-10A, 0-10MΩ | 1 No. |
| 2 | DC Power Supply | 0-30V,0-2A | 1 No. |

## X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

**Accuracy**

1. Apply fixed voltage to analog multimeter.
2. Read applied voltage with analog meter and write value
3. Increase input voltage in steps and repeat above procedure
4. Calculate relative accuracy after completing all readings shown in table 1

**Resolution**

1. Apply fixed voltage (For example 6v ) to analog multimeter.
2. Read applied voltage with analog meter and write value in Colum B
3. Reduce voltage each time gradually and measure voltage with analog meter again write value in Colum B
4. Continue above till least value has been determined that is smallest change in input that produces a detectable change in instrument's output.

**Hysteresis**

1. Apply fixed voltage to analog multimeter.
2. Read applied voltage with analog meter and write value
3. Increase input voltage in steps and repeat above procedure
4. Reach maximum value of range of meter.
5. Decrease input voltage in steps from maximum value towards minimum
6. Plot the graph after completing all readings shown in table 3.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

**XIII Actual Procedure Followed** (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (use blank sheet provided if space not sufficient)

**Table 1: Accuracy of analog multimeter used for voltage measurement**

| Sr. No | Actual voltage given by power supply ( $Y_n$) | Measured voltage with voltmeter ($X_n$) | Relative accuracy $A = 1 - \left\|\frac{Y_n - X_n}{Y_n}\right\|$ | % Accuracy= A X 100 |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

**Table 2: Resolution**

| Sr. No. | Colum A Output of power supply (in voltage) | Colum B Measure voltage on multimeter |
|---|---|---|
| 1 | 6 v | |
| 2 | 5.5 v | |
| 3 | 5.2 v | |
| 4 | 5.1 v | |
| 5 | 5.05 v | |
| 6 | 5.0 v | |

**Table 3: Hysteresis**

| Sr. No | voltage given by power supply in increasing order in uniform steps | Measured voltage with voltmeter | voltage given by power supply in decreasing order in uniform steps | Measured voltage with voltmeter |
|---|---|---|---|---|
| | | | | |
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. List different types scale range of analog multimter available in your lab .
2. State 0 adjustment process for measurement of resistance.
3. State requirement of battery in analog multimeter.
4. State minimum value can be measure by given analog meter.
5. State meaning of full scale deflection of meter.
6. State effect of magnet near the analog meter.

[Space for Answers]

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## XIX References / Suggestions for further reading

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Electronics Component Handbook; Jones, Thomas H., Reston Publishing, Resto, Virginia, USA, ISBN: 978087909222
3. User manual of Meco/ Motwane analog and digital instrument
4. https://youtube/WmIgusHZyPc?t=42

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of results | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 2: Use of analog multimeter

## I Practical Significance

Analog multimeter is the one of important and common instrument used for measurement of voltage, current and Resistance in different circuit and installation in the industry. This practical will help you to use analog multimeter to measure voltage, current and resistances of the circuits and systems.

## II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

## III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

1. Use measuring instrument.
2. Measure accurately using an analog meter.
3. Select instrument as per requirement.

## IV Relevant Course Outcome(s)

- Calibrate different electronic instrument.
- Use the relevant instrument to measure specified parameters.

## V Practical Outcome

- Use analog meters to measure voltage, current and resistance

## VI Relevant Affective domain related Outcome(s)

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

## VII Minimum Theoretical Background

**VOLTAGE Measurement**

The main principle of voltmeter is that it must be connected in parallel to which we want to measure the voltage. Parallel connection is used because a voltmeter is constructed in such a way that it has a very high value of resistance. If that high resistance is connected in series, the current flow will be almost zero which means the circuit has become open. If it is connected in parallel, the load impedance comes parallel with the high resistance of the voltmeter and hence the combination will give

almost the same the impedance that the load had. Rectifier type voltmeter, electrostatic type and also digital voltmeter (DVM) can measure both AC and DC voltages.

**Current Measurement**

Current is one of the basic electrical / electronic parameters, and therefore it is often necessary to measure the current flowing in the circuit to check its operation. Current measurements are made in a different way than voltage and other measurements. When using a multimeter to measure current, the only way that can be used to detect the level of current is to break into the circuit so that the current passes through the meter. From this it can be seen that the circuit in which the current is flowing has to be broken and the multimeter inserted into the circuit. In some circuits where current may often need to be measured, terminals with a shorting link may be added to facilitate the current measurement.

**Resistance Measurement**

Analog multimeters are good for measuring resistance. A high resistance which corresponds to a low current appears on the left hand side of the dial of analog multimeters, and a low resistance which corresponds to a higher current appears on the right hand side of the dial. The meter needs to be "zero'ed" before making a measurement. This is done by connecting the two probes together so that there is a short circuit, and then using the "zero" control to give full scale deflection on the meter, i.e. zero ohms. Each time the range is changed, the meter needs to be zero'ed as the position may change from one range to the next. The meter needs to be zero'ed because the full scale deflection will change according to aspects such as the state of the battery

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample

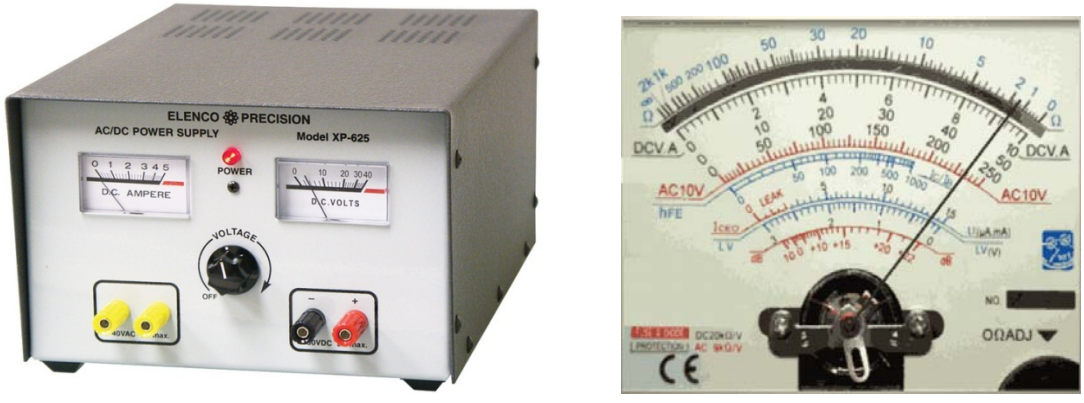


**Figure 1: Power supply and Analog multimeter**


**Figure 2: Multimeter as voltmeter**

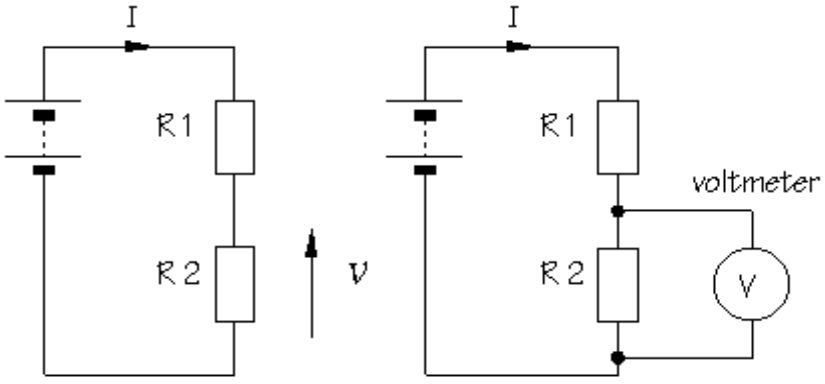


**Figure 3: Schematic Circuit voltage measurement across circuit.**

**b) Actual Circuit/ Experimental set up used in laboratory**
**(Note:You should Draw setup for current and Resistance Measurement)**

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | Analog multimeter | 0-600V,0-10A, 0-10MΩ | 1 No. |
| 2. | DC Power Supply | 0-30V,0-2A | 1 No. |

## X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

**a) Voltage (Voltmeter)**

1. Apply fixed voltage to analog multimeter.
2. Read applied voltage with analog meter and write value
3. Increase input voltage in steps and repeat above procedure

**b) Current (Ammeter)**

1. Apply fixed voltage ( For example 6v ) to potential divider network
2. Connect multimeter in series with resistor branch which current to be measure.
3. Change supply voltage and measure reading at each change in current.

**c) Resistance(Ohm Meter)**

1. Adjust zero setting.
2. Read applied voltage with analog meter and write value
3. Increase input voltage in steps and repeat above procedure
4. Reach maximum value of range of meter value towards minimum
5. Plot the graph after completing all readings shown in table 3

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Qty | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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## XIV Observations and Calculations (use blank sheet provided if space not sufficient)

**Table 4: voltage measurement**

| Sr. No | Actual voltage given by power supply in Volt | Measured voltage with voltmeter in volt |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

**Table 5: Current Measurement:**

| Sr. No | Actual Current Calculated in Ampere | Measured Current with Ammeter in Ampere |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

**Table 3 : Resistance Measurement**

| Sr. No | Resistance Measure using Colour Code in Ohm | Measured Resistance using Ohm Meter in Ohm |
|---|---|---|
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. List different types scale range of analog multimter available in your lab .
2. State 0 adjustment process for measurement of resistance.
3. State requirement of battery in analog multimeter.
4. State minimum value can be measure by given analog meter.
5. State meaning of full scale deflection of meter.
6. State effect of magnet near the analog meter.

**[Space for Answers]**

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## XIX References / Suggestions for further reading


1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Electronics Component Handbook; Jones, Thomas H., Reston Publishing, Resto, Virginia, USA, ISBN: 978087909222
3. User manual of Meco/Sanwa meter.
4. EC1002 -ELECTRONICS ENGINEERING PRACTICES
5. https://youtube/WmIgusHZyPc?t=42

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1 ……

2 ……

3 ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 3: Use of digital multimeter

**I Practical Significance**

Digital multimeter is one of important instrument used by industry to measure volts, ohms and amps. These multi-meters are extremely flexible. This practical will help you to use DMM to measure voltage, current and resistance.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use measuring instrument.
ii. Measure accurately using an analog meter.
iii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Use the relevant instrument to measure specified parameters

**V Practical Outcome**

- Use digital meters to measure voltage, current and resistance.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

Digital voltmeters are instruments that measure voltage or voltage drop in a circuit. They use solid-state components and display values digitally. Typically, digital voltmeters (digital volt meters) can be used to locate excessive resistance that may indicate an open circuit or ground. This voltmeter (DVM) measures an unknown input voltage by converting the voltage to a digital value and then displays the voltage in numeric form. DVMs are usually designed around a special type of analog-to-digital converter called an integrating converter.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample


**Figure 1 Digital multimeter**

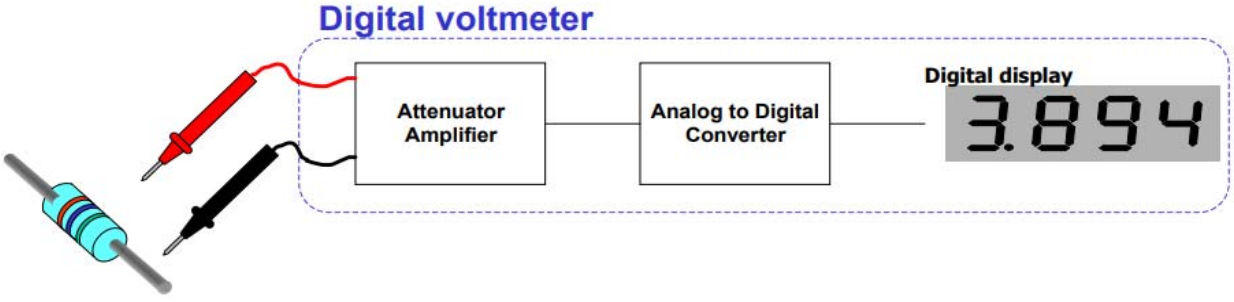


**Figure 2: Multimeter as voltmeter**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | Digital Multimeter | 0-600V,0-10A, 0-10MΩ | 1 No. |
| 2. | DC Power Supply | 0-30V,0-2A | 1 No. |

## X Precautions to be followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

**Voltmeter**

a. Apply fixed voltage to analog multimeter.
b. Read applied voltage with analog meter and write value
c. Increase input voltage in steps and repeat above procedure

**Current**

1. Apply fixed voltage ( For example 6v ) to analog multimeter.
2. Read applied voltage with analog meter and write value in Colum B
3. Reduce voltage each time gradually and measure voltage with analog meter again write value in Colum B
4. Continue above still least value has been determined that is Smallest change in input that produces a detectable change in instruments output

**Resistance**

1. Apply fixed voltage to analog multimeter.
2. Read applied voltage with analog meter and write value
3. Increase input voltage in steps and repeat above procedure
4. Reach maximum value of range of meter.
5. Decrease input voltage in steps from maximum value towards minimum
6. Plot the graph after completing all readings shown in table 3

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (use blank sheet provided if space not sufficient)

**Table 6: voltage measurement**

| Sr. No | Actual voltage given by power supply in Volt | Measured voltage with voltmeter in volt |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

**Table 7: Current Measurement:**

| Sr. No | Actual Current Calculated in Ampere | Measured Current with Ammeter in Ampere |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

**Table 3 : Resistance Measurement**

| Sr. No | Resistance Measure using Colour Code in Ohm | Measured Resistance using Ohm Meter in Ohm |
|---|---|---|
| | | |
| | | |
| | | |
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. List different types scale range of Digital multimter available in your lab .
2. State requirement of battery for multimeter.
3. State minimum value that can be measured by given digital meter.

(Space for Answers)

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## XIX References / Suggestions for further reading

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Electronics Component Handbook; Jones, Thomas H., Reston Publishing, Resto, Virginia, USA, ISBN: 978087909222
3. EC1002 -ELECTRONICS ENGINEERING PRACTICES
4. Electronic Instruments and Measurement Techniques by Cooper.
5. https://youtube/WmIgusHZyPc?t=42

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.4: Calibration of analog voltmeter

**I Practical Significance**

Analog voltmeter is one of important instrument used by industry to measure voltage. These volt-meters are extremely flexible. Calibration is a must process in measurement before the use of meter in industry. This practical will help you to calibrate the analog voltmeter with standard meter and test its accuracy.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use measuring instrument.
ii. Measure accurately using an analog meter.
iii. Select the instrument as per required range.
iv. Maintain quality of meter

**IV Relevant Course Outcome(s)**

- Calibrate the analog meter to measure electrical parameter.

**V Practical Outcome**

- Calibrate analog voltmeter to maintain its accuracy.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipments.

**VII Minimum Theoretical Background**

**Calibration of voltmeter**

The calibration is the process of checking the accuracy of the result by comparing it with the standard value. In other words, calibration checks the correctness of the instrument by comparing it with the reference standard. It helps us in determining the error occur in the reading and adjust the voltages for getting the ideal readings.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample


**Figure 1: Power supply and Analog multimeter**

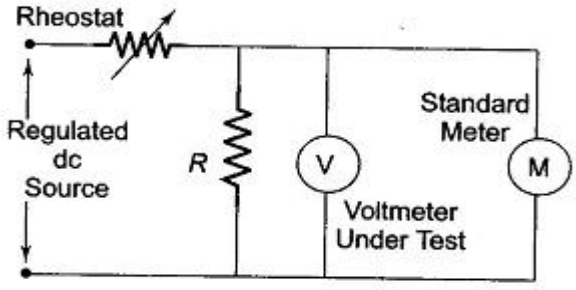


**Figure 2: Schematic Circuit voltage Calibration**

### b) Actual Circuit/ Experimental set up used in laboratory

**Note:You should Draw setup for Voltage Calibration and Measurement**

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | Analog Voltmeter | ANY range available in LAB | 1 No. |
| 2. | Standard Voltmeter | Properly Calibrated with standard | 1No. |
| 3. | DC Power Supply | 0-30V,0-2A | 1 No. |
| 4. | Rheostat / Resistance box / Potentiometer | 0-1k / 0-10k / 1M ohm | 1No each |

## X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

**Voltmeter**

1. Connect the circuit is as shown in figure 2.
2. Apply 0 to 10 Volts using standard supply to analog voltmeter(0-10V).
3. Vary the rheostat to set different voltage on standard voltmeter.
4. Connect Voltmeter under test.
5. Measure voltage on both meter keeping R open.
6. Change the R value from Mega-ohm to certain ohm, repeat the procedure five value
7. Tabulate the Reading
8. Repeat the Procedure for different 3 voltage from steps 5 to 7.
9. Plot the graph for standard meter vs. meter in test and resistance vs. voltage.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Qty | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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## XIV Observations and Calculations (use blank sheet provided if space not sufficient)

**Table 8. FOR V1=10V** [Maximum range it can be decided by instructor depending on available voltmeter and DC power supply]

**Repeat the Observation for V1 = 5V and V1=3V [50% and 30% of Maximum]**

| Sr. No | R value in Ohm | Measured Voltage with Voltmeter under Test in Volt Column A | Measured Voltage with standard Voltmeter in Volt Column B | Difference Voltage between column A and B Column C | %Accuracy= (Col C/Col B)*100 |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| **Sr. No** | **R value in Ohm** | **Measured Voltage with Voltmeter under Test in Volt Column A** | **Measured Voltage with standard Voltmeter in Volt Column B** | **Difference Voltage between column A and B Column C** | **%Accuracy= (Col C/Col B)*100** |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |

| Sr. No | R value in Ohm | Measured Voltage with Voltmeter under Test in Volt Column A | Measured Voltage with standard Voltmeter in Volt Column B | Difference Voltage between column A and B Column C | %Accuracy= (Col C/Col B)*100 |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |

**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. List different ranges of analog multimters available in your lab.
2. State the percentage of accuracy of different voltmeter in laboratory.
3. State the error in analog voltmeter.
4. State minimum value that can be measured by given analog voltmeter.
5. State full scale deflection of the given voltmeter.
6. State effect of resistance which is connected in parallel to the given analog meter.

**[Space for Answers]**

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## XIX References / Suggestions for further reading


1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Transistor Database User Guide, 2016
3. Electronics Component Handbook; Jones, Thomas H., Reston Publishing, Resto, Virginia, USA, ISBN: 978087909222
4. https://youtube/WmIgusHZyPc?t=42
5. https://web.archive.org/web/20090517092309/http://ieee1588.nist.gov/


## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. …….
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 5: Calibration of analog ammeter

**I Practical Significance :**

Analog ammeter is one of important instrument used by industry to measure amps. These ammeter are extremely flexible. Calibration is the must process in measurement before the use of meter in industry. This practical will help you to calibrate the analog ammeter with standard meter and test its accuracy.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use measuring instrument.
ii. Measure accurately using an analog meter.
iii. Select the instrument as per required range.
iv. Maintain quality of meter

**IV Relevant Course Outcome(s)**

- Calibrate different electronic instrument.

**V Practical Outcome**

- Calibrate the given analog ammeter .

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

**Current Calibration**

The calibration is the process of checking the accuracy of the result by comparing it with the standard value. Calibration checks the correctness of the instrument by comparing it with the reference standard. It helps us in determining the error occurred in the reading and adjust the current for getting the ideal reading

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample


**Figure 1: Power supply and Analog Ammeter**

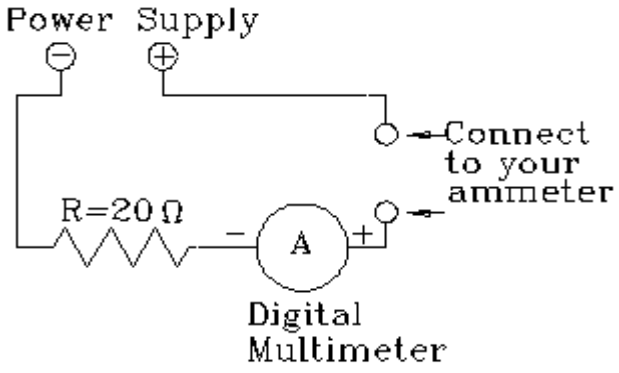


**Figure 2: Schematic Circuit Currentmeter Calibration**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | Analog Ammeter | 0-10A / any range available in lab | 1 No. |
| 2. | DC Power Supply | 0-30V,0-2A | 1 No. |
| 3. | Digital Multimeter | 0-1000V, 0-10A | 1 No |
| 4. | Rheostat / Potention | 0-1 k / 0-10 k / 1MΩ | 1 No |

## X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure that the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Connect the circuit is as shown in figure 2.
2. Apply 0 to 10 Volts using standard supply to analog Ammeter (0-10A).
3. Vary the rheostat to set different Current on standard multimeter.
4. Connect Ammeter under Test.
5. Measure Current on both meters keeping R Short.
6. Change the R value from Mega-ohm to certain ohm, repeat the procedure five value
7. Tabulate the Reading
8. Repeat the Procedure for different 3 currents from steps 5 to 7.
9. Plot the graph for standard meter vs. meter in test and resistance vs. current.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (use blank sheet provided if space not sufficient)

| Sr. No | R value in Ohm | Measured Current with Ammeter under Test in Volt Column A | Measured Current with standard Ammeter in Volt Column B | Difference Current between column A and B Column C | %Accuracy= (Col C/Col B)*100 |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |

**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. List different ranges of analog multimters available in your lab.
2. State the percentage of accuracy of different ammeter in laboratory.
3. State the error in analog ammeter.
4. State minimum value that can be measured by given analog ammeter.
5. State full scale deflection of the given ammeter.
6. State effect of resistance which is connected in parallel to the given analog meter.

(Space for Answers)

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## XIX References / Suggestions for further reading

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. https://web.archive.org/web/20090517092309/http://ieee1588.nist.gov/
3. https://youtube/WmIgusHZyPc?t=42

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. …….
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 6: Use different knob on front panel to measure the waveform

**I Practical Significance**

Cathode ray oscilloscope is one of the most useful electronic equipment, which gives a visual representation of electrical waveform. This common laboratory instrument provides accurate time and amplitude measurements of voltage signals over a wide range of frequencies. Its reliability, stability, and ease of operation make it suitable as a general purpose laboratory instrument. Hence it is one of important instrument used by industry. This practical will help you to select the relevant range of CRO for various measurements by varying positions of front panel knobs.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use measuring instrument.
ii. Measure accurately using an analog meter.
iii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Use the analog meter to measure electrical parameter.

**V Practical Outcome**

- Select the relevant range on CRO for various measurement by varing positions of front panel knobs.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

**C.R.O. Operation: Typical front-panel controls**

1. On–off : switch.
2. INTENS: This is the intensity control connected to the grid G to control the beam intensity and hence the brightness of the screen spot. Don't run the intensity too high, just bright enough for clear visibility. Always have the spot sweeping left to right or the beam may "burn" a hole in the screen.
3. FOCUS: allows you to obtain a clearly defined line on the screen .
4. POSITION: allows you to adjust the vertical position of the waveform on the screen.(There is one of these for each channel).

5. AMPL/DIV: is a control of the Y (ie. vertical) amplitude of the signal on the screen.(There is one of these for each channel).
6. AC/DC switch: This should be left in the DC position unless you cannot get a signal on-screen otherwise. (There is one of these for each channel).
7. A&B/ADD switch: This allows you to display both input channels separately or to combine them into one.
8. +/- switch: This allows you to invert the B channel on the display.
9. Channel A input
10. Channel B input
11. X POSITION: These allow you to adjust the horizontal position of the signals on the screen.
12. LEVEL: This allows you to determine the trigger level; ie. the point of the waveform at which the ramp voltage will begin in timebase mode.
13. ms/µs: This defines the multiplication factor for the horizontal scale in timebase mode.
14. MAGN: The horizontal scale units are to be multiplied by this setting in both time base and xy modes. To avoid confusion, leave it at x1 unless you really need to change it.
15. Time/Div: This selector controls the frequency at which the beam sweeps horizontally across the screen in timebase mode
16. A/B selector: This allows you to choose which signal to use for triggering.
17. -/+ : will force the ramp signal to synchronise its starting time to either the decreasing or increasing part of the unknown signal you are studying.
18. INT/EXT: This will determine whether the the ramp will be synchronised to the signal chosen by the A/B switch or by whatever signal is applied to the EXT. SYNC. input. (See 21 below.)
19. AC/TV: selectors. I've never figured out what this does; find whichever position works.
20. Ext : External trigger input

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample

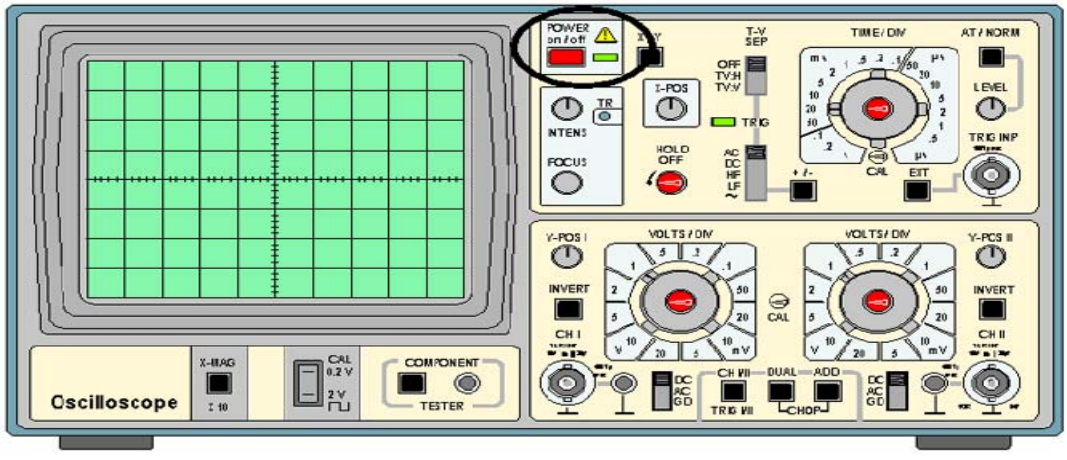


**Figure .1 CRO**

**b) Actual Circuit/ Experimental set up used in laboratory**

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1 | CRO | Dual Channel, 30Mhz BW | 1 No. |
| 2 | Function Generator | 0-3Mhz, 0-20 Vp-p | 1 No. |

## IX Resources Required

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## X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before

## XI Procedure

1 The continuity of the connecting wires should be tested first.
2 The frequency of the signal generator should be varied such that steady waveform is observed on CRO.
3 Note down performance of each knob
4 Connect CRO probe at channel 1(y)
5 Connect CRO probe output positive terminal to calibrate point**.[0.2Vpp]**
6 Set the V/div knob on 1V.
7 Measure number of vertical division on display screen.
8 Multiply with V/div.
9 Tabulate reading.
10 Repeat Step 7 to 9 for V/div for 0.2V and 0.05V.
11 Set the time/div knob on 1ms .
12 Measure number of Horizontal division on display screen for full cycle.
13 Multiply with Time/div.
14 Tabulate reading.
15 Repeat Step 12 to 14 for time/div for 0.2ms and 0.5ms.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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## XIV Observations and Calculations (use blank sheet provided if space not sufficient)

**Table 9**

| Sr. No | Name of Knob | Use of knob |
|---|---|---|
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| Sr.No | Volt/Div | Measured voltage | Time/Div | Measured Time |
|---|---|---|---|---|
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## XV Results

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## XVI Interpretation of Results (Give meaning of the above obtained results)

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## XVII Conclusions (Actions/decisions to be taken based on the interpretation of results).

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## XVIII Practical Related Questions

1. Interpret the display if input is connected to channel one and trigger the channel two in dual mode.
2. Interpret the Display of CRO if CRO in NORMAL mode and LEVEL trigger is not set.
3. Explain the procedure to test the CRO probe.
4. State function of Attenuation Probe.
5. State meaning of X*5.
6. State meaning of 20 MHz.
7. State the use of Z modulation of CRO.
8. State maximum Voltage measure by CRO with Normal Probe.
9. State the method to measure Mains(line voltage) voltage on CRO

**[Space for Answers]**

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## XIX References / Suggestions for further reading


1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Tektronix Oscilloscope Guide [1]
3. Aplab/scientech CRO user manual.
4. https://youtube/WmIgusHZyPc?t=42


## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 7: Use of CRO for Frequency and Amplitude Measurement

**I Practical Significance**

The Cathode Ray Oscilloscope is the most versatile tool for deployment of electronic circuit and system used in industry. CRO have been used for measure amplitude, frequency as well as it is used to observe waveform. This practical will help you to use to measure amplitude and frequency.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use measuring instrument.
ii. Measure accurately using an analog meter.
iii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Use the relevant instrument to measure specified parameters.

**V Practical Outcome**

Use CRO to measure amplitude and frequency of the given input signal.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

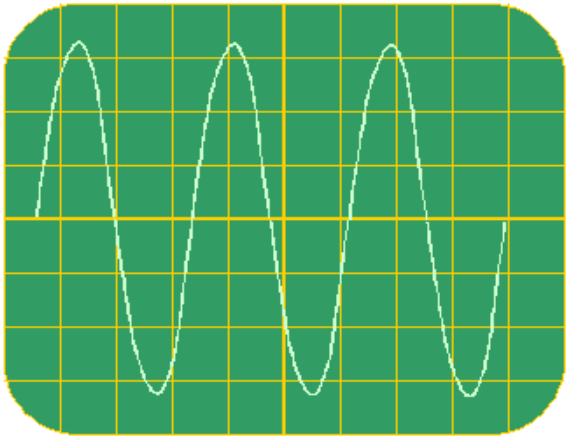
**VII Minimum Theoretical Background**

The CRO used to display amplitude as a function of time. The intensity of beam on CRO depends on the moments of an electron beam which is being bombarded on a screen coated with a fluorescent material to produce a visual spot.

## VIII Practical set-up / Circuit diagram / Work Situation

**Amplitude and frequency Measurements**

**a) Sample**



- The y-gain is set at 2 V/cm
- The total height of the wave from peak to trough is 6.4 cm

$\Rightarrow V_{pk\,to\,pk} = 12.8$ V

$\Rightarrow V_0 = \mathbf{6.4\ V}$

- The time base is set at 0.5 ms/cm.
- 1 cycle occupies 2.9 cm

$\Rightarrow T = 1.45$ ms $= \mathbf{1.45 \times 10^{-3}}$ s

$\Rightarrow$ Frequency $= 1 \div 1.45 \times 10^{-2}$ s $= \mathbf{690\ Hz}$

**Figure .1**

**b) Actual Circuit/ Experimental set up used in laboratory**

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | CRO | Dual Channel, 0-20Mhz, | 1 No. |
| 2. | Function Generator | 0-3Mhz,0-20Vp-p | 2 No. |

## X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1 The continuity of the connecting wires should be tested first.

2 The frequency of the signal generator should be varied such that steady waveform is formed.

3 The vertical height i.e. peak-to-peak height is measured. When this peak-to-peak height is multiplied by volt/div, we get the peak-to-peak voltage

4 The horizontal length between two successive peaks is noted, multiplied by the time base(m) i.e. sec/div , we get the time-period(T).The reciprocal of the time-period(1/T) gives the frequency(f). This can be verified with the frequency measured by the multi-meter.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Qty | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (use blank sheet provided if space not sufficient)

**Table 10: Voltage measurement**

| Sr. No | No. of vertical divisions (A) | Y gain (Voltage/ Division) (B) | Measured voltage = A x B (volts) |
|---|---|---|---|
| | | | |
| | | | |
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**Table 2: Frequency measurement**

| Sr. No | No. of horizontal divisions for one complete cycle (A) | X gain (Time/ Division) (B) | Measured Time T= A x B | Measured frequency = 1/T (Herts) |
|---|---|---|---|---|
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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## XVIII Practical Related Questions

1. State adjustment process needed for measurement of frequency with CRO.
2. State adjustment process needed for measurement of voltage with CRO.
3. State maximum and minimum value of frequency measured with CRO
4. State maximum and minimum value of voltage measured with CRO.
5. State method of Current measurement using CRO.
6. State the method to Measure unknown frequency using Z input.

(Space for answers)

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## XIX References / Suggestions for further reading

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Electronics Component Handbook; Jones, Thomas H., Reston Publishing, Resto, Virginia, USA, ISBN: 978087909222
3. https://youtube

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. ……..
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 8: Use of lissajous pattern for frequency measurement

**I Practical Significance**

The Cathode Ray Oscilloscope is the most versatile tool for deployment of electronic circuit and system used in industry. CRO have been used to measure amplitude, and frequency; it is also used to observe waveforms. There are different methods to measure and interpret unknown frequency. Lissajous Pattern method is one of them. This practical will help you to use to measure frequency using lissajous figure/pattern.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use measuring instrument.
ii. Measure accurately using an analog meter.
iii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Use the relevant instrument to measure specified parameters.

.

**V Practical Outcome**

- Generate Lissajous pattern on CRO to measure frequency of the given input signal

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

When both pairs of the deflection plates (horizontal deflection plates and vertical deflection plates) of CRO (Cathode Ray Oscilloscope) are connected to two sinusoidal voltages, the patterns appear at CRO screen are called the Lissajous pattern.

**Examples of Lissajous pattern given below:**

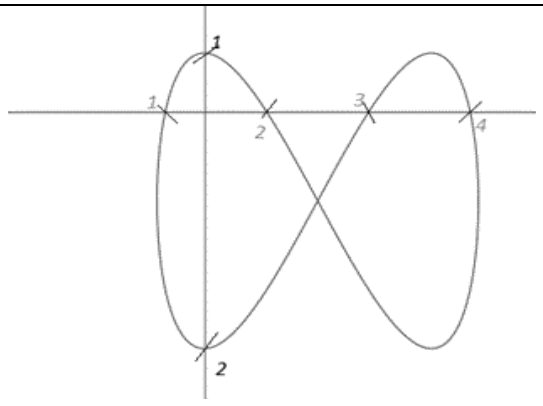
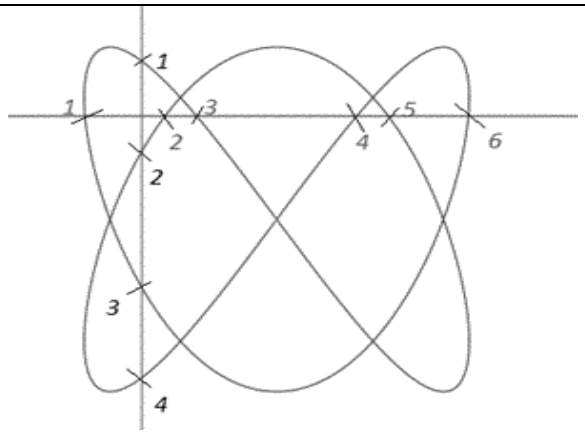
| SR. No | Lissajous Pattern | Unknown frequency $(\frac{fy}{fx} = \frac{\text{Number of horizontal tangencies}}{\text{Number of Vertical tangencies}})$ |
|---|---|---|
| |  | $\frac{fy}{fx} = \frac{4}{2}$ |
| |  | $\frac{fy}{fx} = \frac{6}{4}$ |

**Figure .1**

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample

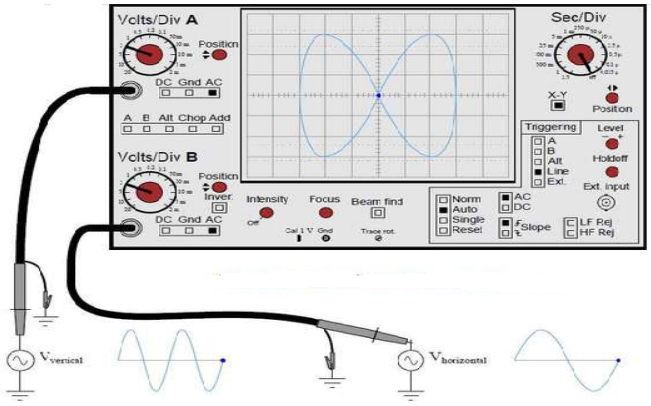



**Figure .2**

**b) Actual Circuit/ Experimental set up used in laboratory**

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | CRO | 0-20Mhz | 1 No. |
| 2. | Function Generator | 0-3Mhz | 2No. |

## X Precautions to be Followed

1. Ensure proper earthling to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Use Two signal generators, consider the first generator as the standard frequency source where as frequency from the second function generator is consider as unknown.
2. Set the frequency of generator first to 1 kHz, vary the frequency of second function generator until a stable Lissajous pattern is displayed to the screen of CRO.
3. Trace the pattern, record the number of horizontal and vertical tangents and frequency of second function generator.
4. Repeat the procedure for 4-5 unknown frequencies it will give different Lissajous pattern.
5. Consider known frequency equal to $f_x$
6. Unknown frequency of signals applied to CRO is calculated by

$$\frac{fy}{fx} = \frac{Number\ of\ horizontal\ tangencies}{Number\ of\ Vertical\ tangencies}$$

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

**XIII Actual Procedure Followed** (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (use blank sheet provided if space not sufficient)

**Lissajous Pattern**

| SR. No | Lissajous Pattern | Unknown frequency fx is calculated as ($\frac{fy}{fx} = \frac{Number\ of\ horizontal\ tangencies}{Number\ of\ Vertical\ tangencies}$) |
|---|---|---|
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. State the meaning of sweep and XY mode in CRO.
2. State any other method to find unknown frequency using CRO.
3. State the reason of lissajous figure generation.
4. State the effect of change in amplitude on lissajous figure..
5. State the point at which lissajous figure become stable.

(Space for answers)

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## XIX References / Suggestions for further reading

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Electronics Component Handbook; Jones, Thomas H., Reston Publishing, Resto, Virginia, USA, ISBN: 978087909222
3. https://youtube/WmIgusHZyPc?t=42

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 9: Use of lissajous pattern for phase measurement

**I Practical Significance**

The Cathode Ray Oscilloscope is the most versatile tool for deployment of electronic circuit and system used in industry. CRO is used to measure amplitude and frequency; it is also used to observe waveforms. There are different method to measure and interpret unknown phase. Lissajous Pattern method is one of them This practical will help you to use to measure phase using lissajous figure.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Use the relevant instrument to measure specified parameters.

.

**V Practical Outcome**

- Generate Lissajous pattern on CRO to measure phase of the given input signal

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

When both pairs of the deflection plates (horizontal deflection plates and vertical deflection plates) of CRO (Cathode Ray Oscilloscope) are connected to two sinusoidal voltages, the patterns appear at CRO screen are called the Lissajous pattern. Shape of **Lissajous pattern** changes with changes of phase difference between signal of **CRO**. Which makes **Lissajous patterns** very useful to analysis the signals applied to CRO.

**Lissajous Pattern**

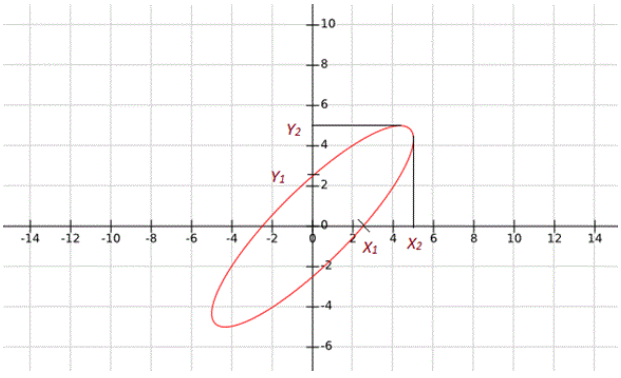
There are two cases to determine the phase difference ø between two signals applied to the horizontal & vertical plates,

**Case - I:** When, $0 < ø < 90^o$ or $270^o < ø < 360^o$ : -

when the angle is in the range of $0 < ø < 90^o$ or $270^o < ø < 360^o$, the Lissajous pattern is of the shape of Ellipse having major axis passing through origin from first quadrant

to third quadrant:

Let's consider an example for $0 < ø < 90^o$ or $270^o < ø < 360^o$, as shown in figure below,




In this condition the phase difference will be $\left(\varphi = \sin^{-1}\frac{x1}{x2}\right) = \sin^{-1}\frac{y1}{y2}$ Another possibility of phase difference $(\varphi') = 360 - (\sin)^{-1}\varphi$ From Above given Lissajous pattern $(x1) = 2.25$ & $(x2) = 4.5$

Hence $(\varphi) = \sin^{-1}\frac{x1}{x2} = \sin^{-1}\frac{2.25}{4.5} = 30^0$

another Possibility of Phase Difference,

$(\phi') = 360° - (\phi) = 360° - 30° = 330°$

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample

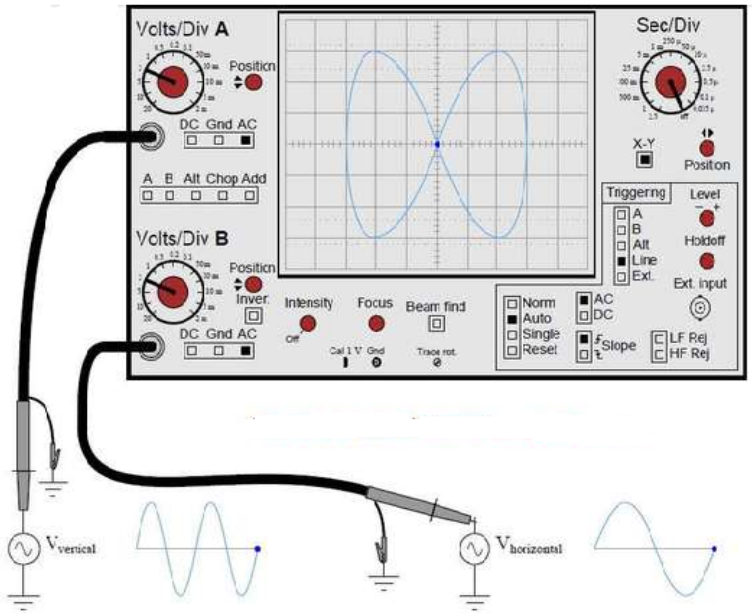



**Figure .1**

**b) Actual Circuit/ Experimental set up used in laboratory**

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | CRO | Dual Channel 0-20Mhz | 1 No. |
| 2. | Function Generator | 0-3Mhz,0-20Vp-p | 2 No. |

## X Precautions to be Followed

1. Ensure proper earthling to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Use Two signal generators; consider the first generator as the standard frequency source and frequency from the second function generator is considered as unknown.
2. Set the frequency of generator first to 1 kHz, vary the frequency of second function generator until a stable Lissajous pattern is displayed to the screen of CRO.
3. Trace the pattern in observation table
4. Calculate phase difference as explained above in theoretical Background.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (use blank sheet provided if space not sufficient)

**Lissajous Pattern**

| SR. No | Lissajous Pattern | Unknown Phase |
|---|---|---|
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. State the meaning of sweep and XY mode in CRO.
2. State any other method to find unknown frequency using CRO.
3. State the reason for lissajous figure generation.
4. State effect of change in amplitude on lissajous figure..
5. State point at which lissajous figure becomes stable.

(Space for answers)

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## XIX References / Suggestions for further reading

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Electronics Component Handbook; Jones, Thomas H., Reston Publishing, Resto, Virginia, USA, ISBN: 978087909222
3. https://youtube/WmIgusHZyPc?t=42

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. …….
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.10: Use function generator to generate different types of waveforms

**I Practical Significance**

Some of the most common waveforms produced by the function generator are the sine wave, square wave, triangular wave and saw tooth shapes. Function generator is a device that produces a desired signal of specified frequency, shape and amplitude. This implies that you would be able to adjust the frequency, set the shape or function (sinusoidal, triangle and square/rectangular) and change the amplitude level. There is also another adjustment possible and that is the offset. Offset is the DC level of the signal either positive or negative. This practical will help you to use to generate different waveform and observe on DSO.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Use the relevant instrument to measure specified parameters.

.

**V Practical Outcome**

- Use function generator to generate different types of waveforms and observe them on DSO.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

A function generator is an electronic test equipment used to generate different types of electrical waveforms over a wide range of frequencies. Some of the most common waveforms produced by the function generator are the sine wave, square wave, triangular wave and saw tooth shapes. A digital storage oscilloscope (often abbreviated DSO) is an oscilloscope which stores and analyses the signal digitally rather than using analog techniques.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample

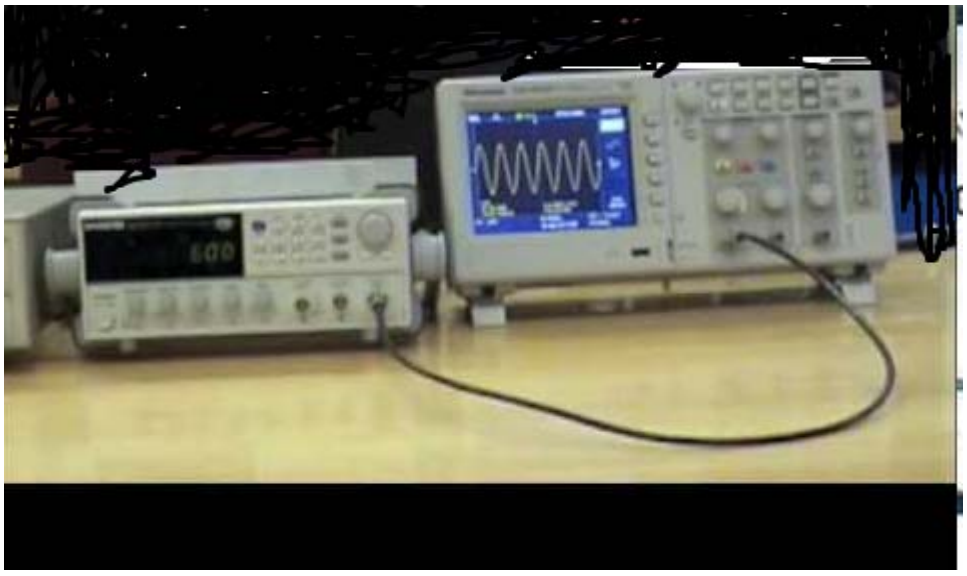

**Figure .1**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1 | DSO | 0-70/100Mhz LCD display | 1 No. |
| 2 | Function Generator | 0-3Mhz 20Vp-p | 1 No. |

## X Precautions to be Followed

1. Ensure proper earthling to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Turn on a function generator. The digital ones will take a few seconds to complete internal tests, but the analog ones will be ready right away.
2. Turn on the digital oscilloscope. After the scope completes its internal tests, press the "Clear menu" button at the lower right hand corner of the display screen.
3. Get a couple of BNC cables Probe. Use the BNC cables to connect the "main" output of the generator to CH1 of the oscilloscope and the "aux" (or "sync" or "TTL") output to CH2.
4. Set the controls of the function generator to produce a sine wave of about 1000 Hz frequency and a few volts amplitude depending on your generator specification.
5. Set DSO on auto run.
6. Press the measure switch. Select the cursor for amplitude.
7. Move the cursor at two peak point.
8. Observe measurement on display, Or measure waveform amplitude using scale value with number of division like normal CRO method.
9. Measure time using cursor with time cursor or normal CRO method.
10. Change function to Square wave of function generator. Repeat the step 5 to 9 for the selected wave.
11. Tabulate observation with measurement and waveform.
12. Draw the waveform on graph paper.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (use blank sheet provided if space not sufficient)

**Lissajous Pattern**

| Sr. No | Name Of Function | Amplitude in Volt | Time in Second | Frequency in Hz | Waveform |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. State the meaning of sweep and XY mode in CRO.
2. State the difference between DSO and CRO in measurement method
3. State the method to select the cursor in DSO.

4. List the different function / wave forms generated by given function generator.
5. State the maximum amplitude which can be set by given function generator.
6. State the meaning of 20dB and 40dB attenuation on function generator.
7. State minimum Voltage Amplitude generated by given function generator.

(Space for answers)

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## XIX References / Suggestions for further reading

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Electronics Component Handbook; Jones, Thomas H., Reston Publishing, Resto, Virginia, USA, ISBN: 978087909222
3. https://youtube/WmIgusHZyPc?t=42

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.11: Use DSO to measure and observe different types of waveforms.

**I Practical Significance**

A digital storage oscilloscope (DSO) is an oscilloscope which stores and analyses the signal digitally rather than using analog techniques. It is the most common type of oscilloscope because of its advanced trigger, storage, display and measurement features. This practical will help you to use DSO to measure different waveform and save on DSO and in USB.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

1. Use advance test and measuring instrument.
2. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Use the relevant instrument to measure specified parameters.

.

**V Practical Outcome**

- Use DSO to measure amplitude and frequency of given input signal.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

A DSO is usually electronic test equipment used to measure different types of electrical waveforms over a wide range of frequencies. A digital storage oscilloscope (often abbreviated DSO) is an oscilloscope which stores and analyses the signal digitally rather than using analog techniques. The input analogue signal is sampled and then converted into a digital record of the amplitude of the signal at each sample time. These digital values are then turned back into an analog signal for display on a cathode ray tube (CRT), or transformed as needed for the various possible types of output—liquid crystal display, chart recorder, plotter or network interface.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample

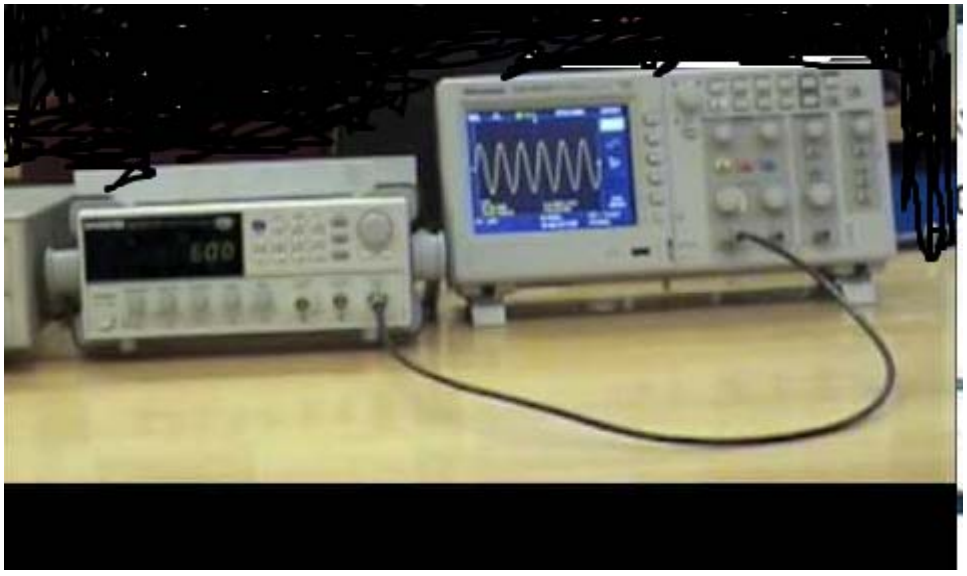

**Figure .1**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | DSO | 0-70/100Mhz Dual Channel with USB | 1 No. |
| 2. | Function Generator | 0-3Mhz 20Vp-p | 1 No. |

## X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Turn on a function generator. The digital ones will take a few seconds to complete internal tests, but the analog ones will be ready right away.
2. Turn on the digital oscilloscope. After the scope completes its internal tests, press the "Clear menu" button at the lower right hand corner of the display screen.
3. Get a couple of BNC cables Probe. Use the BNC cables to connect the "main" output of the generator to CH1 of the oscilloscope and the "aux" (or "sync" or "TTL") output to CH2.
4. Set the controls of the function generator to produce a sine wave of about 1000 Hz frequency and a few volts amplitude depending on your generator specification.
5. Set DSO on auto run.
6. Press the measure switch. Select the cursor for amplitude.
7. Move the cursor at two peak point.
8. Observe measurement at display. Or measure waveform amplitude using scale value with number of division like normal CRO method.
9. Measure time using cursor with time cursor or normal CRO method.
10. Change function to Square wave of function generator. Repeat the step 5 to 9 for the selected wave.
11. Tabulate observation with measurement and waveform.
12. Draw the waveform on graph paper.
13. Save one off signal on DSO and USB Pen Drive and Recollect it.
14. Change AC, DC coupling and observe wave on DSO.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Qty | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (use blank sheet provided if space not sufficient)

| SR. No | Type of signal | Amplitude in Volt By scale | Amplitude by Cursor | Time in Second by scale | Time in Second by cursor | Frequency in Hz |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. State the difference between DSO and CRO in measurement method.
2. State any method to select the cursor in DSO.
3. List the different function and wave can be created by given function generator.
4. State the maximum amplitude measured by DSO.
5. State the minimum Voltage Amplitude which can be generated by given function generator.
6. List additional knobs/switches on DSO front panel than Analog CRO.
7. State the meaning of scale X10, X100 on DSO.
8. State any method of change of AC, DC, Coupling on given DSO.

(Space for answers)

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**XIX References / Suggestions for further reading**

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Electronics Component Handbook; Jones, Thomas H., Reston Publishing, Resto, Virginia, USA, ISBN: 978087909222
3. https://youtube/WmIgusHZyPc?t=42

**XX Suggested Assessment Scheme**

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.12: Use spectrum analyzer to measure and observe different types of waveforms.

**I Practical Significance**

By analyzing the spectra of electrical signals, characteristics such as dominant frequency, power, distortion, harmonics, bandwidth, and other spectral components of a signal can be observed that are not easily detectable in time domain waveforms. These parameters are useful in the characterization of electronic devices, such as wireless transmitters. The display of a spectrum analyzer has frequency on the horizontal axis and the amplitude on the vertical axis. To the casual observer, a spectrum analyzer looks like an oscilloscope and, in fact, some lab instruments can function either as an oscilloscope or a spectrum analyzer. This experiment help to use of spectrum analyzer to measure frequency spectrum.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use advance test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Use the relevant instrument to measure specified parameters.

.

**V Practical Outcome**

- Use spectrum analyzer to measure frequency band of the given input signal.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

A spectrum analyzer measures the magnitude of an input signal versus frequency within the full frequency range of the instrument. Its primary use is to measure the power of the spectrum of known and unknown signals. The input signals that a spectrum analyzer measures is electrical; however, spectral compositions of other signals, such as acoustic pressure waves and optical light waves, can be considered through the use of an appropriate transducer. Optical spectrum analyzers also exist, which use direct optical techniques such as a mono- chromator to make measurements.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample


**Figure .1**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | Spectrum Analyzer | 0-3Ghz, 0-30Vp-p | 1 No. |
| 2. | Function Generator | 0-10Mhz, 20Vp-p, with AM, FM | 1 No. |

## X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Turn on a function generator. The digital ones will take a few seconds to complete internal tests, but the analog ones will be ready right away.
2. Turn on the Spectrum Analyzer. After the analyzer completes its internal tests, press the "Clear menu" button at the lower right hand corner of the display screen.
3. Get a couple of BNC cables Probe. Use the BNC cables to connect the "main" output of the generator to spectrum analyzer.
4. Set the controls of the function generator to produce a sine wave of about 1000 Hz frequency and a few volts amplitude depending on your generator specification.
5. Set Spectrum Analyzer auto run.
6. Press the measure switch. Select the cursor for amplitude.
7. Move the cursor at two peak point.
8. Observe measurement at display. Or measure waveform amplitude using scale value with number of division like normal CRO method.
9. Measure time using cursor with time cursor or normal CRO method.
10. Change function to Square wave of function generator. Repeat the step 5 to 9 for the selected wave.
11. Tabulate observation with measurement and waveform.
12. Draw the waveform on graph paper.
13. Save one off signal on Spectrum Analyzer and USB Pen Drive and Recollect it.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Qty. | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (use blank sheet provided if space not sufficient)

| Sr. No | Type of signal | Amplitude in Volt By scale | Time in Second by scale | Time in Second by cursor | Frequency in Hz | Waveform/ Graph |
|---|---|---|---|---|---|---|
| | | | | | | |
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. State the difference between Spectrum Analyzer, DSO and CRO in measurement method.
2. State method to select the cursor in Spectrum Analyzer.
3. State the maximum amplitude that can be measured by Spectrum Analyzer.
4. State the minimum Voltage Amplitude that can be measured by given Spectrum Analyzer.
5. List additional knobs/switches on Spectrum Analyzer front panel than Analog CRO.
6. State the meaning of scale X10, X100 on Spectrum Analyzer.
7. State the Maximum bandwidth analyzed with given analyzer.

**[Space for Answers]**

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## XIX References / Suggestions for further reading

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Electronics Component Handbook; Jones, Thomas H., Reston Publishing, Resto, Virginia, USA, ISBN: 978087909222
3. https://youtube/WmIgusHZyPc?t=42

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. ……
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.13: Test Characteristics of Potentiometer

**I Practical Significance**

The Potentiometers 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. There is widespread use of potentiometers in consumer electronics. This practical helps to test the characteristics of potentiometer.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

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**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use advance test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Interpret working of various types of sensors and transducers.

.

**V Practical Outcome**

- Test characteristics of potentiometer

**VI Relevant Affective domain related Outcome(s)**

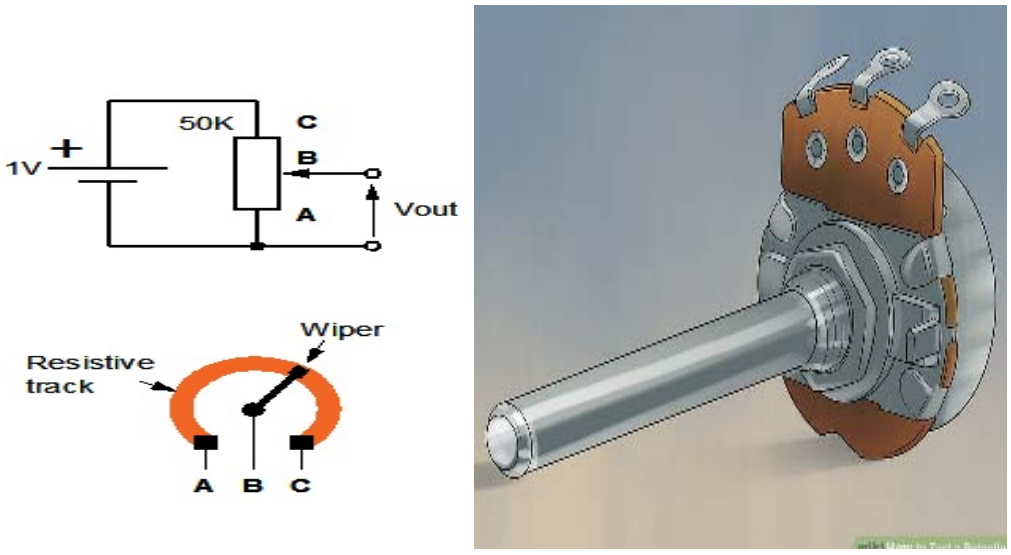
- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

A potentiometer is a manually adjustable variable resistor with 3 terminals. Two terminals are connected to both ends of a resistive element, and the third terminal connects to a sliding contact, called a wiper, moving over the resistive element. The position of the wiper determines the output voltage of the potentiometer. The potentiometer essentially functions as a variable voltage divider. The resistive element can be seen as two resistors in series(potentiometer resistance), where the wiper position determines the resistance ratio of the first resistor to the second resistor.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample



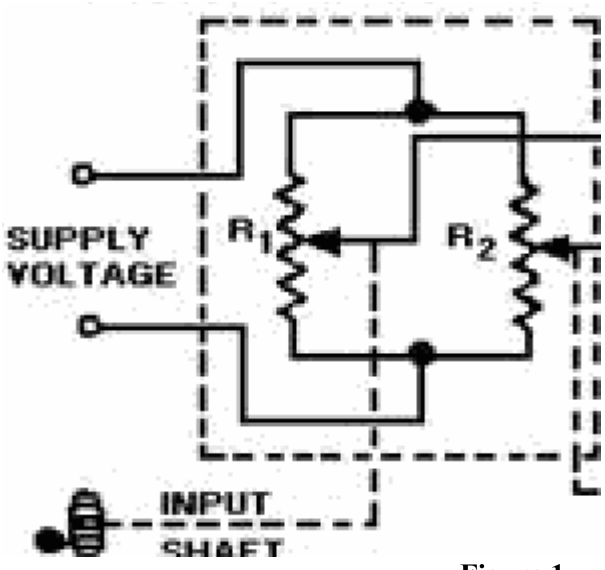




**Figure 1**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | Potentiometer | 0-100K, linear, type | 2No. |
| 2. | DC Power Supply | 0-30V,0-2A | 1 No. |
| 3. | Multimeter | Digital | 1No. |
| | | | |

## X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Connect the Potentiometer as shown in figure 1.
2. Connect other potentiometer parallel to it.
3. Connect Multimeter as Voltmeter 0-20V range.
4. Vary the potentiometer and measure the voltage keeping load pot constant.
5. Repeat procedure 10 times by varying potentiometer.
6. Plot the graph angle vs voltage.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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## XIV Observations and Calculations (use blank sheet provided if space not sufficient)

| SR. No | ANGLE in Degree | Amplitude in Volt $R_{l=}$100K | Amplitude in Volt $R_{l=}$10K | Amplitude in Volt $R_{l=}$1K | Amplitude in Volt $R_{l=}$100 |
|---|---|---|---|---|---|
| | | | | | |
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. State the Application of potentiometer.
2. State the effect of parallel connection of potentiometer.
3. State the effect of variation of voltage applied on potentiometer.
4. State the method of measurement of resistance of potentiometer.

[Space for Answers]

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## XIX References / Suggestions for further reading


1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Electronics Component Handbook; Jones, Thomas H., Reston Publishing, Resto, Virginia, USA, ISBN: 978087909222
3. NEETS Module 15 — Principles of Synchros, Servos, and Gyros
4. https://youtube/WmIgusHZyPc?t=42


## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. ……
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.14: Test the displacement characteristics of 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 test displacement characteristics of LVDT.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use advance test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Interpret working of various types of sensors and transducers.

.

**V Practical Outcome**

- Test relation between Linear displacement and output voltage using LVDT

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

LVDT is passive inductive transducer. It consist of single primary winding and two secondary winding wound on hollow cylindrical former. Primary is connected to an AC source. Secondary winding has an equal number of turns and is identically placed on either side of primary winding.

Principle of LVDT is based on mutual induction. It converts linear motion into electrical voltage. It is a displacement sensor in which variation of inductance is the function of displacement achieved by mutual inductance. The displacement to be measured is applied to an arm attached to the soft iron core.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample

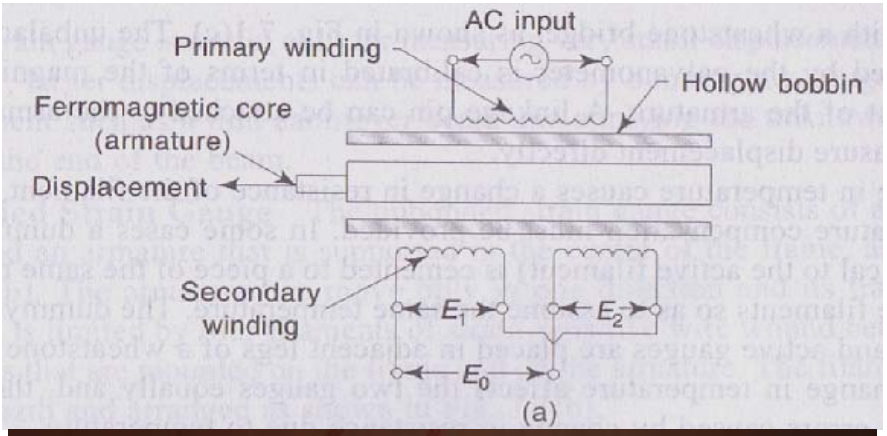


**Figure .1**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | LVDT set up | 0-100K, linear, | 2No. |
| 2. | Function Generator | 0-20Mhz,0-20Vp-p | 1 No. |
| 3. | MULTIMETER | Digital | 1No. |

## X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Connect the LVDT in given set up.
2. Connect Voltmeter at secondary with LVDT in differential mode.
3. Move core to observe 0 volt on voltmeter.
4. Mark 0 reading on scale.
5. Rotate the spindle or scale to move core one side(left/inside) by1 cm.
6. Measure the voltage.
7. Repeat steps 5th and 6th for 5 to 10 readings.
8. Rotate the spindle or scale to move core other side (right/inside) by1 cm.
9. Measure the Voltage.
10. Repeat steps 8th and 9th for 5 to 10 readings.
11. Plot the graph by considering left movement positive and right movement negative.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations (use blank sheet provided if space not sufficient)**

| Sr. No | Displacement Positive Direction | Output Voltage | Displacement Negative Direction | Output Voltage |
|---|---|---|---|---|
| 1 | Null Position | | Null Position | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |

**XV Results**

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**XVI Interpretation of Results (Give meaning of the above obtained results)**

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**XVII Conclusions (Actions/decisions to be taken based on the interpretation of results).**

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**XVIII Practical Related Questions**

1. State Application of LVDT other than displacement.
2. State the reason of shifting of null position of LVDT.
3. State the method of setting the null position.
4. Write the voltage at primary of LVDT.
5. State whether LVDT characteristics is linear or nonlinear.

**[Space for Answers]**

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**XIX References / Suggestions for further reading**

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. lvdt lab manualUploaded by guruabhay on Oct 13, 2014
3. https://youtube/WmIgusHZyPc?t=42

**XX Suggested Assessment Scheme**

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. ……..
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.15: Use strain gauge to measure applied pressure

**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)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use advance test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Use various types of transducers and sensors to measure quantities.

**V Practical Outcome**

- Use strain gauge to measure applied pressure

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

Strain gauge is a resistive transducer, whose resistance changes when it is subjected to stress (due to changes in length, area and resistivity). When strain gauge is subjected to a positive stress, the length will increase and cross section will decrease so resistance increase with stress. There will two types of strain gauges, bounded and unbounded gauge. Gauge will be connected in bridge arm. The bridge will be connected to DC supply. Depending on applied pressure resistance will change bridge will unbalance, current will flow and it will be converted to equivalent voltage and then measured by voltmeter and then calibrated as equivalent pressure.

Gauge factor $=(\Delta R/R)/(\Delta L/L)$

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample


**Figure .1**

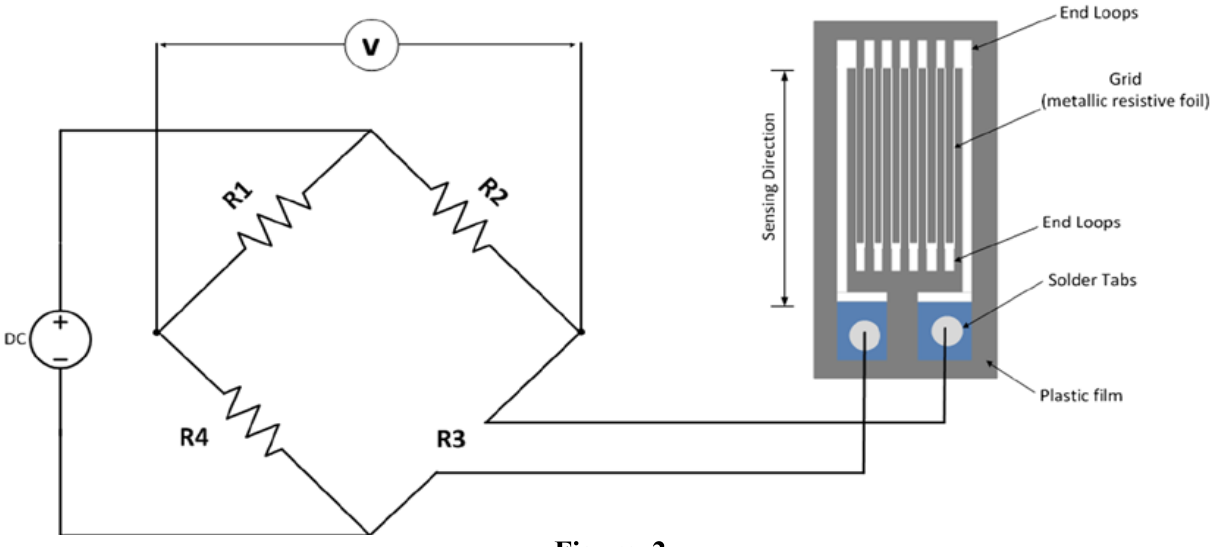


**Figure .2**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | Load Cell setup | Bridge with strain gauge | 2No. |
| 2. | Different weight | 500gram,1Kg, 5Kg | 1 No. |
| 3. | MULTIMETER | As Voltmeter and Ohmmeter. | 1No. |

## X Precautions to be Followed

1. Ensure proper earthling to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Connect the strain gauge to given set up.
2. Calibrate to Zero setting.
3. Apply different pressure or different weights on cell.
4. Measure Resistance of bridge. Tabulate the reading.
5. Switch on setup.
6. Measure the voltage at output of setup.
6. Plot the graph weight vs voltage.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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## XIV Observations and Calculations (use blank sheet provided if space not sufficient)

| SR. No | Weight in Kg | Resistance in Ohm | Voltage in Volt | Multiplying constant |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. State the Application of strain Gauge.
2. State the calibration process of DC bridge.
3. State the effect of variation of voltage applied on Strain Gauge.
4. State the method of measurement of resistance of Bridge.

**[Space for Answers]**

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**XIX References / Suggestions for further reading**


1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. Shull, Larry C., "Basic Circuits", Hannah, R.L. and Reed, S.E. (Eds.) (1992).*Strain Gage Users' Manual*, p. 122. Society for Experimental Mechanics. ISBN 0-912053-36-4.
3. **Jump up^** Spark, N. (2006). *A History of Murphy's Law*. Periscope Film. ISBN 978-0-9786388-9
4. https://youtube/WmIgusHZyPc?t=42


**XX Suggested Assessment Scheme**

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. …….
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.16: Use RTD (PT-100) to measure temperature of the given liquid.

**I Practical Significance**

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 zero degree temperature. Since RTD have higher accuracy and repeatability, they are slowly replacing thermocouple in industrial application below $600^{o}$ C. This practical will help you to measure temperature using RTD for given liquid.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use advance test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Interpret working of various types of sensors and transducers.

.

**V Practical Outcome**

- Use RTD (PT-100) to measure temperature of the given liquid.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

Resistance thermometers (RTD) is A sensor to measure temperature. Many RTD elements consist of a length of fine wire wrapped around a ceramic or glass core but other construction are also used. RTD wire is made of pure materials of platinum, Nickel or copper. The material has accurate resistance/temperature relationship which is to provide an indication of temperature.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample

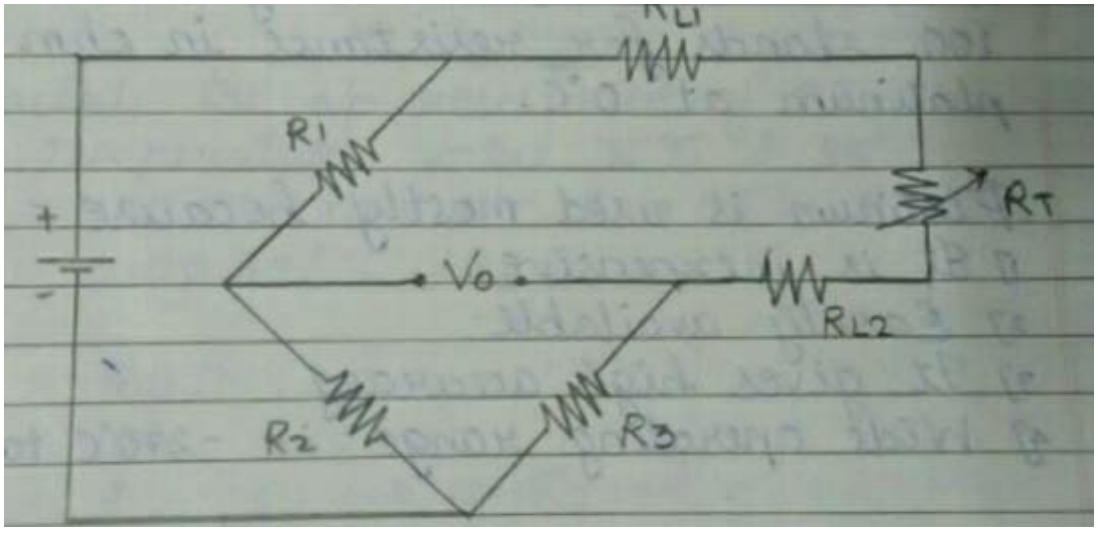


**Figure 1:** Schematic Circuit Diagram

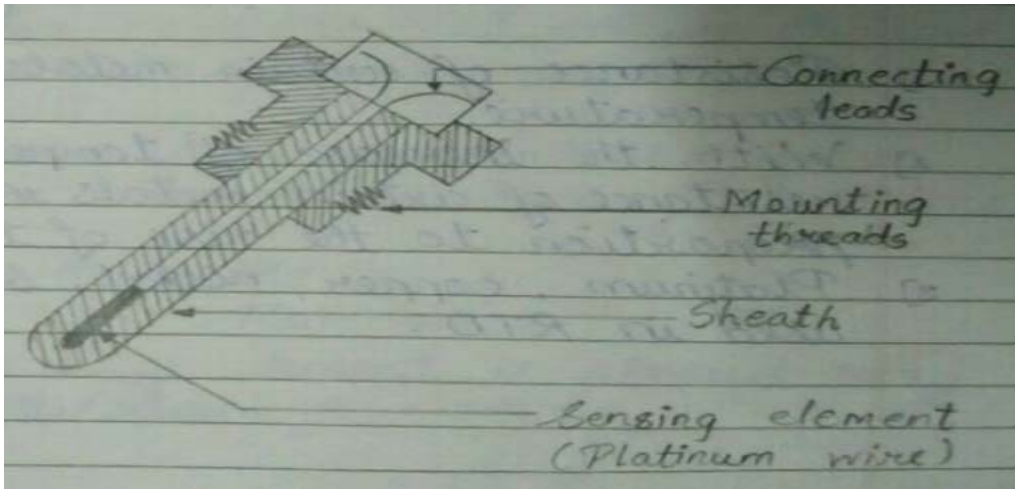


**Figure 2: RTD constructional Diagram**

**Figure 3: Practical Setup**

**b) Actual Circuit/ Experimental set up used in laboratory**

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | RTD setup | Any setup with standard RTD, | 1No. |
| 2. | DC Power Supply | 0-30V,0-2A | 1 No. |
| 3. | MULTIMETER | Digital | 1No. |

## X Precautions to be Followed

1. Ensure proper earthling to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Connect RTD in bridge circuit as shown in setup.
2. Place mercury thermometer in given liquid.
3. Place RTD's metal part to same liquid.
4. Measure resistance of RTD for each $10^{o}$ rise in temperature using heater on.
5. Switch on the setup, measure voltage for $10^{o}$ rise in temperature using heater on
6. Repeat the procedure for 10 times.
7. Plot the Graph.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

**XIII Actual Procedure Followed** (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (use blank sheet provided if space not sufficient)

| SR. No | Temperature in Degree | Amplitude in Volt | Resistance in ohm | Calibration Relation | Calculated temperature |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. State method of conversion of RTD resistance to temperature.
2. List standard type of RTD available in market.
3. State method of measurement of resistance of RTD.
4. State Practical reason to cover RTD with metal case.
5. State the Meaning of PT-100.
6. State resistance of RTD at Room temperature.

**[Space for Answers]**

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## XIX References / Suggestions for further reading

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. APPLICATION NOTES-PRACTICAL TEMPERATURE MEASUREMENTS from OMEGA
3. https://youtube/WmIgusHZyPc?t=42

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. ……..
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.17: Use Thermocouple to measure temperature of liquid.

**I Practical Significance**

Thermocouple is the active temperature transducer based on Seebeck 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 thermocouple for measuring the temperature of the given liquid.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use advance test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Interpret working of various types of sensors and transducers.

.

**V Practical Outcome**

- Use the thermocouple to measure the temperature of liquid.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

A thermocouple is an electrical device consisting of two dissimilar electrical conductors forming electrical junction at different temperatures. A thermocouple produces a temperature dependent voltage as a result of thermoelectric effect. Commercial thermocouple are inexpensive, interchangeable and with standard connectors. It does not require external power. Accuracy and sensitivity are good.

| Type | Tempreture Range | Material Used |
|---|---|---|
| J | -200 to 900 | Iron/Constantan |
| K | -200 to 1250 | Chromel/Alumel |
| R | 0 to 1600 | Platinum/Platinum 13% Rhodium |
| T | -200 to 400 | Copper/Constantan |

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample

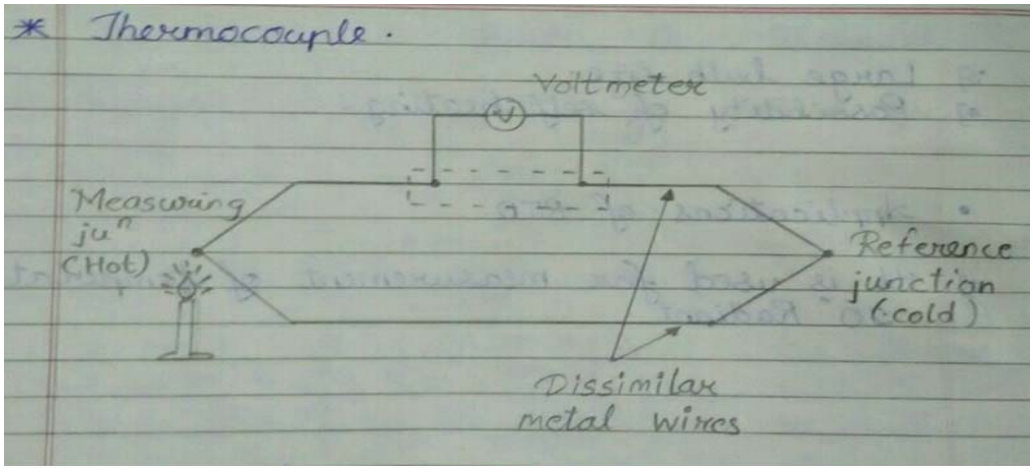


**Figure .1:** PRINCIPLE SHCEMATIC

**Figure .2:** PRACTICAL SETUP

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | Thermocouple | K type, | 1No. |
| 2. | Heater/paraffin bath | 0-400$^{o}$C | 1 No. |
| 3. | Multimeter | Digital | 1No. |
| 4. | Thermometer | 0-400$^{o}$C | 1No. |

## X Precautions to be Followed

1. Ensure proper earthling to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Connect thermocouple in setup.
2. Place the mercury thermometer in given liquid.
3. Place the thermocouple metal part to same liquid.
4. Switch on setup measure voltage for 10$^{o}$ rise in temperature using heater on.
5. Repeat the procedure for 10 times.
6. Plot the Graph.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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## XIV Observations and Calculations (use blank sheet provided if space not sufficient)

| SR. No | Temperature | Voltage in Volt | Calibration factor | Temperature Using thermocouple |
|---|---|---|---|---|
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. State the reason for replacing thermocouple by RTD in industry.
2. State method of conversion of Thermocouple voltage to temperature.
3. List standard type of Thermocouple available in market.
4. State method of measurement of voltage of Thermocouple.
5. State Practical reason to cover Thermocouple with metal case.
6. State the Meaning of K type.
7. State voltage of thermocouple at Room temperature.

[Space for Answers]

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## XIX References / Suggestions for further reading

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. APPLICATION NOTES-PRACTICAL TEMPERATURE MEASUREMENTS from Omega
3. https://youtube/WmIgusHZyPc?t=42

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1. | Handling of the instruments. | 10 % |
| 2. | Making connection of instrument. | 20 % |
| 3. | Measuring value using suitable instrument | 20 % |
| 4. | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5. | Calculate theoretical values of given meter | 10 % |
| 6. | Interpretation of result | 05 % |
| 7. | Conclusions | 05 % |
| 8. | Practical related questions | 15 % |
| 9. | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.18: Use bourdon tube and LVDT to measure applied pressure.

**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 of pressure using bourdon tube. This practical help you to test displacement characteristics of LVDT.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use advance test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Interpret working of various types of sensors and transducers.

.

**V Practical Outcome**

- Use bourdon tube and LVDT to measure applied pressure.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

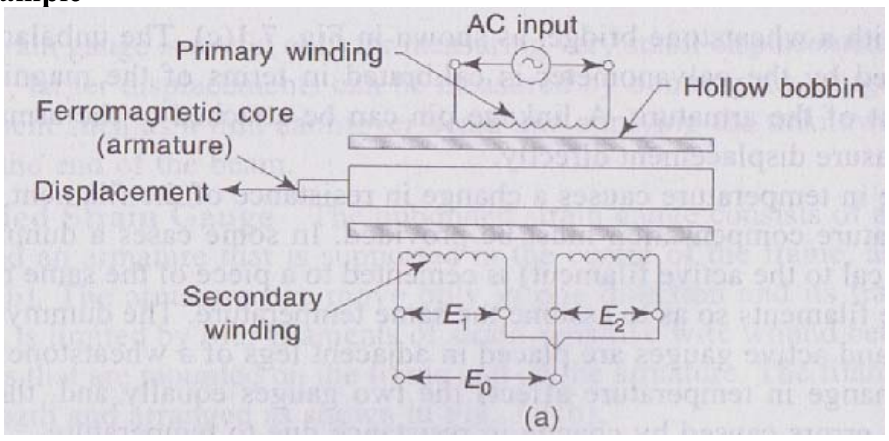
**VII Minimum Theoretical Background**

LVDT is passive inductive transducer. It consist of single primary winding and two secondary winding wound on hollow cylindrical former. Primary is connected to an AC source. Secondary winding has an equal number of turns and is identically placed on either side of primary winding.

Principle of LVDT is based on mutual induction. It converts linear motion into electrical voltage that is electrical signal. It is a displacement sensor in which variation of inductance is the function of displacement achieved by mutual inductance. The displacement to be measured is applied to an arm attached to the soft iron core.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample



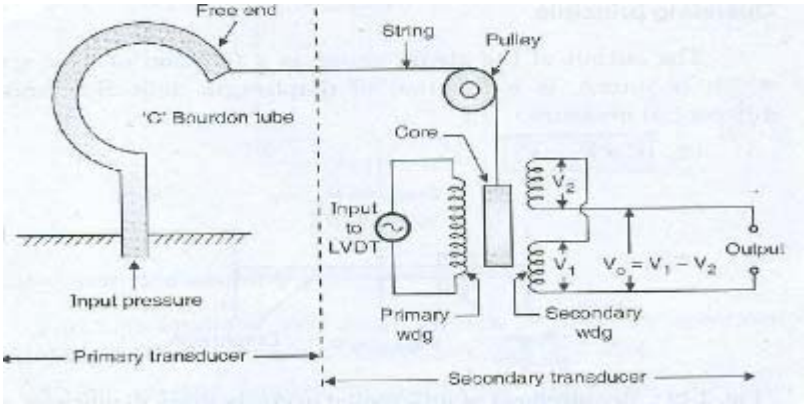




**Figure .1**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1. | LVDT set up/Bourden Tube | linear | 2No. |
| 2. | Weight | 100gm to 5Kg | 1 No. |
| 3. | Multimeter | Digital | 1No. |

## X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure

1. Connect the LVDT and bourdon tube in given set up.
2. Connect Voltmeter at secondary with LVDT in differential mode.
3. Move core to observe 0 volt on voltmeter.
4. Mark 0 reading on scale.
5. Place weight on pan.
6. Measure the voltage.
7. Repeat steps for 5 to 10 readings.
8. Plot the graph by considering left movement positive and right movement negative.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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## XIV Observations and Calculations (use blank sheet provided if space not sufficient)

| SR. No | Weight in Kg | Output Voltage | Displacement In mm |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |

| | | | |
|---|---|---|---|
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |

**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. State Application of LVDT other than displacement measurement.
2. State reason of shifting of null position of LVDT.
3. State method of setting the null position.
4. Write the voltage at primary of LVDT.
5. State whether LVDT characteristics is linear or nonlinear.

[Space for Answers]

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## XIX References / Suggestions for further reading

1. Laboratory Manual for Introductory Electronics Experiments, Maheshwari, L.K.; Anand, M.M.S., New Age International Pvt. Ltd. New Delhi; ISBN: 9780852265543
2. sensorland.com, "How sensors work - LVDT displacement transducer", http://www.sensorland.com/HowPage006.html (current December 2002).ACT-
3. National Instruments, "Getting Started with SCXI", Part Number 320515F-01, July 2000.
4. https://youtube/WmIgusHZyPc?t=42

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 19: Venturi Tube

**I Practical Significance:**

Venturi tube is one of important instrument used by industry for fluid flow measurement. It which uses a converging section of pipe to give an increase in the flow velocity and a corresponding pressure drop from which the flow rate can be deduced.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:**. Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems
- **Engineering tools:**. Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry-identified competency: **Maintain electronic automated system in process and manufacturing in industries.'**

i. Use measuring instrument.
ii. Measure accurately using Venturi tube.
iii. Select the instrument as per required range.

**IV Relevant Course Outcomes :**

- Analyse characteristics of measuring instrument.

**V Practical Outcome :** Use Venturi tube to measure fluid flow

**VI Relevant Affective domain unrelated Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment

**VII Minimum Theoretical Background**

A Venturi meter is a tube with a constricted throat that increases velocity and decreases pressure (see Figure 1). Venturi meters are used for measuring the flow rate in a pipeline. The Venturi effect is the reduction in fluid pressure that results when a fluid flows through a constricted section of pipe. The fluid velocity must increase through the constriction to satisfy the equation of continuity, while its pressure must decrease due to conservation of energy: the gain in kinetic energy is balanced by a drop in pressure or a pressure gradient force. An equation for the drop in pressure due to Venturi effect may be derived from a combination of Bernoulli's principle and the equation of continuity.

$$Q_a = \frac{C_v S_2}{\sqrt{1-\beta^4}} \sqrt{2g\Delta H}$$

Where $Q_a$ = Volumetric flow rate

$C_v$ = 0.985

$S_2$= Cross sectional area of throat = $1.76 \times 10^{-4} m^2$ (For example)

$\beta$ = Diameter of throat to pipe = 0.4848 (For example)

g= fluid density in plane of upstream tapping, kg/m³

**a) Sample**

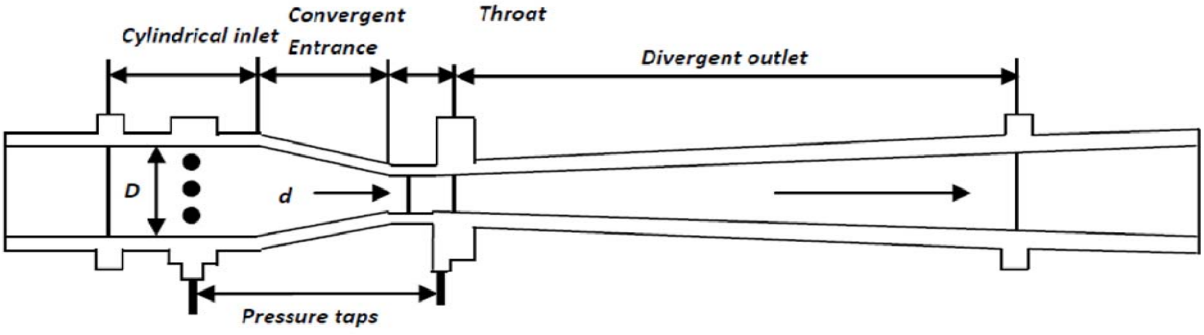


**Figure 1: Venturi meter**

**Practical set-up / Circuit diagram / Work Situation**

**b) Actual Circuit/ Experimental set up used in laboratory**

## VIII Resources required :

Following Table Format Should be Single Line

| S. No. | Instrument /Components | Specification | Quantity | Remarks |
|---|---|---|---|---|
| 1 | Venturi tube | 12" × 4.35" or equivalent, Wide range of diameter ratios, tube operates with minimum head loss, Accuracy : 0.25% | 01 | Or equivalent |

## IX Precautions :

1. Handle the equipment properly.
2. Ensure proper input flow.
3. Check for sufficient water level in the tank.
4. Ensure proper settings of range of meter before use.

## X Procedure :

1. Check all the clamp for tightness.
2. For measurement through venturi, open the outlet valve of the venture meter and close the valve of meter.
3. For a good amount of variation in discharge, close the by-pass valve of pump.
4. Now switch on the pump.
5. Open the gate valve and start the flow.
6. If any air bubbles exist in U-tube manometer remove them through air cock valve. Operate the air cock valve slowly and cautiously to avoid mercury run away through water.
7. Wait for a while for stabilization of flow.
8. Close the gate valve of measuring tank and measure the time for discharge of five litres of water and the manometer difference. Before taking any measurements, make sure the flow is stable.
9. Repeat the procedure by changing discharge by slowly opening the by-pass valve and take the six readings.

## XI Resources used (with major specifications) :

| S. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
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## XII Actual procedure followed :

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## XIII Precautions followed :

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## XIV Observations and Calculations:

**Table 1: Measurement of $V_F$ and $I_F$**

| SR No. | h1 (cm) | h2 (cm) | Time ( Seconds) | Qa (m3/Sec) |
|---|---|---|---|---|
| | | | | |
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**Calculations:**

$$Q_a = \frac{C_v S_2}{\sqrt{1 \quad \beta^4}} \sqrt{2g\Delta H}$$

## XV Results:

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## XVI Interpretation of results

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## XVII Conclusions & Recommendation

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## XVIII Practical related Questions:

1. What is the disadvantage of Venturi tube?
2. Make list of Venturi tube manufacturer from India.
3. Which flow meter is used for flow measurement when low permanent pressure loss is required?
4. Give typical value of an entry cone (angle) of and an exit cone (angle) of Venturi Tube

[Space for Answers]

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**XIX References / Suggestions for further Reading:**

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**XX Assessment Scheme:**

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 20: Orifice Plate

**I Practical Significance:**

Orifice meter is one of important instrument used by industry for fluid flow measurement. It is a cylindrical tube that contains a plate with a thin hole in the middle of it. The thin hole forces the fluid to flow faster through the hole in order to maintain flow rate.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:**. Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems
- **Engineering tools:**. Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry-identified competency: **Maintain electronic automated system in process and manufacturing in industries.'**

i. Use measuring instrument.
ii. Measure accurately using orifice plate.
iii. Select the instrument as per required range.

**IV Relevant Course Outcomes :**

- Analyse characteristics of measuring instrument.

**V Practical Outcome :** Use orifice plate to measure fluid flow

**VI Relevant Affective domain unrelated Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment

**VII Minimum Theoretical Background**

When an orifice plate is placed in a pipe carrying the fluid whose rate of flow is to be measured, the orifice plate causes a pressure drop which varies with the flow rate. This pressure drop is measured using a differential pressure sensor and when calibrated this pressure drop gives the flow rate. The flow rate is given by.

.

$$Q_a = \frac{C_v S_2}{\sqrt{1-\beta^4}} \sqrt{2g\Delta H}$$

Where $Q_a$ = Volumetric flow rate

$C_v$ = 0.985

$S_2$= Cross sectional area of throat = $1.54 \times 10^{-4} m^2$ (For example)

$\beta$ = Diameter of throat to pipe = 0.4904 (For example)

g= fluid density in plane of upstream tapping, kg/m$^3$

**a) Sample**

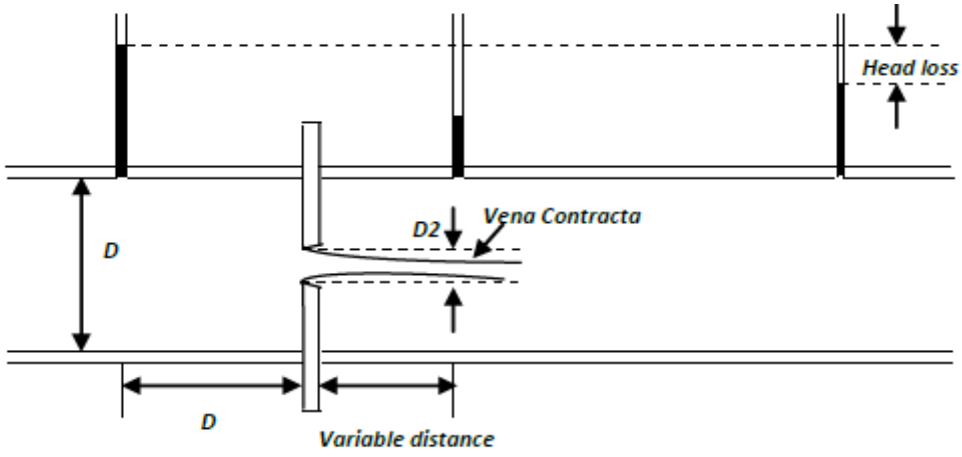


**Figure 1: orifice plate**

**Practical set-up / Circuit diagram / Work Situation**

**b) Actual Circuit/ Experimental set up used in laboratory:**

## VIII Resources required

Following Table Format Should be Single Line

| S. No. | Instrument /Components | Specification | Quantity | Remarks |
|---|---|---|---|---|
| 1 | Orifice plate | Allowable pressure difference 20 bar for temperatures up to 400 °C and $D_1/D_3 \geq 0.1$. | 01 | Or equivalent |

**IX Precautions -**

1. Handle the equipment properly.
2. Ensure proper input flow.
3. Check water level in tank is sufficient.
4. Ensure proper settings of range of meter before use.

**X Procedure**

1. Check all the clamp for tightness.
2. For measurement through orifice, open the outlet valve of the orifice plate and close the valve of meter.
3. For a good amount of variation in discharge, close the by-pass valve of pump.
4. Now switch on the pump.
5. Open the gate valve and start the flow.
6. If any air bubbles exist in U-tube manometer remove them through air cock valve. Operate the air cock valve slowly and cautiously to avoid mercury run away through water.
7. Wait for a while for stabilization of flow.
8. Close the gate valve of measuring tank and measure the time for discharge of five litres of water and the manometer difference. Before taking any measurements, make sure the flow is stable.
9. Repeat the procedure by changing discharge by slowly opening the by-pass valve and take the six readings.

**XI Resources used (with major specifications) :**

| S. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
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**XII Actual procedure followed :**

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**XIII Precautions followed**

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## XIV Observations and Calculations:

**Table 1: Measurement of $V_F$ and $I_F$**

| SR No. | $h_1$ (cm) | $h_2$ (cm) | Time ( Seconds) | Qa (m3/Sec) |
|---|---|---|---|---|
| | | | | |
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**Calculations:**

$$Q_a = \frac{C_v S_a}{\sqrt{1-\beta^4}} \sqrt{2g\Delta H}$$

## XV Results:

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## XVI Interpretation of results

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## XVII Conclusions & Recommendation

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**XVIII Practical related Questions:**

1. What is the disadvantage of orifice plate?
2. Make list of orifice plate manufacturer from India.
3. Name any two materials used for making orifice plate.
4. Give dimensions of Orifice Plate.

[Space for Answers]

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**XIX References / Suggestions for further Reading:**

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**XX Assessment Scheme:-**

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. ……
4. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 21: Rotameter

**I Practical Significance**

Rotameter is one of the important instrument used by industry for fluid flow measurement. It belong 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. This meter is always mounted in vertical position.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:**. Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems
- **Engineering tools:**. Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use measuring instrument.
ii. Measure accurately using an analog meter.
iii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Analyse characteristics of measuring instrument.

**V Practical Outcome**

Use rotameter to measure fluid flow

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

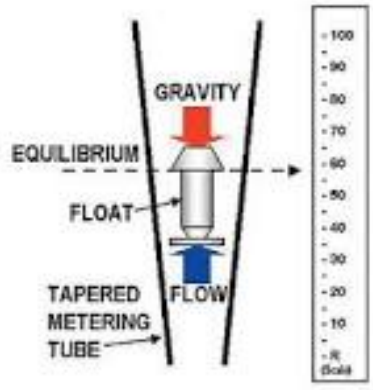
**VII Minimum Theoretical Background**

Rotameters measure flow rate by varying the cross-sectional area of the path that fluid travels. A float inside a closed tube balances itself at different heights from forces due to gravity and drag. The area of the closed tube increases from bottom to top which functionally will decrease drag force on the float until a balance is reached with gravitational forces. Vertical positions of the float are designed to correspond to reference flow rates. Rotameters belong to a class of variable area meters. Generally,

they require no external power source and taps into the flow of the fluid to measure flow rates making them inexpensive to operate.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample




**Figure; Rotameter**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1 | Rotameter | Scale,Accuracy : +/- 2% of Full Scale | 1 No. |

**X Precautions to be Followed**

1. Handle the equipment properly.
2. Ensure proper input flow.
3. Check water level in tank is sufficient.
4. Ensure proper settings of range of meter before use.

**XI Procedure**

1. Check proper alignment of rotameter.
2. Start the flow by operating the inlet taps or valve slowly..
3. Observe the annular passage which is opened between the walls of the tapered glass tube & float periphery as the float moves upwards.
4. Stop the inlet valve adjustment and observe that the float comes to equilibrium position.
5. Measure the float position manually by using a scale from the bottom of rotameter.
6. note down the flow readings from the calibrated scale in terms of flow rate according to the equilibrium position of the float.
7. Repeat the procedure by changing the valve position.

**XII Resources Used**

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

**XIII Actual Procedure Followed** (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (use blank sheet provided if space not sufficient)

**Table 1: Measurement of position of float and flow rate**

| Sr. No. | Position in (cm) | Flow rate in (lit/sec) |
|---|---|---|
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. Why rotameter should be installed vertically? Justify?
2. Why metallic rotameter is preferred over glass rotameter?
3. Which type of force is acting on the float?

[Space for Answers]

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**XIX References / Suggestions for further reading**

Brodkey, Robert S.; Hershey, Harry C. (2003), Transport Phenomena: A Unified Approach, Brodkey Publishing (McGraw Hill)

**XX Suggested Assessment Scheme**

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. …….
3. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 22 : pH Meter

**I Practical Significance:-**

PH meter is one of important instrument used for comical laboratories in industry. The pH of a solution can be measured accurately with the help of a pH meter. Measurement of pH is employed to monitor the cause of acid-base titration. This practical will help you to use of pH meter.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:**. Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems
- **Engineering tools:**. Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry-identified competency: **Maintain electronic automated system in process and manufacturing in industries.'**

i. Use measuring instrument.
ii. Measure accurately using venturi tube.
iii. Select the instrument as per required range.

**IV Relevant Course Outcomes :**

- Analyse characteristics of measuring instrument.

**V Practical Outcome :** Use pH meter to measure pH value of given solution.

**VI Relevant Affective domain unrelated Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment

**VII Minimum Theoretical Background -**

The pH value of solution is defined as negative logarithm of hydrogen ion concentration. It is expressed in gram/ion lit. pH of neutral solution = $-\log_{10}10^{-7} = 7$ ;Consequently, PH of neutral solution is 7; in acidic solution PH<7, on the other hand pH of the alkaline solution is >7, pH value of distilled water = 7

pH of the solution is tested by using pH paper. This gives different color with different values.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample

**Figure 1:pH measurement using pH meter**

| pH range | Description | Colour |
|---|---|---|
| 0-3 | Strong acid | Red |
| 3-6 | Acid | Orange/Yellow |
| 7 | Neutral | Green |
| 8-11 | Base | Blue |
| 11-14 | Strong Base | Violet/Purple |

**Figure 2 pH paper**

### b) Actual Circuit/ Experimental set up used in laboratory

**IX Resources required:**

Following Table Format Should be Single Line

| S. No. | Instrument /Components | Specification | Quantity | Remarks |
|---|---|---|---|---|
| 1 | pH meter | pH Range, 0.00~14.00 pH.<br>Accuracy, ±0.1 pH ±1°C.<br>Resolution, 0.01 pH. | 01 | Or equivalent |

**X Precautions -**

1. Handle the equipment properly.
2. Ensure proper earthing to the equipment.
3. Ensure the power switch is in 'off' condition initially.

**XI Procedure**

1. Take the standard solution in 100mlBeaker
2. Dip the pH electrode in the Beaker & note down the pH.
3. Then take the another solution in a beaker dip the electrode & note pH of solution also dip the pH paper & observe the colour Change & note down the nature of solution.
4. Take the four different reading of four different solutions & Write the result as either the solution are acidic, basic or neutral.

**XII Resources used (with major specifications) :**

| S. No. | Instrument /Components | Specification | Quantity |
|---|---|---|---|
| | | | |

**XIII Actual procedure followed**

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**XIV Precautions followed**

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## XV Observations and Calculations:

**Table 1: Measurement of pH value of solution**

| S.No | Solution | pH paper | Change in Colour | Type of Solution |
|---|---|---|---|---|
| **1** | Solution-1 | Neutral pH paper | | |
| **2** | Solution-2 | Neutral pH paper | | |
| **3** | Solution-3 | Neutral pH paper | | |

## XVI Results:

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## XVII Interpretation of results

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## XVIII Conclusions & Recommendation

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## XIX Practical related Questions:

1 Define term pH value.
2 What is the pH of water?
3 Which different methods are used for determination of pH?
4 Describe working of pH electrode.

**[Space for Answers]**

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## XX References / Suggestions for further Reading

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## XXI Assessment Scheme-

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. …….
3. …….
4. …….

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 23: Trouble Shoot the System Signal Conditioning

**I Practical Significance**

Signal conditioning is basically used to eliminate the noise and other undesired interferences caused in critical and weak signals. The signal conditioners are also used to facilitate long distance travel of weaker signals.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use measuring instrument.
ii. Measure accurately using an analog meter.
iii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Analyse characteristics of measuring instrument.

**V Practical Outcome**

Use signal conditioner to get the required output.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

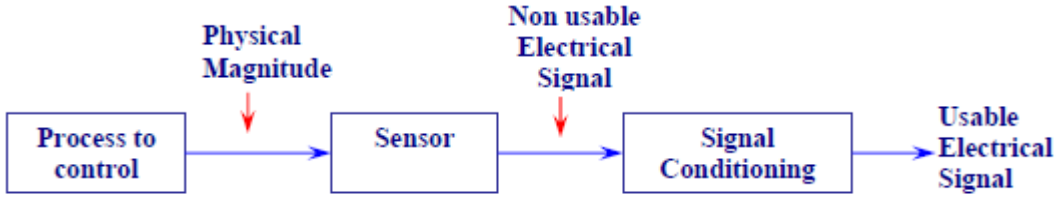
The signal conditioning circuit is an electronic circuit that converts signals provided by a sensor to useful electric signals. These electric signals must meet specific criteria so that they are correctly interpreted and processed by the rest of the system's circuitry. The use of Op-amps allows signal conditioning circuits to be more compact and precise in their implementations.

**Signal conditioning carries out one or several of the following actions:**

1. **Change voltage levels** so that they are compatible with the following circuitry.
2. **Convert current to voltage**. Some sensors, such as the NTC (Negative Temperature Coefficient) and the PTC (Positive Temperature Coefficient) RTD (Resistance Temperature Dependent) convert the variations of the process to resistance variations. Signal conditioning circuits provide the necessary current that converts a resistance variation to an appropriate voltage.
3. **Linearize** and compensate sensor's non-linear variations. This linearization is the conversion of non-linear signals into linear signals by using Taylor series.
4. **Convert the analog signal to digital signal.** The signal conditioning circuit ensures the analog signal is at levels that are compatible with the analog to digital conversion circuitry.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample




**Figure; Signal Conditioning**

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1 | Signal conditioner | For RTD: Pt100,Pt200,Pt500,Pt1000, Cu10 | 1 No. |

## X Precautions to be Followed

1. Ensure proper connections.
2. Ensure the power switch is OFF initially.

## XI Procedure

1. Draw a signal conditioning circuit available in your laboratory.(for eg. wheatstone's bridge, RTD circuit)
2. Measure the output voltages of different node of circuit by using first Multimeter and then CRO.
3. Change variable pot to get proper voltages
4. Measure corrected voltages after varying pot.(signal conditioning).

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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## XIV Observations and Calculations (use blank sheet provided if space not sufficient)

**Table 1: Signal conditioning**

| Sr. No. | Node number | voltages before signal conditioning | voltages after signal conditioning |
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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. What is signal conditioning?
2. Which type of signal conditioning is required in thermocouple?
3. What is the importance of signal conditioning? What are its applications?

[Space for answers]

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**XIX References / Suggestions for further reading:**

https://in.omega.com/prodinfo/signalconditioners.html

http://www.advantech.in/products/signal-conditioning-modules/sub_1-2mlkjq

**XX Suggested Assessment Scheme**

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. ……
4. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No. 24: Data Acquisition System

**I Practical Significance**

The purpose of data acquisition is to measure an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound. PC-based data acquisition uses a combination of hardware, software, and a computer to take measurements.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use measuring instrument.
ii. Measure accurately using an analog meter.
iii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Analyse characteristics of measuring instrument.

**V Practical Outcome**

Use data acquisition system to determine electrical and physical parameters.

**VI Relevant Affective domain related Outcome(s)**

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition systems (DAS or DAQ) convert analog waveforms into digital values for processing. The components of data acquisition systems include sensors to convert physical parameters to electrical signals, signal conditioning circuitry to convert sensor signals into a form that can be converted to digital values and Analog-to-digital converters to convert conditioned sensor signals to digital values.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample

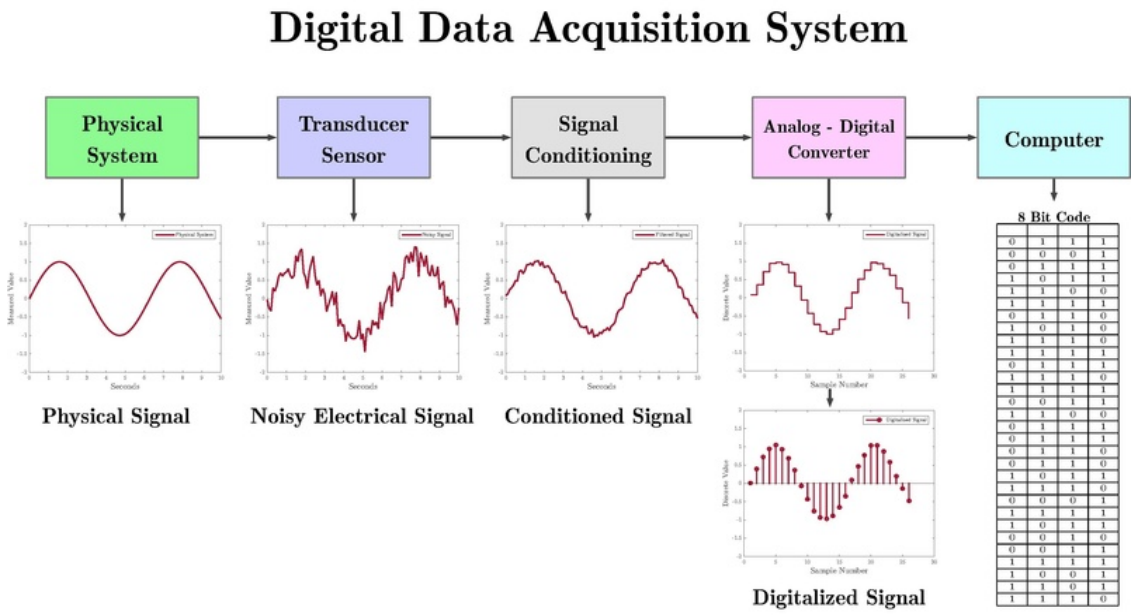


**Figure:** Block Diagram of Digital Data Acquisition System

### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1 | Data acquisition system | 16-channel module for Measuring Voltage, Current & IEPE Sensor lnputs. | 1 No. |
| | | Power supply unit: lnput: Output: 24V DC, max. L.25 A,2 m cable with suitable connector | 1 No. |
| | | Software to configure HW& analysis of acquired data | 1 No. |
| | | Portable Host Controller with i5 processer, 4GB RAM, 500GBHDD,14" Display unit & winl-O software | 1 No. |
| | | Cables: Ethernet cable (Cat6)-2 No. and Firewire cable- 1 No. | 1 set |

## X Precautions to be Followed

- Ensure proper connections.
- Ensure the power switch is in 'off' condition initially.

## XI Procedure

- Calculate the number of channels.
- Measure the electrical and physical parameters as per apparatus available in your laboratory.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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## XIV Observations and Calculations (use blank sheet provided if space not sufficient)

Prepare observation table as per the apparatus available in your laboratory.

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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

- List the type of data acquisition system available in your lab .
- Signal conditioner is an important part of an analog data acquisition system. Why?
- Which technique is most widely used in the single channel data acquisition system?

[Space for answers]

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## XIX References / Suggestions for further reading


- COMDEX Fall November 18, 1981 Las Vegas, NV, "Tecmar shows 20 IBM PC option card.. LabMaster, LabTender, DADIO, DeviceTender, IEEE-488.."
- PC Magazine Vol1 No.1, "Taking the Measure" by David Bunnell, "Tecmar deployed 20 option cards for the IBM PC"
- PC Magazine Vol1 No.5, "Tecmar Triumph" by David Bunnell, Scientific Solutions releases 20 new products for the PC
- BYTE Vol7 No.1 "Scientific Solutions – Advertisement for data acquisition boards, stepper controllers, IEEE-488 products
- Test&Measurement World Vol 11 No 10 Decade of Progress Award: Scientific Solutions – LabMaster First in PC Data Acquisition
- Data logger, Recorder, Data Acquisition – Background informatihttp://localhost:1613/Source/UPDESCO/StaticPages/RTI2-hi.aspxon Byte Paradigm – explains the differences between data logging and data acquisition.


## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……
2. ……
3. …….
4. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
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# Practical No.25: Troubleshooting of Potentiometer

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**I Practical Significance**

Troubleshooting of potentiometer is a process of having a special outlook on potentiometer that comes out with remedies to repair it. The unexpected behavior exhibited by the circuit is due to improper locating or soldering of potentiometer, potentiometer damage due to aging, faults, overheat, and so on. Such a type of behavior can cause undesired results or even circuit damage. With this experiment you are able to Troubleshoot the potentiometer.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use advance test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Interpret working of various types of sensors and transducers.

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**V Practical Outcome**

Troubleshoot circuit that contain potentiometer

**VI Relevant Affective domain related Outcome(s)**

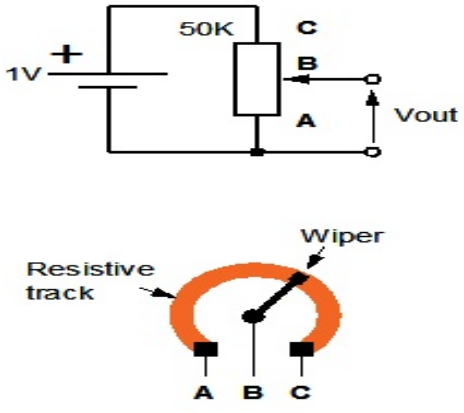
- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

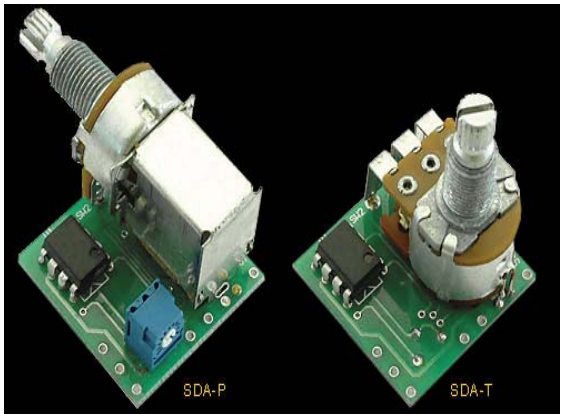
**VII. Minimum Theoretical Background**

A system can be described in terms of its expected, desired or intended behavior. Events or inputs to the system are expected to generate specific results or outputs. Any unexpected or undesirable behavior is a symptom. Troubleshooting is the process of isolating the specific cause or causes of the symptom. Frequently the symptom is a failure of the product or process to produce any results. Corrective action can then be taken to prevent further failures of a similar kind.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample




### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1 | POTENTIOMETER | 0-100K, linear, | 2No. |
| 2 | DC Power Supply | 0-30V,0-2A | 1 No. |
| 3 | MULTIMETER | Digital | 1No. |

## X Precautions to be Followed

1. Ensure proper earthling to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of analog meter before use.

## XI Procedure (Make changes in procedure according to the circuit available in your laboratory)

1. Check if each component is correctly mounted.
2. Connect the multimeter as ohm meter and measure the resistance at two extreme terminal as per specification of given Pot.
3. Rotate the shaft of Pot and measure the resistance between B and C for linearity.
4. Plot the graph for it
5. Repeat the step three for terminal A and B.
6. Plot the graph for it.
7. Interpret fault in the potentiometer.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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## XIV Observations and Calculations (draw observation table as per circuit available in your laboratory)

**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1 How do fixed resistors usually fail?
2 What is the effect on circuit if with ohms law voltage increases & resistance remains same?
3 Which type of resistor is used in SIPS and DIPS?
4. List faults occur in potentiometer.
5. State the method to rectify the fault.

[Space for answers]

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## XIX References / Suggestions for further reading

- https://www.allaboutcircuits.com/textbook/experiments/chpt-3/potentiometer
- https://www.phidgets.com/docs21/Potentiometer_Primer
- https://www.phidgets.com/docs21/Potentiometer_Primer
  https://www.maximintegrated.com/en/app-notes/index.mvp/id/1956

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. ……
3. ……
4. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.26: Troubleshooting of Strain Gauge.

**I Practical Significance**

Troubleshooting of strain gauge is a process of having a special outlook on strain gauge that comes out with remedies to repair it. The unexpected behavior exhibited by the circuit is due to improper locating or wiring of strain gauge, damage due to aging, faults, overheat, and so on. Such a type of behavior can cause undesired results or even circuit damage. With this experiment you are able to Troubleshoot the circuit that contain strain gauge.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use advance test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Use various types of transducers and sensors to measure quantities.

**V Practical Outcome**

- Trouble shoot the performance of the strain gauge.

**VI Relevant Affective domain related Outcome(s)**

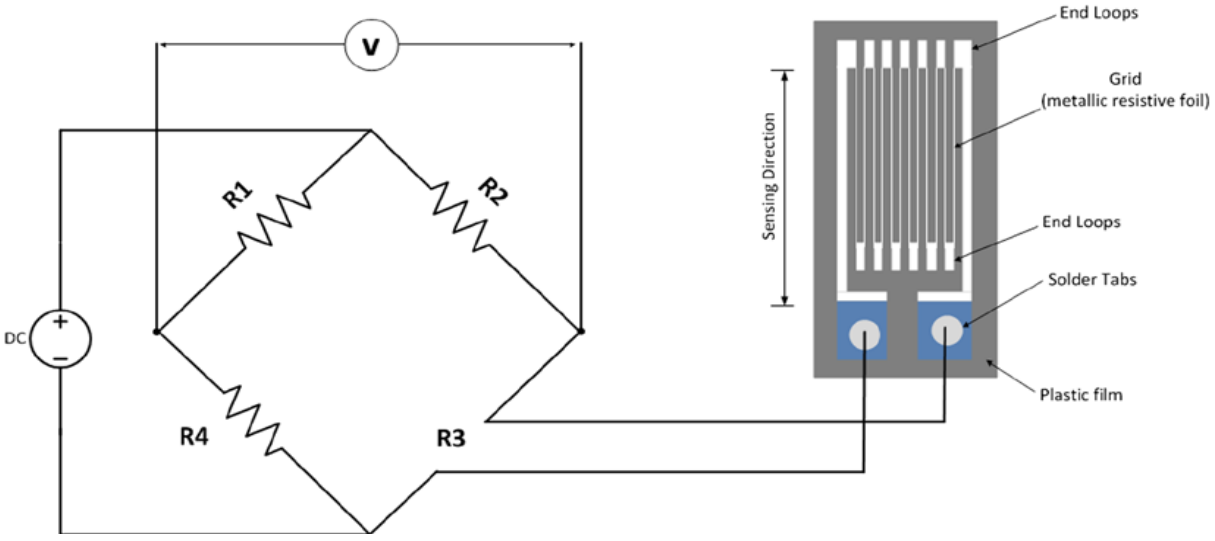
- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

Troubleshooting is a form of problem solving, often applied to repair failed products or processes on a machine or a system. It is a logical, systematic search for the source of a problem in order to solve it, and make the product or process operational again.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample


### b) Actual Circuit/ Experimental set up used in laboratory

## IX Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1 | Load Cell setup | Bridge with strain gauge, ±0.1% of reading ±3 counts. (Normal mode operation at Gage Factor = 2.000) | 2No. |
| 2 | Different weight | 500gram,1Kg, 5Kg | 1 No. |
| 3 | MULTIMETER | As Voltmeter and Ohmmeter. | 1No. |

## X Precautions to be Followed

1. Ensure proper wiring of strain gauge.
2. Ensure proper connection of the bridge.
3. Ensure that the Power Supply switch is in off condition.
4. Ensure proper settings of range of meter before use.

## XI Procedure

a. Check each component in bridge are correctly mounted.
b. Test the resistance in each terminal.
c. Apply known weight on bridge and measure the resistance of each arm.
d. Apply multiple of weight in linear variation (1 to 10) on bridge.
e. Measure the resistance for each variation
f. Test sensitivity and linearity of bridge.
g. Interpret the result.

## XII Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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## XIV Observations and Calculations (draw observation table as per circuit available in your laboratory)

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**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1. What is the type of fault observed in strain gauge?
2. What is null shift compensation of bridge?
3. Electrical strain gauge works on which principle?
4. Bonding element in a strain gauge must have _____
   a) zero insulation resistance
   b) low insulation resistance
   c) high insulation resistance
   d) infinite insulation resistance.

[Space for answers]

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## XIX References / Suggestions for further reading

1. Adwww.cedrat-technologies.com/sensors/strain_gauges
2. www.continuummechanics.org/straingauges.html
3. https://www.kulite.com/docs/products_overview/StrainGageManualDigital.pdf

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. …….
2. ……..
3. ……
4. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.27: Troubleshooting of Venturi Tube

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**I Practical Significance**

Troubleshooting of Venturi tube is a process of having a special outlook that comes out with remedies to repair it. The unexpected behavior exhibited by the venturi tube is due to improper setting, damage due to ageing, faults, overheat, and so on. Such a type of behavior can cause undesired results or even set-up damage. With this experiment you are able to troubleshoot the venturi-tube.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use advance test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

Interpret working of various types of venturi tube.

**V Practical Outcome**

Troubleshoot set-up that contains venturi-tube

**VI Relevant Affective domain related Outcome(s)**

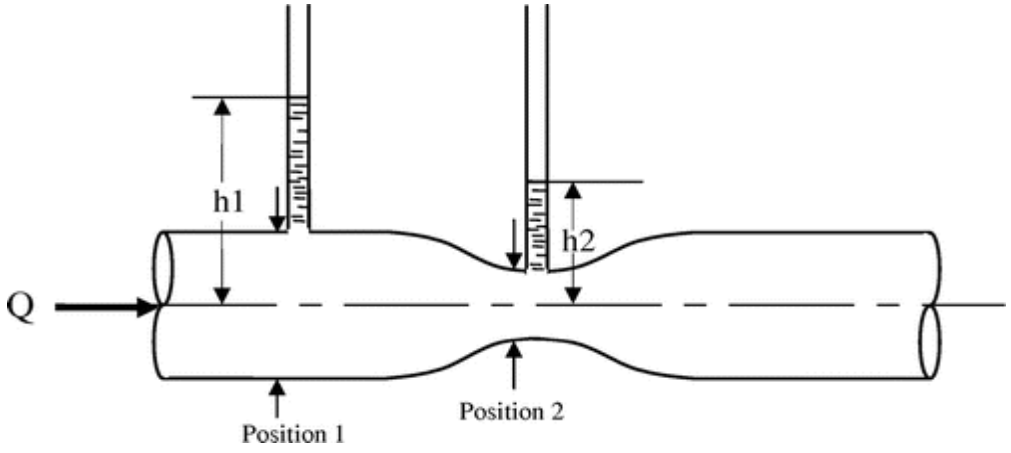
- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VII Minimum Theoretical Background**

A system can be described in terms of its expected, desired or intended behavior. Events or inputs to the system are expected to generate specific results or outputs. Any unexpected or undesirable behavior is a symptom. Troubleshooting is the process of isolating the specific cause or causes of the symptom. Frequently the symptom is a failure of the product or process to produce any results. Corrective action can then be taken to prevent further failures of a similar kind.

## VIII Practical set-up / Circuit diagram / Work Situation

### a) Sample




### b) Actual Circuit/ Experimental set up used in laboratory

**IX Resources Required**

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1 | Venturi tube | Line Size: 100 mm to 800 mm<br>Accuracy: +/-0.25% to +/-3.0%.<br>Flow coefficient value: 0.98 for all ratios of diameter<br>Beta ratios: 0.3 and 0.75. | 1No. |

**X Precautions to be Followed**

1. Uninstall all physical components starting from power connections.
2. Clean dust from the components.
3. Perform a visual check or electronic check as required.
4. Reinstall all components carefully and properly.

**XI Procedure (Make changes in procedure according to the circuit available in your laboratory)**

1 Check whether venture tube is mounted properly.
2 Check whether the fluid entering inside the tube is proper.
3 Check the type of fluid.

**XII Resources Used**

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

**XIII Actual Procedure Followed** (use blank sheet provided if space not sufficient)

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**XIV Observations and Calculations** (draw observation table as per circuit available in your laboratory)

**XV Results**

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**XVI Interpretation of Results (**Give meaning of the above obtained results)

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**XVII Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVIII Practical Related Questions**

1 How do venturi tube usually get damaged?
2 What modifications are done for gas flow measurement?
3 What modifications are done for slurry liquids?

[Space for answers]

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## XIX References / Suggestions for further reading

http://scharfautomation.com/venturi-meter
www.wermac.org/specials/venturiflowmeter.html
www.deconuk.com/.../DECON%20Flow%20Meters/

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. ……..
2. ……
3. ……
4. ……

| Marks Obtained | | | Dated signature of Teacher |
|---|---|---|---|
| **Process Related(15)** | **Product Related(10)** | **Total (25)** | |
| | | | |

# Practical No.28: Troubleshooting of Rotameter.

**I Practical Significance**

Troubleshooting of rotameter is a process of having a special outlook that comes out with remedies to repair it. The unexpected behavior exhibited by the rotameter is due to improper setting, damage due to ageing, faults, overheat, and so on. Such a type of behavior can cause undesired results or even set-up damage. With this experiment you are able to troubleshoot rotameter.

**II Relevant Program Outcomes (POs)**

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics technologies and tools with an understanding of the limitations.

**III Competency and Practical Skills**

This practical is expected to develop the following skills for the industry identified competency ***'Maintain electronic automated system in process and manufacturing industries'***:

i. Use advance test and measuring instrument.
ii. Select the instrument as per required range.

**IV Relevant Course Outcome(s)**

- Interpret working of various types of rotameter.

.

**V Practical Outcome**

Troubleshoot set-up that contains rotameter

**VI Relevant Affective domain related Outcome(s)**

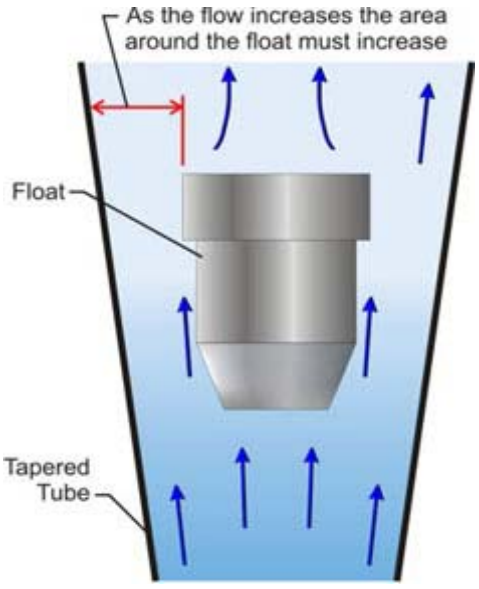
- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.

**VI Minimum Theoretical Background**

A system can be described in terms of its expected, desired or intended behavior. Events or inputs to the system are expected to generate specific results or outputs. Any unexpected or undesirable behavior is a symptom. Troubleshooting is the process of isolating the specific cause or causes of the symptom. Frequently the symptom is a failure of the product or process to produce any results. Corrective action can then be taken to prevent further failures of a similar kind.

## VII Practical set-up / Circuit diagram / Work Situation

### a) Sample




### b) Actual Circuit/ Experimental set up used in laboratory

## VIII Resources Required

| S. No. | Name of Resource | Suggested Broad Specification | Quantity |
|---|---|---|---|
| 1 | Rotameter | Various Material of Construction<br>Line Size from 15 NB to 80 NB<br>Heavy Duty Design with Maximum Visibility<br>Ranges between 2.0 LPH to 25000 LPH | 1No. |

## IX Precautions to be followed

1. Uninstall all physical components starting from power connections.
2. Clean dust from the components.
3. Perform a visual check or electronic check as required.
4. Reinstall all components carefully and properly

## X Procedure (Make changes in procedure according to the circuit available in your laboratory)

1 Check whether rotameter is mounted in vertical direction.
2 Check whether the fluid entering inside the tube is proper.
3 Check the type of fluid whose flow rate is to be checked.

## XI Resources Used

| S. No. | Name of Resource | Broad Specifications | | Quantity | Remarks (If any) |
|---|---|---|---|---|---|
| | | Make | Details | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |

## XII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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.....
.....

## XIII Observations and Calculations (draw observation table as per circuit available in your laboratory)

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**XIV Results**

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**XV Interpretation of Results (**Give meaning of the above obtained results)

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**XVI Conclusions (**Actions/decisions to be taken based on the interpretation of results).

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**XVII Practical Related Questions**

1 How does rotameter usually get damaged?

2 What are the different types of floats used?

3 What modifications are done for slurry liquids?

[Space for answers]

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## XIX References / Suggestions for further reading

www.rotameters.co.in/glass-tube-rotameter.html
https://www.omega.com/prodinfo/rotameters.html
www.uklindia.com/rotameter.html

## XX Suggested Assessment Scheme

| Performance indicators | | Weightage |
|---|---|---|
| **Process related: 15 Marks** | | **60%** |
| 1 | Handling of the instruments. | 10 % |
| 2 | Making connection of instrument. | 20 % |
| 3 | Measuring value using suitable instrument | 20 % |
| 4 | Working in team | 10 % |
| **Product related: 10 Marks** | | **40%** |
| 5 | Calculate theoretical values of given meter | 10 % |
| 6 | Interpretation of result | 05 % |
| 7 | Conclusions | 05 % |
| 8 | Practical related questions | 15 % |
| 9 | Submitting the journal in time | 05% |
| **Total (25 Marks)** | | **100 %** |

***Names of Student Team Members***

1. …….
2. …….
3. ……
4. ……..

| Marks Obtained | | | Dated signature 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 | 22101 |
| 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 | 22213 |
| 12 | Elements of Electrical Engineering | 22215 |
| 13 | Basic Electronics | 22216 |
| 14 | 'C' programming Language | 22218 |
| 15 | Basic Electronics | 22225 |
| 16 | Programming in "C" | 22226 |
| 17 | Fundamentals 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 Chemicals | 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 Measurements | 22420 |
| 12 | Digital Electronics And Microcontroller Applications | 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 |

## Fifth Semester:

| | | |
|---|---|---|
| 1 | Design of Steel and RCC Structures | 22502 |
| 2 | Public Health Engineering | 22504 |
| 3 | Heat Transfer Operation | 22510 |
| 4 | Environmental Technology | 22511 |
| 5 | Operating Systems | 22516 |
| 6 | Advanced Java Programming | 22517 |
| 7 | Software Testing | 22518 |
| 8 | Control Systems and PLC's | 22531 |
| 9 | Embedded Systems | 22532 |
| 10 | Mobile and Wireless Communication | 22533 |
| 11 | Industrial Machines | 22523 |
| 12 | Switchgear and Protection | 22524 |
| 13 | Energy Conservation and Audit | 22525 |
| 14 | Power Engineering and Refrigeration | 22562 |
| 15 | Solid Modeling and Additive Manufacturing | 22053 |
| 16 | Guidelines & Assessment Manual for Micro Projects & Industrial Training | 22057 |

## 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 |

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