I

Name _____

Roll No. _____ Year 20____20____

Exam Seat No. _____

MECHANICAL GROUP | SEMESTER - IV | DIPLOMA IN ENGINEERING AND TECHNOLOGY

A LABORATORY MANUAL

FOR

MECHANICAL ENGINEERING MEASUREMENTS (22443)

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

Mechanical Engineering Measurements

(22443)

Semester– (IV)

(ME)

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

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

Maharashtra State
Board of Technical Education

Certificate

This is to certify that Mr. / Ms …….

Roll No…….of Fourth Semester of Diploma in

…….of Institute

……..

(Code……..) has completed the term work satisfactorily in course **Mechanical Engineering Measurements (22443)** for the academic year 20…….to 20…..... as prescribed in the curriculum.

Place ……. Enrollment No……

Date:…..... Exam Seat No. …….....

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

Seal of the Institute

Preface

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

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

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

Measurement activities are given prime importance in industry. The art of measurement plays an important role in all branches of engineering. With advances in technology, measurement techniques have also taken rapid strides, with many types of instrumentation devices, innovations, refinements. The course aims at making a Mechanical Engineering diploma holder familiar with the principles of instrumentation, transducers and measurement of non-electrical parameters like temperature, pressure, flow, speed, force, torque for engineering applications.

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

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

Following POs and PSO are expected to be achieved through the practicals of the (Mechanical Engineering Measurement) course.

PO 1. **Basic knowledge :** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based mechanical engineering problems

PO 2. **Discipline knowledge:** Apply mechanical engineering knowledge to solve broad-based mechanical engineering related problems.

PO 3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based mechanical engineering problems.

PO 4. **Engineering tools:** Apply relevant mechanical technologies and tools with an understanding of the limitations

PO 5. **The engineer and society:** Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in field of mechanical engineering.

PO 6. **Environment and sustainability:** Apply mechanical engineering solutions also for sustainable development practices in societal and environmental contexts.

PO 7. **Ethics:** Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of mechanical engineering

PO 8. **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

PO 9. **Communication:** Communicate effectively in oral and written form.

PO 10. **Life-long learning:** Engage in independent and life-long learning activities in the context of technological changes also in the mechanical engineering and allied industry.

Program Specific Outcomes (PSOs)

PSO 1: Modern Software Usage: Use latest mechanical related software for simple design, drafting, manufacturing, maintenance and documentation of mechanical components and processes.

PSO 2: Maintenance and selection of machines, equipment, instruments: Maintain and select appropriate machine, equipment and instrument in field of Mechanical Engineering.

PSO 3: Manage Mechanical Process: Manage the mechanical process by selection and scheduling right type of machinery, equipment, substrates, quality control techniques, operational parameters and software for a particular mechanical process or job for economy of operations.

List of Industry Relevant Skills:

The following industry relevant skills of the competency 'Use relevant analogue and digital measuring devices in Mechanical Engineering related Applications' are expected to be developed in you by undertaking the practical of this laboratory manual.

1. Use relevant measuring devices for measuring various parameters Of machine components.
2. Measure the displacement, Force, Torque, Temperature of a given machine Component
3. Measure the Pressure, Temperature and flow of a given system.
4. Measure vibrations, sound, strain of a Machine component

****

Practical- Course Outcome matrix

Course Outcomes (COs)

a. Use relevant instrument for measuring displacement.
b. Use relevant instrument for measuring force and torque.
c. Use relevant pressure and temperature measuring instruments.
d. Use relevant instruments for measurement of flow.
e. Select relevant instruments for measurement of vibration and strain.
f. Select relevant instruments for speed and sound measurement

S. No.	Practical Outcome	CO a.	CO b.	CO c.	CO d.	CO e.	CO f.
1.	Identify contact and Non-Contact Type Instruments	√	-	-	-	-	-
2.	Calibration of LVDT transducer for displacementMeasurement	-	√	-	-	-	-
3.	Use Load cell to measure force on given system.	-	√	-	-	-	-
4.	Measure Force Using Eddy Current Dynamometer.	-	√	-	-	-	-
5.	Calibration of Bourdon's Tube Pressure gauge	-	-	√	-	-	-
6.	Measure Pressure using McLeod Gauge	-	-	√	-	-	-
7.	Calibration of Thermocouple	-	-	√	-	-	-
8.	Measure flow of liquid by Rotameter	-	-	-	√	-	-
9.	Measure flow of liquid by Ultrasonic Flow meter	-	-	-	√	-	-
10.	Calibration of Stroboscope.	-	-	-	-	√	-
11.	Measure Speed of Rotating Machine using Inductive Pick up	-	-	-	-	√	-
12.	Use of Vibration Meter for Measuring Vibration of Machine	-	-	-	-	√	-
13.	Use of Vibration Meter for Measuring Vibration of Structure	-	-	-	-	√	-
14.	Use Strain gauge To measure Strain induced on member	-	-	-	-	√	-
15.	Use Psychrometer to measure Air properties	-	-	-	-	-	√
16.	Use Sound Meter to measure sound level of a given system	-	-	-	-	-	√

Guidelines to Teachers

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

Instructions for Students

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

Content Page

List of Practical and Progressive Assessment Sheet

Note: To be transferred to Proforma of CIAAN-2017.

A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.

Practical No. 1 Identify contact and Non-Contact Type Instruments

I Practical Significance

Transducer is a device which converts one form of energy into another form like Electrical to Mechanical, Mechanical to Electrical, Thermal to Electrical and etc. Emphasis in the instrumentation trainers will be directed toward electronic instrumentation systems rather than mechanical systems. In most cases electronic systems provide better data more accurately, completely characterize the design or process being experimentally evaluated. Also the electronic system provides an electrical output signal that can be used for automatic data reduction or for the control of the process.

II Relevant Program Outcomes (POs)

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

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

PO4 -**Engineering tools:** Apply relevant mechanical technologies and tools with an understanding of the limitations

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency 'Use Relevant Analogue and digital measuring devices in Mechanical Engineering related applications*':*

1. Select relevant measuring instrument for measuring various mechanical properties of given machine components.

IV Relevant Course Outcome(s)

- Use relevant instrument for measuring displacement

V Practical Outcome

- Identify contact and Non-Contact Transducers

VI Relative Affective Domain-

- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.

VII Minimum Theoretical Background

Measuring Instruments are basically classified in to

1. Contact Type- A contact type instruments are those which make a physical contact with object to be measured.

2. Non-Contact Type- Theses instruments are those which do not make any physical contact with object to be measured

VIII Experimental setup

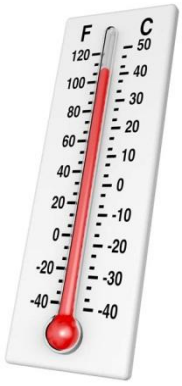

Fig No 1 Thermometer

Fig No2 Infrared Thermometer

Fig No 3 Rotameter

Fig No 4 Anemometer

Fig No 5 Digital Tachometer

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Thermometer	Alcohol Thermometer Range 0 ^{0}C to 300^{0}C	1
2.	Infra-red Thermometer	Range -30^{0}C to 1500^{0}C	1
3.	Steel Rule	Range 0 to 30 cm	1
4.	Bourdons Tube Pressure gauge	Range 0 to 12 bar	1
5.	Rota meter	0 to 40 Lit/min	1
6.	Anemometer	Max 50 m/sec	1
7.	Tachometer	Speed upto 1000rpm	1
8.	Infra red Tachometer	Speed upto 1000rpm	1

X Precautions to be Followed

1. Avoid improper handling of Measuring Instruments

XI Procedure

1. Measure displacement by Scale
2. Measure temperature of water using Thermometer
3. Measure temperature of water using Infrared Thermometer
4. Measure pressure of given system with the help of Bourden's Tube pressure gauge.
5. Measure flow rate of water using Rota meter
6. Measure velocity of air stream leaving from split air conditioner using Anamometer
7. Measure speed of electric motor using tachometer
8. Measure speed of electric motor using Infrared tachometer

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

S. No	Instruments	Type of Measurement
1	Thermometer	
2	Infra-red Thermometer	
3	Scale	
4	Bourdon's Tube Pressure gauge	
5	Rota meter	

6	Anemometer	
7	Tachometer	
8	Infra red Tachometer	

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. Identify Contact and Non-contact Measuring devices
2. List different Measuring devices available on I.C Engine test rig in your Power Engineering laboratory.

[Space for Answer]

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?reload=9&v=Ck2mfd0n0gE
2. www.youtube.com/watch?v=QItuf6lNvmI
3. www.youtube.com/watch?v=Y1mA50tEmLQ

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	40%
Product Related (15 Marks)		**(60%)**
2	Interpretation of result	20%
3	Conclusions	20%
4	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

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

Practical No.2: Calibration of LVDT Transducer for Displacement Measurement

I Practical Significance

LVDT works under the principle of mutual induction and the displacement which is a non-electrical energy is converted into an electrical energy. LVDT consists of a cylindrical former where it is surrounded by one primary winding in the center of the former and the two secondary windings at the sides. The number of turns in both the secondary windings are equal, but they are opposite to each other i.e., if the left secondary windings is in the clockwise direction, the right secondary windings will be in the anti-clockwise direction, hence the net output voltages will be the difference in voltages between the two secondary coil.

II Relevant Program Outcomes (POs)

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

PO2 **- Discipline knowledge:** Apply mechanical engineering knowledge to solve broad-basedmechanical engineering related problems.

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

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

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'**Use Relevant Analogue and digital measuring devices in Mechanical Engineering related applications*:*

1. Use LVDT transducer for Displacement measurement

IV Relevant Course Outcome(s)

- Use relevant instrument for measuring displacement

V Practical Outcome

- Use inductive transducer to measure displacement

VI Relative Affective Domain-

- Practice energy conservation.
- Demonstrate working as a leader/a team member.

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VII Minimum Theoretical Background

Differential transformers works on a variable inductance principle, are also used to measure displacement. The most popular variable inductance transducer for linear displacement measurement is the Linear Variable Differential Transformer (LVDT). The LVDT consists of three symmetrically spaced coils would on to an insulated

bobbin. A magnetic core moves through the bobbin without contact, provides a path for magnetic flux linkage between coils. The position of the magnetic core controls the mutual inductance between the center or primary coil and with the two outside of secondary coils.

When an AC carrier excitation is applied to the primary coil, voltages are induced in the two secondary coils that are wires in a series-opposing circuit. When the core is centered between the two secondary coils, the voltage induces between the secondary coils are equal but out of phase by 180^{o}. The voltage in the two coil cancels and the output voltage will be zero. When the core is moves from the center position, an imbalance in mutual inductance between the primary coil and the secondary coil occurs and an output voltage develops. The output voltage is a linear function of the core position as long as the motion of the core is within the operating range of the LVDT

VIII Experimental setup

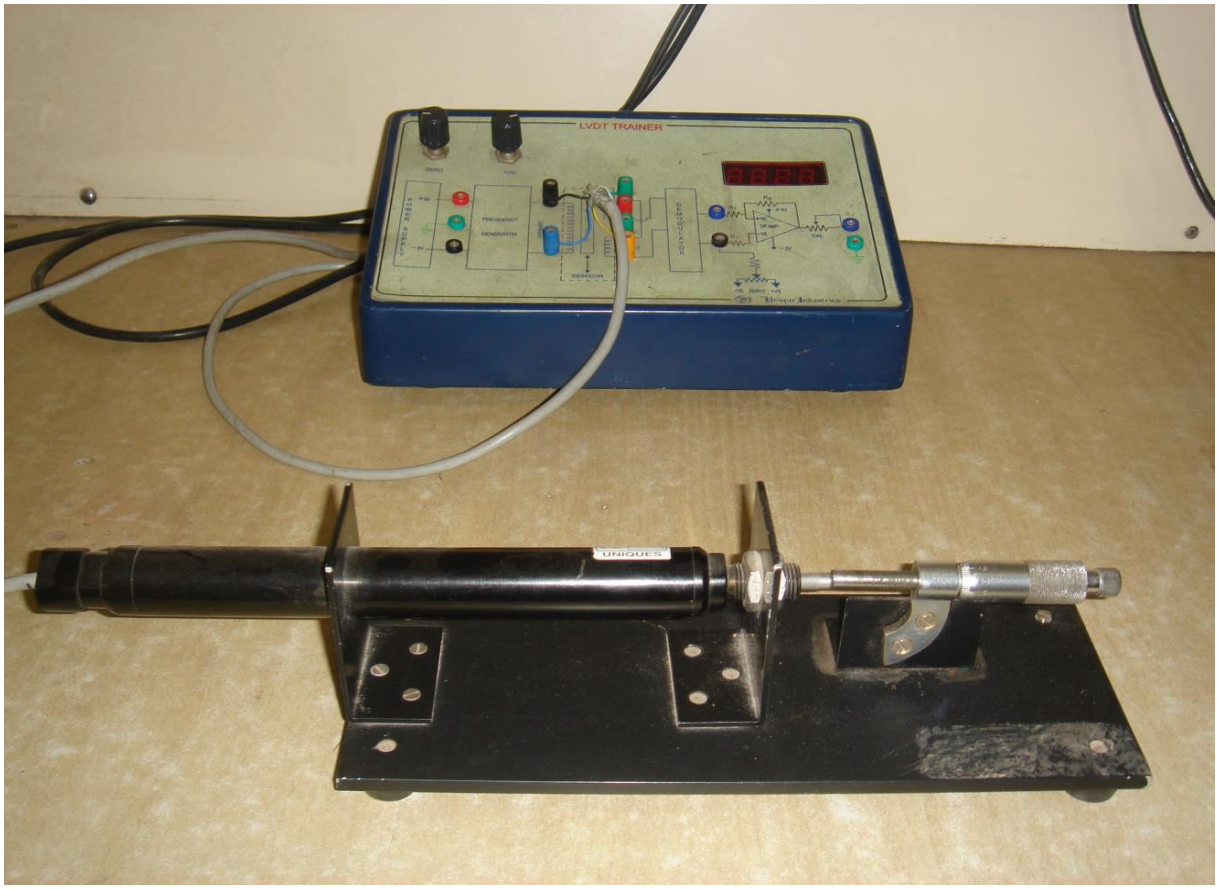

Figure-1

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Inductive transducer-	Measurement range -0 to 100 mm -Sensor- inductive (non linear) solenoid type on board with micrometer, micrometer screw gauge assembly for displacement, bridge balance type circuit Display 3.5 digit digital display	1

X Precautions to be Followed

1. Avoid improper handling of Transducer

XI Procedure

1. Connect the power supply chord at the rear panel to the 230V 50Hz supply.
2. Switch ON the instrument by pressing down the toggle switch. The display glows to indicate the instrument is ON.
3. Allow the instrument in ON position for 10 minutes for initial warm-up.
4. Rotate the micrometer till it reads “20.0”.
5. Adjust the potentiometer at the front panel so that the display reads “10.0”
6. Rotate the core of micrometer till the micrometer reads “10.0”
7. Adjust the ZERO potentiometer till the display reads “00.0”.
8. Rotate back the micrometer core upto 20.0
9. Adjust once again Potentiometer till the display read.
10. As the core of LVDT moves the display reads the displacement in mm.
11. Rotate the core of the micrometer in steps of 1 or 2 mm
12. Tabulate the readings.
13. Tabulate the readings and Plot the graph of Actual V/s indicator readings

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

S N	Actual Micrometer Reading (mm)	Indicator Reading (LVDT)(mm)	Error	% Error
1				
2				
3				
4				
5				

Error = (Actual Scale Reading- Indicator Scale Reading)

% Error = (Error/ distance of Step) *100

XVI Results

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XVII Interpretation of Results

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Scale
X-axis -
Y-axis -

XVIII Conclusions

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XIX Practical Related Questions

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

1. Write specifications of LVDT
2. List the causes of errors in displacement Measurement

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?reload=9&v=Ck2mfd0n0gE
2. www.youtube.com/watch?v=QItuf6lNvmI
3. www.youtube.com/watch?v=Y1mA50tEmLQ

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40 %)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

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

Practical No. 3: Use Load Cell to Measure Force On Given System.

I Practical Significance

Load cell is a force Transducer, which can be used to measure force or weight through the deflection. Load cells are available in different types- Mechanical, Hydraulic, Pneumatic and strain Gauge load cells.

II Relevant Program Outcomes (POs)

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

PO2 - **Discipline knowledge:** Apply mechanical engineering knowledge to solve broad-Based mechanical engineering related problems.

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

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency ‘‘Use Relevant Analogue and digital measuring devices in Mechanical Engineering related applications.’

1. Compare different types of load cell
2. Select load cell for relevant application

IV Relevant Course Outcome(s)

- Use relevant instrument for measuring force and torque

V Practical Outcome

- Use Load cell to measure force on given system.

VI Relative Affective Domain-

- Demonstrate working as a leader/a team member.

VII Minimum Theoretical Background

Load cells are force transducers as they convert force in to electrical signals. Strain Gauges are ultra thin heat treated metallic foils and chemically bonded to a thin elastic layer. Load cells consists of steel cylinder which has four identical strain gauges mounted upon it . These four gauges are connected to four limbs of Wheatstone bridge circuit.

VIII Experimental setup

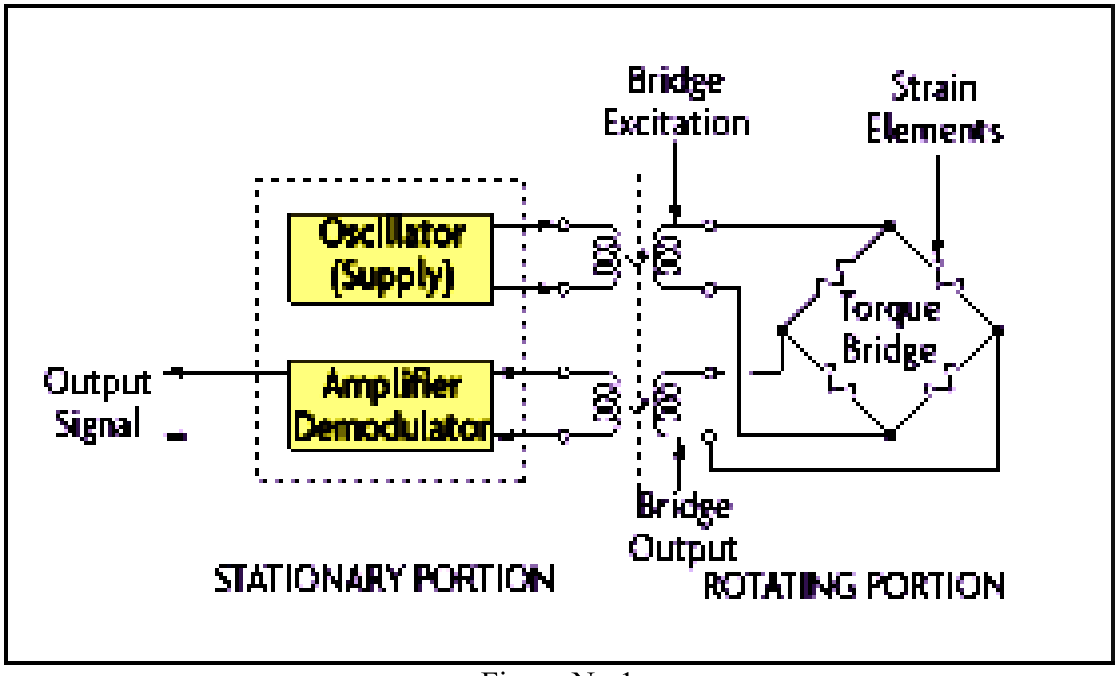

Figure No 1

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	4 arm bridge with strain gauge	Capacity Minimum 2 Kg	1
2.	Dead weights	1Kg to 50 kg	10
3.	Display	digital	1

X Precautions to be Followed

1. Avoid improper handling of instrument

XI Procedure

1. Make connections to load cell
2. Switch ‘ON’ unit
3. Check initially the output in ‘Zero’
4. Put dead weights on platform
5. Note readings
6. Increase load on load cell
7. Take five readings with specific load

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

S N	Applied Load (kg)	Output Load Cell readings (Kg)	Difference
1			
2			
3			
4			
5			

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. Write Specification of Load Cell available in the laboratory
2. State the causes of Errors in Load cell readings during Practical

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XX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=nMaeVfu5_Bw
2. https://www.youtube.com/watch?v=nGUpzwEa4vg&t=96s
3. https://www.youtube.com/watch?v=wk906FPmrgM

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	40%
Product Related (15 Marks)		**(60%)**
2	Interpretation of result	20%
3	Conclusions	20%
4	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

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

Practical No. 4: Measure Force Using Eddy Current Dynamometer.

I Practical Significance

Eddy current Dynamometer operates on the principle that when an isolated conductor moves through a magnetic flux, voltage is induced and current flows in the conductor. Theses current called Eddy current.

II Relevant Program Outcomes (POs)

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

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

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use Measurement and control of Relevant Equipment'***:

1. Use relevant measuring instrument for measuring various mechanical properties of machine complements
2. Use of Eddy Current Dynamometer.

IV Relevant Course Outcome(s)

- Use relevant instrument for measuring force and torque

V Practical Outcome

- Use Eddy Current Dynamometer to measure tangential force.

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VII Minimum Theoretical Background

A toothed steel rotor is mounted on to the shaft of the machine whose Tangential force is to be measured. It rotates inside a smooth bared cast iron stator having less clearance between stator and rotor. The rotor carries an exciting coil which is energized with a D C supplied from an external source. The stator is cradled on antifriction terminus and is provided with a brake arm to which scale or spring balance is attached.

VIII Experimental setup

Figure No 1 Experimental set up of eddy current dynamometer

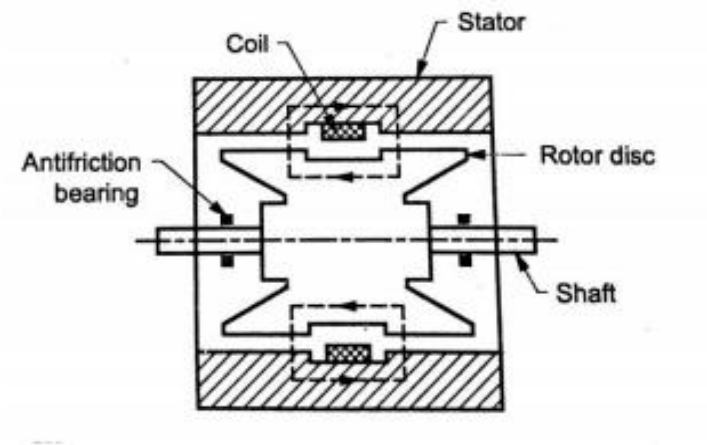

Figure No 2 Basic Features Dynamometer

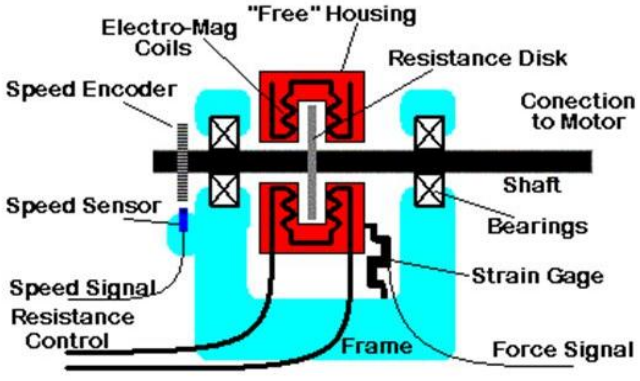

Figure No 3 Constructional Features of Eddy Current dynamometer

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Eddy Current Dynamometer	Power rating: 0.18 kW to 55 kW,Max Speed: 4,000 RPM;	1
2.	Speed Sensor:	60-Tooth wheel with Magnetic Speed Pick up Sensor	2
3.	Torque Indicator: Spring Balance OR Digital Indicator with Zero, Span, Calibration presets;	Max Torque: 100 kgm(1000 Nm);	2
4.	Torque Sensor:	Spring Balance with Pulley and rope, Load cell or Rotary Torque Sensor;	2

X Precautions to be Followed

1. Avoid improper handling of Transducer
2. Don’t apply excessive pressure on tips of Transducer .

XI Procedure

1. Connect dynamometer to load cell
2. Switch ‘ON’ unit
3. Check initially the output in ‘Zero’
4. Put dead weights on platform
5. Note readings
6. Increase load on load cell
7. Take five readings with specific load

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

S N	Engine speed *N* (rpm)	Shaft power (W)	Torque N-m	Force N	Remarks (If any)
1					
2					
3					
4					
5					

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. Write Specifications of Eddy Current dynamometer used in the practical
2. State the Voltage induced in Eddy Current dynamometer used in the practical

[Space for Answer]

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XX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=nMaeVfu5_Bw

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …….
2. …….
3. …….
4. …….

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

Practical No. 5: Calibration of Bourdon's Tube Pressure gauge.

I Practical Significance

Transducers that measure force, torque or pressure usually contains an elastic member that converts the quantity to be measured to a deflection or strain. A deflection sensor or, alternatively, a set of strain gauges can be used to measure the quantity of interest (force, torque or pressure) indirectly. Characteristics of transducers, such as range, linearity and sensitivity are determined by the size and shape of the elastic member, the material used in its fabrication. A wide variety of transducers are commercially available for measuring force, torque and pressure.The different elastic member employed in the design of these transducer include link, columns, rings, beams, cylinders, tubes, washers, diaphragms, shear webs and numerous other shapes of special purpose applications. Strain gauges are usually used as sensors; however linear variable differential transformers (LVDT) and linear potentiometers are sometime used for static or quasistatic measurement.

II Relevant Program Outcomes (POs)

PO1 - Basic knowledge: Apply knowledge of basic mathematics, sciences and basic Engineering to solve the broad-based Mechanical Engineering problems.

PO 2 -Discipline knowledge: Apply mechanical engineering knowledge to solve broad-Based mechanical engineering related problems

PO3 - Experiments and practice: Plan to perform experiments and practices to use the results to solve broad-based Mechanical Engineering problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency *'*Use Relevant Analogue and digital measuring devices in Mechanical Engineering related applications*':*

1. Use of Pressure gauges

IV Relevant Course Outcome(s)

- Use relevant instrument for measuring force and torque

V Practical Outcome

- Use Bourdon's Tube Pressure gauge measure pressure in a given system. .

VI Relative Affective Domain-

- Demonstrate working as a leader/a team member.

VII Minimum Theoretical Background

Pressure cells are divisors that convert pressure into electrical signal through a measurement of either displacement strain or Piezoelectric response. Diaphragm type pressure transducers with strain gauges as sensor is used here for measurement of pressure. This type of pressure transducers uses diaphragm as the elastic element.

Diaphragms are used for low and middle pressure ranges. Strain gauges are bonded on the diaphragm and the pressure force is applied to the specimen. The material gets elongated or compressed due to the force applied i.e., the material get strained. The strain incurred by the specimen depends on the material used and its elastic module. This strain is transferred to the strain gauges bonded on the material resulting in change in the resistance of the gauge. Since the strain gauges are connected in the form of Whetstones Bridge any change in the resistance will imbalance the bridge. The imbalance in the bridge will inturn gives out the output in mV proportional to the change in the resistance of the strain gauge.

VIII Experimental setup

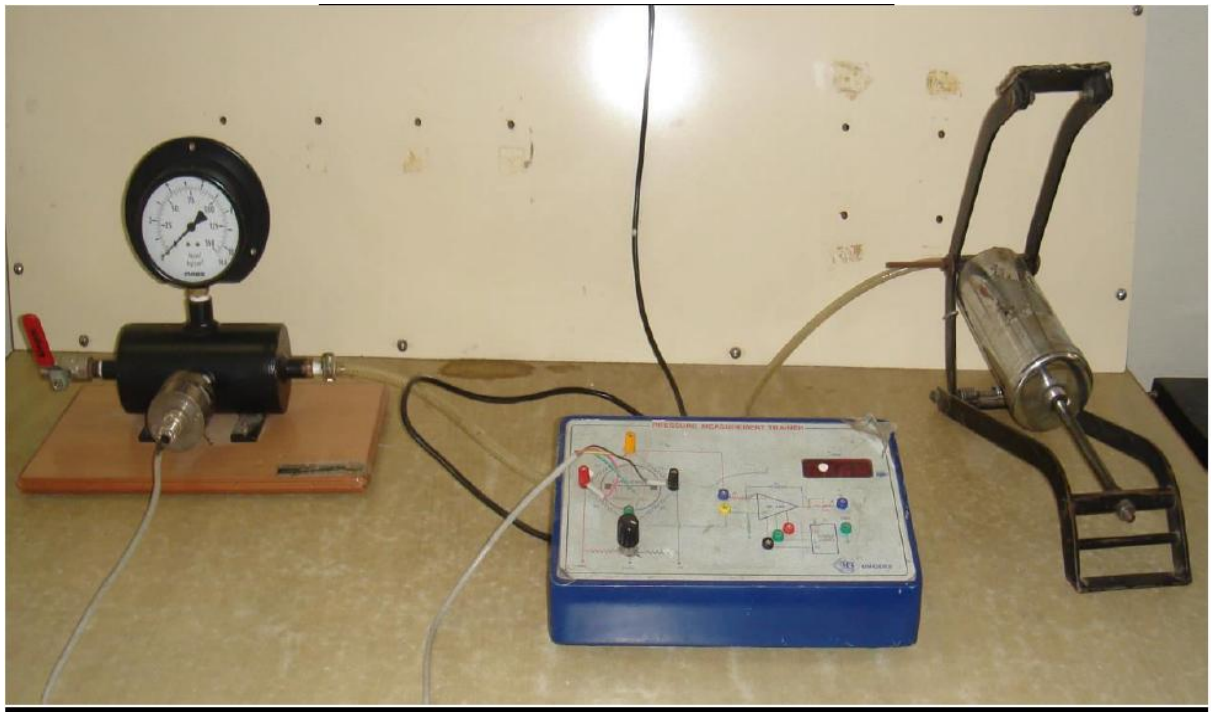

Figure No 1

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Strain gauges bonded on steel diaphragm for pressure measurement	Bourdon's Gauge (Max 10 bar), 3 ½ digit seven segment LED display is used for the indicator of 200mV full scale deflection to read +/- 1999, Front panel zero adjustment through Potentiometer, 230CV D C	01

X Precautions to be Followed

1. Avoid improper handling of Transducer
2. Don't apply excessive pressure on tips of Transducer.

XI Procedure

1. Switch ON the instrument by rocker switch at the front panel.
2. The display glows to indicate the instrument is ON.
3. Allow the instrument in ON Position for 10 minutes for initial warm-up.
4. Adjust the Potentiometer in the front panel till the display reads "000"
5. Apply pressure on the sensor using the loading arrangement.
6. The instrument reads the pressure Display through LED.

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

SR No	Actual Pressure (bar)	Indicator Pressure (bar)	Error	% Error
1				
2				
3				
4				
5				

% Error = (Error/ Max. Load) *100

Plot Graph- Actual Reading V/S Indicator Reading


Scale
X-axis -
Y-axis -

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. List different Bourden's Tube pressure gauges on the basis of measuring Range
2. Name the material used for elliptical tube of Bourdons Pressure gauge

[Space for Answer]

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XX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=CSL2B91bjHk
2. https://www.youtube.com/watch?v=Ja_XCJAg_l8

XXI Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

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

Practical No. 6: Measure Pressure Using Mcleod Gauge

I Practical Significance

A McLeod Gauge is a Scientific instrument used to measure very low pressure up to 10^{-6}torr.Pressure of gases containing vapors can not normally measures with McLeod gauge, for this purpose compression is needed to condensate the vapors. Mcleod gauge generally used for calibration purpose.

II Relevant Program Outcomes (POs)

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

PO 2 - **Discipline knowledge:** Apply mechanical engineering knowledge to solve broad-Based mechanical engineering related problems

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

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency *'*Use Relevant Analogue and digital measuring devices in Mechanical Engineering related applications*':*

1. Use of Pressure gauges

IV Relevant Course Outcome(s)

- Use relevant instrument for measuring force and torque

V Practical Outcome

- Use McLeod gauge for measuring pressure in a given system. .

VI Relative Affective Domain-

- Practice good housekeeping.
- Practice energy conservation.

VII Minimum Theoretical Background

McLeod gauge woks on principle, Compression of known volume of low pressure gas to higher pressure and measuring resulting volume and pressure. McLeod gauges operate by taking in a sample volume of gas from a vacuum chamber, then compressing it by tilting and infilling with mercury. The pressure in this smaller volume is then measured by a mercury manometer, and knowing the compression ratio (the ratio of the initial and final volumes), the pressure of the original vacuum can be determined by applying Boyle's law.

VIII Experimental setup

Figure.1

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Bourdon's pressure Gauge	-1 to 2 bar	01
2.	Mcleod Gauge	Range 0.01 mm to 50 mm of Hg	01
3.	Vacuum Pump		01

X Precautions to be Followed

1. Avoid improper handling of gauge

XI Procedure

1. Note down Atmospheric Pressure.
2. Start Vacuum Pump for 10 minutes for creating Vacuum in Chamber
3. Note down pressure in the chamber with the help of Pressure gauge
4. Connect Mcleod gauge
5. Raise the Mercury level until it reaches to Zero reference line
6. Note down reading of volume remaining in the capillary from the scale
7. Note down difference in height of two column

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

P_1 = unknown Pressure

a = Area of capillary in mm^2

V_1 = Initial Volume (Volume of bulb + Volume of capillary)

P_f = Final amplified pressure

$P_f = P_1 h$

V_f = Final Volume of gas in capillary after compression in mm^2

$$V_f = (a \times h)$$

$$P_1 V_1 = P_f V_f$$

$$P1 = \frac{ah^2}{V1 - ah}$$

If Final Volume=V_f = ah

$$P1 = \frac{ah^2}{V1}$$

1. Volume of bulb = mm^3
2. Volume of Capillary = mm^3
3. Initial Volume V_f = Volume of Bulb + Volume of Capillary = mm^3
4. Cross Sectional area of Capillary Tube = mm^2

SR No	Bourdon's Pressure gauge Reading in mm of Hg	McLeod Gauge Reading		
		Difference in height of two column 'h' in mm	Final Volume V_1 =(a x h) mm^2	Initial Pressure P_1 in mm of Hg
1				
2				
3				
4				

Difference in height of Two Column (h) = mm

$P_1V_1 = P_fV_f$

V_f= mm^3

$P_f = P_1 + h$=

V_f=a. h

P_1= $P_f \times V_f / V_1$ = mm of Hg

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. List the applications of Vacuum in Mechanical Industry
2. State the function of Vacuum pump used in the practical

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?v=7SyrkSuA0dE
2. www.youtube.com/watch?v=WbXN0U4oUJA

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

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

Practical No. 7: Calibration of Thermocouple.

I Practical Significance

Thermocouple is a active transducer which generates e.m.f. It is simple electrical temperature sensitive device. It provides a reliable method of temperature measurement. It is widely used in industrial applications to monitor temperature of liquid and gaseous in storage and pipes.

II Relevant Program Outcomes (POs)

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

PO 2 **-Discipline knowledge:** Apply mechanical engineering knowledge to solve broad-based mechanical engineering related problems

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

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency ‘‘Use Relevant Analogue and digital measuring devices in Mechanical Engineering related applications*’:*

1. Use of Temperature Measuring Instruments

IV Relevant Course Outcome(s)

- Use relevant instrument for measuring Temperature of given system

V Practical Outcome

- Use liquid in glass Thermometer and Thermocouple to measure temperature.

VI Relative Affective Domain-

- Follow safety practices.
- Practice energy conservation.

VII Minimum Theoretical Background

Thermocouple basically consist of two dissimilar metallic wires connected together so as to form two junctions. One junction is kept at constant temperature (cold junction) and other is heated (hot junction).

VIII Experimental setup

Figure No 1

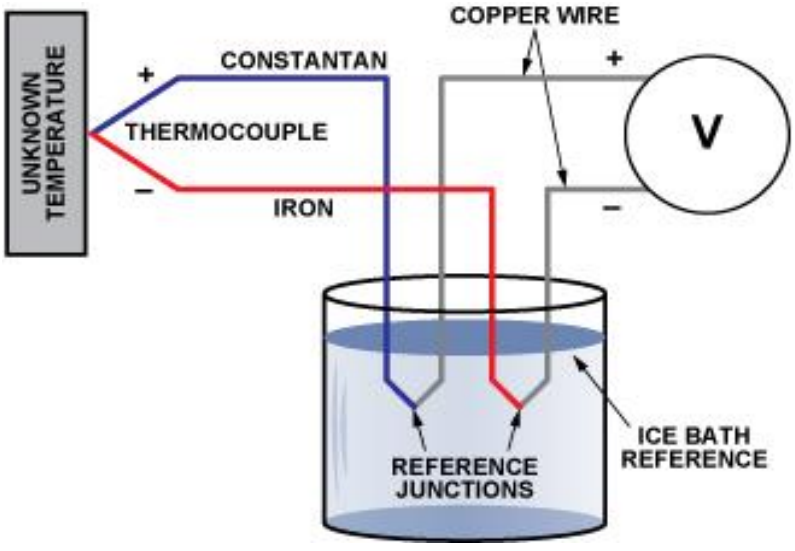

Figure No 2

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Thermocouple Set up assembly with heating arrangement	Thermocouple, Liquid in gas Thermometer, Vessel for hot and cold junction, millimeter. Induction heater.	1
2.	Display	3.5 digital display	1
3.	Power supply	12V, 500 mA to drive A to d converter	1

X Precautions to be Followed

1. Avoid improper handling of Thermocouple

XI Procedure

1. Immerse Thermocouple hot junction and cold junction in the pan
2. Place Thermometer at hot pot
3. Keep system in 'ON' position for 10 minutes
4. Note down the temperature of Thermometer and indicator
5. Note down the E M F reading with the help of Multi meter

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Sr No	Indicator Reading using Thermocouple	EMF generated Millivolt	Actual Temperature by Thermometer ^{o}C
1			
2			
3			
4			
5			

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. Name material used for thermocouple
2. List different temperature measuring devices available in the laboratory with their specifications

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?v=Xp7ZNAc9Fis
2. www.youtube.com/watch?v=ODdzZLkQL98
3. www.youtube.com/watch?v=xaxGZZR21sc

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	40%
Product Related (15 Marks)		**(60%)**
2	Interpretation of result	20%
3	Conclusions	20%
4	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……
2. ……
3. ……
4. …….

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

Practical No. 8: Measure flow of liquid by Rotameter.

I Practical Significance

In variable flow meters, the flow restrictions are of fixed size and the differential pressure across it changes with the flow rate. Rotameters are most commonly used form of variable area flow meters. The basic principles, The pressure differential across the orifice is proportional to the square of its flow area and square of the flow rate.

II Relevant Program Outcomes (POs)

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

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

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'**Use Relevant Analogue and digital measuring devices in Mechanical Engineering applications.

1. Use of flow Measuring Instruments

IV Relevant Course Outcome(s)

- Use relevant instrument for measurement of Flow

V Practical Outcome

- Use Rotameter to measure flow

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.

VII Minimum Theoretical Background

Rota meter is a device that measures the flow rate of liquid in a closed tube. It is the variable area flow meter where pressure drop at the inlet and outlet is kept constant by changing the annular area. It is always installed vertically as flow measurement is done from lower level to upper level

VIII Experimental setup

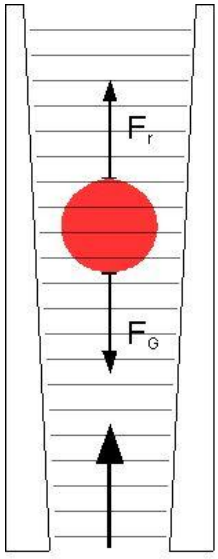

Figure .1 Principle of Rotameter

Figure .2 Rotameter

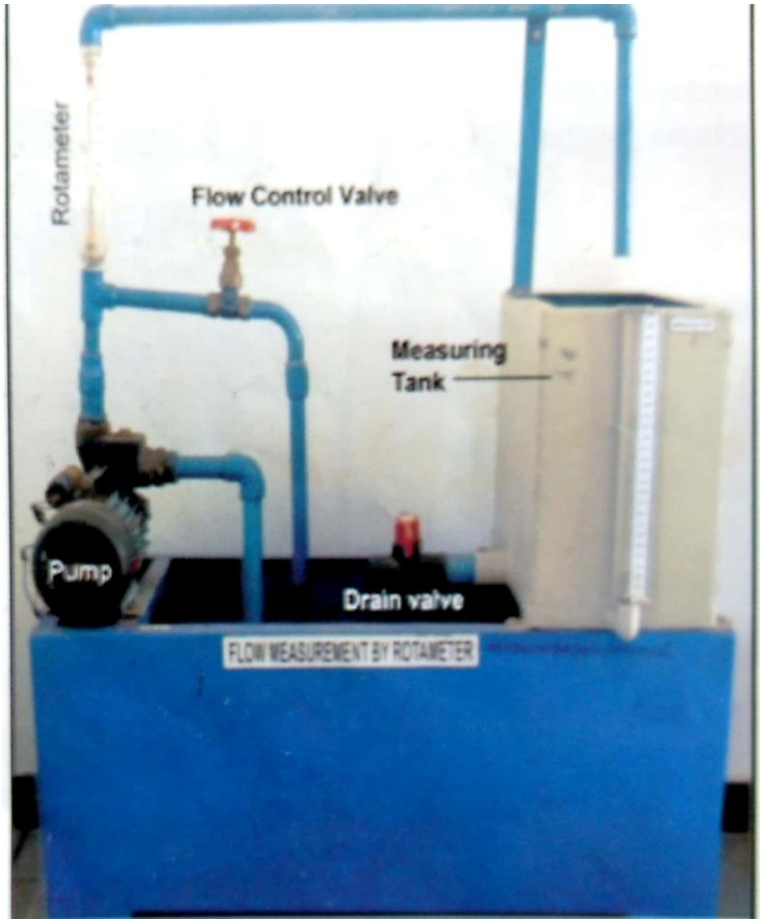

Figure 3- Experimental set up of Flow meaurement using Rotameter

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Hydraulic Bench with Rotameter	Measuring Tank, Flow control Valve	1

X Precautions to be Followed

1. Avoid improper handling of flow control valve

XI Procedure

- Start the flow of water by opening the flow control valve
- Float starts rising
- Rising and Falling action of float depends on rate of flow
- Note down the readings
- Note down the flow in the Discharge tank

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Sr No	Rotameter Reading Lit/Min(LPM)	Actual Flow in the discharge tank LPM	Difference
1			
2			
3			
4			
5			

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. State the working principle of rotameter
2. Write the specification of Rotameter used in practical

[Space for Answer]

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?v=ELJoieQDe6w
2. www.youtube.com/watch?v=peQdiWlfFUg

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	40%
Product Related (15 Marks)		**(60%)**
2	Interpretation of result	20%
3	Conclusions	20%
4	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……
2. ……
3. ……
4. …….....

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

Practical No. 9: Measure flow of liquid by Ultrasonic Flow meter.

I Practical Significance

An ultrasonic flow meter is a type of flow meter that measures the velocity of a fluid with ultrasound to calculate volume flow. Using ultrasonic transducers, the flow meter can measure the average velocity along the path of an emitted beam of ultrasound, by averaging the difference in measured transit time between the pulses of ultrasound propagating into and against the direction of the flow or by measuring the frequency shift from the Doppler effect. Ultrasonic flow meters are affected by the acoustic properties of the fluid and can be impacted by temperature, density, viscosity and suspended particulates depending on the exact flow meter.

II Relevant Program Outcomes (POs)

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

PO 2-**Discipline knowledge:** Apply mechanical engineering knowledge to solve broad-Based mechanical engineering related problems

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

PO4 **-Discipline knowledge:** Apply mechanical engineering knowledge to solve broad-based mechanical engineering related problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency 'Use Relevant Analogue and digital measuring devices in Mechanical Engineering related applications'

1. Use of flow Measuring Instruments

IV Relevant Course Outcome(s)

- Use relevant instrument for measurement of Flow

V Practical Outcome

- Use Ultrasonic Flow meter to measure flow

VI Relative Affective Domain-

- Practice good housekeeping.

VII Minimum Theoretical Background

Ultrasonic flow meters measure the difference of the transit time of ultrasonic pulses propagating in and against flow direction. This time difference is a measure for the average velocity of the fluid along the path of the ultrasonic beam. By using the absolute transit times both the averaged fluid velocity and the speed of sound can be calculated.

VIII Experimental setup

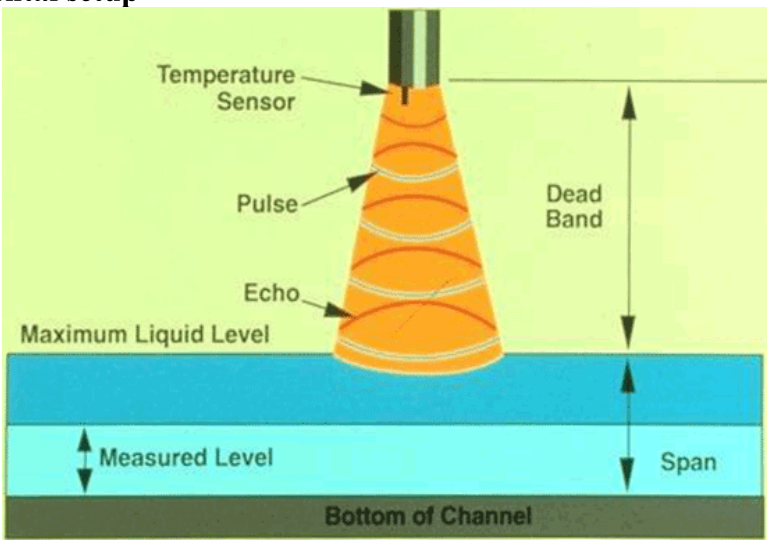

Figure No 1 Principle of Ultrasonic Flow meter

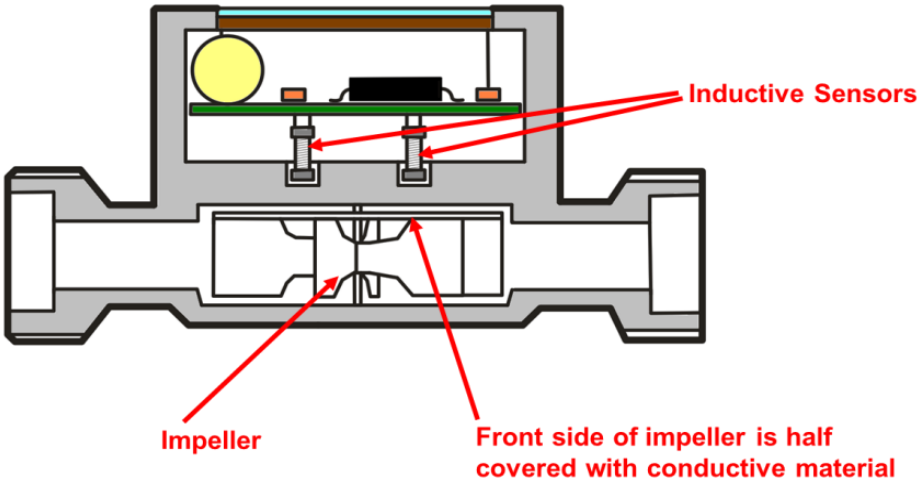

Figure No 2 - Constructional feature of Ultrasonic Flow meter

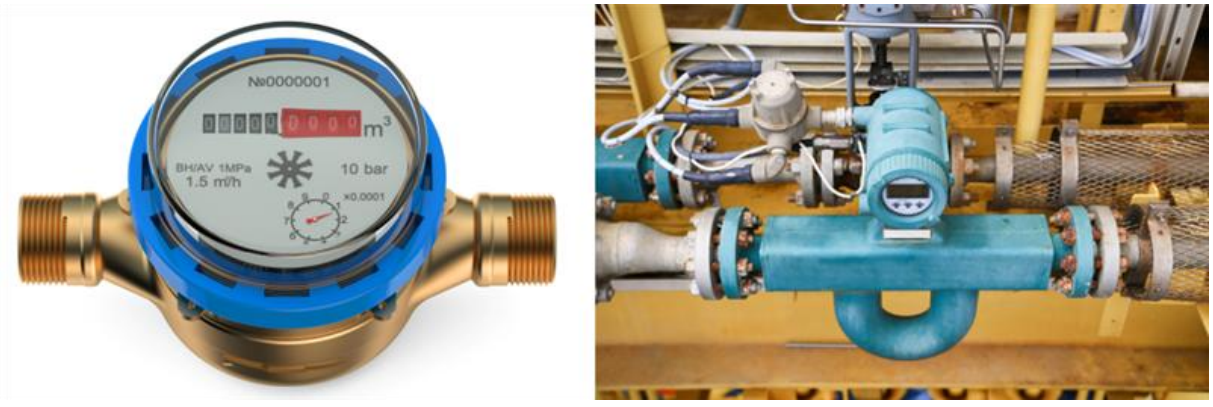

Figure No 3 -Experimental set up of Flow meaurement using Ultrasonic flow meter

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Portable Ultrasonic Flow meter	Accuracy: ±1% of reading >(0.2m/s) 0.6 ft/s Repeatability: 0.2% Linearity: 0.5% Response Time: 0 to 999 seconds (user configured) Velocity: (±0.01 to 30 m/s) ±0.03 to 105 ft/s bi-directional Temperature Range: Standard: 0 to 70°C (32 to 158°F) With High Temp Transducers: 0 to 160°C (32 to 320°F) Transducer Frequency: 1 MHz Totalizer: 7-digit totals for positive, negative and net flow lock-out code Display: 4 x 16 English letters Communications: RS232C (baud rate from 75 to 115,200 bps) Transducer Cable Length: 5 m (15') Power: 3 "AAA" Ni-H built-in batteries (included) with 90 to 230 Vac charger, fully charged lasts over 12 hrs	1

X Precautions to be Followed

1. Avoid improper handling of flow control valve

XI Procedure

- Place Electromagnetic Transducers at a ‘X’ distance over a pipe
- Note down the length between Transducer
- Start Supply of water through the pipe
- Record the pulses from Transducers
- Note down the transit time
- Vary the supply of water through pipe and repeat the process for 5 times

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Time for Down Streaming $t_d = \frac{L}{c + V\cos\theta}$

Time for Up Streaming $t_u = \frac{L}{c - V\cos\theta}$

t_d = Downstream Transit Time between Transducer 'A' and Transducer 'B'

t_u = Up stream Transit Time between Transducer 'B' and Transducer 'A'

L = Path length in meter

X = Axial length between Transducers in meter

θ = Angle between Sound Direction and flow direction

c = speed of sound In the liquid

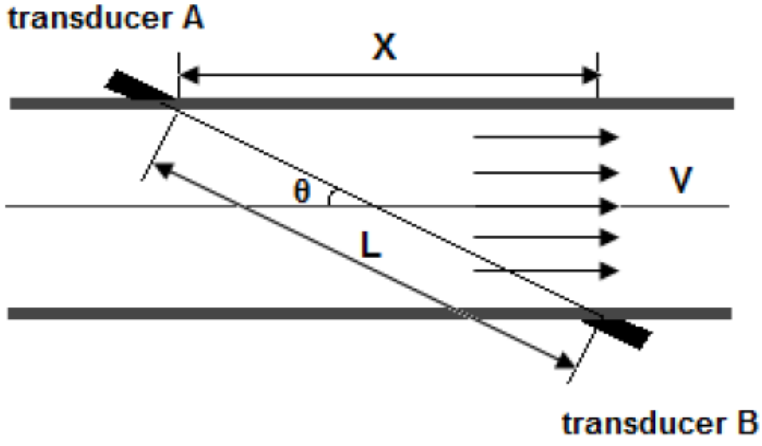

Fig no.4

$$\text{Cos } \theta = X/L$$

Average Velocity of Flow = V = [$L^2(t_u - t_d)$ / 2 X. $t_u.t_d$]

Sr No	Downstream Transit Time t_d (sec)	Upstream Transit Time (t_u) (sec)	Speed of sound (c)	Average Velocity of Flow (m/s)
1				
2				
3				
4				
5				

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. List any five applications of ultrasonic flow meter
2. Distinguish between rotameter and ultrasonic flow meter w.r.t accuracy

[Space for Answer]

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?v=Bx2RnrfLkQg
2. www.youtube.com/watch?v=vopAJLuHwJY
3. www.youtube.com/watch?v=DD2bBLu6kLM

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……
2. ……
3. …….
4. ……..

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

Practical No. 10: Calibration of Stroboscope.

I Practical Significance

Speed of an object is the magnitude of its velocity. Speed is either measured for linear movements or for rotational movement. Stroboscope utilizes the phenomenon of vision when the object is viewed intermittently.

II Relevant Program Outcomes (POs)

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

PO 2-**Discipline knowledge:** Apply mechanical engineering knowledge to solve broad- based mechanical engineering related problems

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

PO4 -Discipline knowledge: Apply mechanical engineering knowledge to solve broad-based mechanical engineering related problems

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency *'*Use Relevant Analogue and digital measuring devices in Mechanical Engineering related applications*':*

1. Use of Speed Measuring Instruments

IV Relevant Course Outcome(s)

- Use relevant instrument for measurement of speed

V Practical Outcome

- Use of Stroboscope to measure speed of Rotating shaft

VI Relative Affective Domain-

- Follow safety practices.

VII Minimum Theoretical Background

Stroboscope consist of whirling disc attached to a motor whose speed can be varied and measured. A reference mark on the rotating shaft is observed through an opening in the rotating disc. The speed of disc is adjusted until the mark on the shaft appears to be stationary.

VIII Experimental setup

Figure 1 Stroboscope

IX Resources Required

S. No	Name of Resource	Suggested Broad Specification	Quantity
1.	Stroboscope	• Course and fine flash rate adjustments to freeze and analyze rotating objects • Battery operation brings motion analysis to any location • Unique display features characters that reverse direction depending on measurement mode • Large 0.4" (10mm) 5 digit LCD display • Microprocessor based with quartz crystal oscillator to maintain high accuracy • Tachometer memory stores last, max, and min readings	1
2.	Tachometer	Range 0 to 4000 RPM	01

X Precautions to be Followed

1. Avoid improper handling of flow control valve

XI Procedure

- Make a dark mark on the end section of rotating element
- Switch on Stroboscope
- Allow circular disc to attain constant speed by varying the rpm
- Switch 'ON' the stroboscope
- Flash frequency is gradually increased from Zero until the rotating member appears to be stationary.
- Note down the reading
- Note down reading of rotating member with help of Tachometer
- Take five different readings

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Sr No	Actual Speed using Tachometer (rpm)	Stroboscope Reading (rpm)	Error
1			
2			
3			
4			
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XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. Justify, is it possible to use Stroboscope for speed measurement of 100 to 200 rpm.
2. Write Technical Specification of Stroboscope used in practical

[Space for Answer]

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?v=ngFZN3llqnU
2. www.youtube.com/watch?v=OBRu3Vx1H68

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	40%
Product Related (15 Marks)		**(60%)**
2	Interpretation of result	20%
3	Conclusions	20%
4	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. ……
3. ……
4. …….

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

Practical No. 11: Measure Speed of Rotating Machine using Inductive Pick up.

I Practical Significance

Inductive pick up is a non-contact type of Tachometer. It consists of permanent magnet with a coil wound on it. This pick up is placed near a metallic toothed rotor whose speed is to be measured. As the shaft rotates , the teeth pass in front of the pick-up and produce a change in the reluctance of the magnetic circuit.

II Relevant Program Outcomes (POs)

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

PO 2-**Discipline knowledge:** Apply mechanical engineering knowledge to solve broad- based mechanical engineering related problems

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

PO4 -Discipline knowledge: Apply mechanical engineering knowledge to solve broad-engineering related problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency 'Use Relevant Analogue and digital measuring devices in Mechanical Engineering related applications'

1. Use of Speed Measuring Instruments

IV Relevant Course Outcome(s)

- Use relevant instrument for measurement of speed

V Practical Outcome

- Use of inductive pick up to measure speed of Rotating Machine

VI Relative Affective Domain-

- Follow safety practices.

VII Minimum Theoretical Background

As shaft Rotates, pulses generates due to passing of tooth. As Magnetic field expands and collapses and voltage induced in the coil. The frequency of pulses depends on the number of teeth on the wheel and its speed of rotation. Speed of rotation can be determined by measuring pulse frequency.

VIII Experimental setup

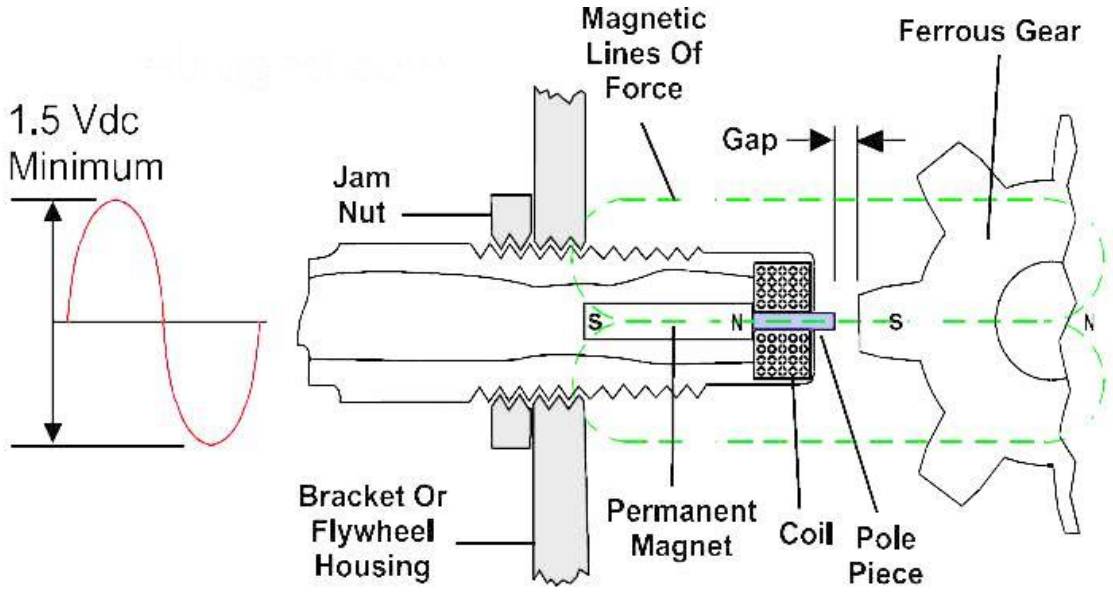

Figure 1- Inductive Pick-up

Figure No2- Experimental set up

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Inductive Pick Up set up	System Range : 5000 RPM Max. Instrumentation : Pulse generator, counter, decoder, driver. Readout : 4 digit digital readout 0.5" Red. Controls a. Speed control. b. Mains ON / OFF. Test Points- Multi – colored test points are provided at various stages in the circuit to observe waveforms and Voltages. Indicator Power Requirements : 230V,± 10% AC, 50Hz 1 phase.	1
2.	CRO		1

X Precautions to be Followed

1. Avoid improper handling of flow control valve

XI Procedure

1. Connect inductive Pick up circuit to CRO
2. Adjust speed of Rotating shaft with the help of Knob
3. Measure the frequency with the help of CRO
4. Repeat the procedure for five different positions of Knob

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Diameter of disc = d =

Number of teeth on segment = t =

Sr No	Knob Position	Frequency Recorded (f)	No of pulses
1			
2			
3			
4			
5			

Speed = [Frequency x Diameter of disc / Number of teeth on segment]

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. Define Pulse frequency
2. State the procedure of Pulse generation

[Space for Answer]

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?v=37oJtcUTpL8
2. www.youtube.com/watch?v=YeXlmdlXp2s

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

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

Practical No. 12 and 13: Use of Vibration Meter for Measuring Vibration of Machine and Structure.

I Practical Significance

Vibration analysis is used to detect early precursors to machine failure, allowing machinery to be repaired or replaced before expensive failure occurs. All machines vibrate and have a 'signature' which changes as operating conditions change. Vibration analysis can help detect a wide variety of fault conditions. When a disruption in the vibration signature is detected, data is collected that allows workers to detect and assess the severity of fault conditions such as imbalance, misalignment, looseness, and bearing faults. It is most effective on high-speed rotating equipment. Vibration sensors can be the most expensive component of a Predictive Monitoring program to get set up and running, but it allows the user to evaluate the condition of equipment and avoid failures.

II Relevant Program Outcomes (POs)

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

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

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use Measurement and control of Relevant Equipment'***:

1. Use relevant measuring instrument for measuring various mechanical properties of machine complements
2. Use of Vibration Measuring Instruments

IV Relevant Course Outcome(s)

- Use relevant instrument for measurement of vibration and strain

V Practical Outcome

- Use of FFT analyzer/Vibration meter to measure vibrations of a given structure.
- Use of FFT analyze/ Vibration Meter to measure vibrations of a given Machine

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VII Minimum Theoretical Background

Vibration is the back and forth or repetitive motion of an object from its point of rest. When a force is applied to the mass, it stretches the spring and moves the weight to the lower limit. When the force is removed, the stored energy in the spring causes the weight to move upward through the position of rest to its upper limit. Here, the mass stops and reverses direction traveling back through the position of rest to the lower limit. In a friction-free system the mass would continue this motion indefinitely. All real systems are damped, that is they will gradually come to their rest position after several cycles of motion, unless acted upon by an external force. The characteristics of this vibratory motion are period, frequency, displacement, velocity, acceleration, amplitude and phase. Continued vibration of this spring mass system would only repeat the characteristics shown in this single cycle.

VIII Experimental setup

Figure No 1Vibration Meter

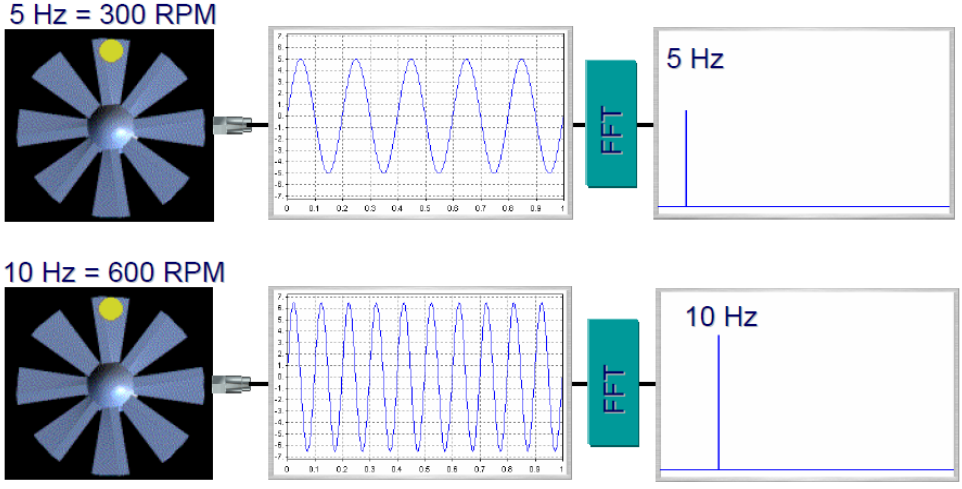

Figure No 2 Spectrum Analysis

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Vibration Meter	• Displacement : 0.1-199.9 µm peak-peak • Velocity : 0.1-199.9 mm/s true RMS • Acceleration : 0.1-199.9 m/s^2peak • Overall Accuracy : ±5% of display ±2 digits • Temperature Range : 5-50 deg C • Frequency Response : 10-1000Hz (Outside accelerometer) • Battery : 9V 6F22, 25 hours of continuous operation. • Pickup : Accelerometer with hand-held probe and magnetic base	1
2.	Tachometer	Range 0 to 4000 rpm	

X Precautions to be Followed

1. Avoid improper handling of flow control valve
2. Don't apply excessive pressure on tips of Transducer .

XI Procedure

- Connect an accelerometer to the machine/structure properly
- Run the machine
- Measure the speed with the help of Tachometer
- Measure the frequency and Vibrational Amplitudes with the help of Vibration meter
- Take at least five readings of different Machine/Structure

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Sr No	Machine/Structure	Speed RPM	Frequency recorded Hz	Vibration measured
1	Bearing of Machine			
2	Shaft of machine			
3	Pump rotor			
4	Gear Drive			
5	Shaft of Motor			
6	Crank shaft of I C engine			

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. State the Necessity of Vibration Measurement.
2. List the applications of FFT analyzer.

[Space for Answer]

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?v=dQY6kLcFMQ4
2. www.youtube.com/watch?v=8Bq74FklKVI
3. www.youtube.com/watch?v=LXBsg5w6T2A

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……
2. …….
3. …….
4. …….

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

Practical No. 14: Use Strain gauge to measure Strain induced on member

I Practical Significance

Strain Gauge is a device used to measure strain on an object. It is passive resistive transducer which converts mechanical elongation to change in resistance.

II Relevant Program Outcomes (POs)

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

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

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use Measurement and control of Relevant Equipment'***:

1. Use relevant measuring instrument for measuring various mechanical properties of machine complements
2. Use of Vibration Measuring Instruments

IV Relevant Course Outcome(s)

- Use relevant instrument for measurement of vibration and strain

V Practical Outcome

- Use Strain to measure strain induced on member

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VII Minimum Theoretical Background

The principle of the electrical resistance strain gauge was discovered by Lord Kelvin, when he observed that a stress applied to a metal wire, besides changing its length and diameter, also changes its electrical resistance. Metallic electrical strain gauges are made in to two basic forms, bonded wire and bonded foil. Wire gauges are sandwiched between two sheets thin paper and foil gauges are sandwiched between two thin sheets of epoxy. The resistance **R** of a metal depends on its electrical resistivity **r,** its area **a** and the length according to the equation. R= **r** l / a. Thus to obtain a high resistance gauge occupying a small area the metal chosen has a high resistivity, a large number of grid loops and a very small cross sectional area. The most common material for strain gauges is a copper- nickel alloy known as advance.

The strain gauge is connected to the material in which it is required to measure the strain, with a thin coat of adhesive. Most common adhesive used is Eastman, duco cement,etc. As the test specimen extends are contracts under stress in the direction of windings, the length and cross sectional area of the conductor alter, resulting in a corresponding increase or decrease in electrical resistance.

VIII Experimental setup

Figure No. 1 Experimental Set Up

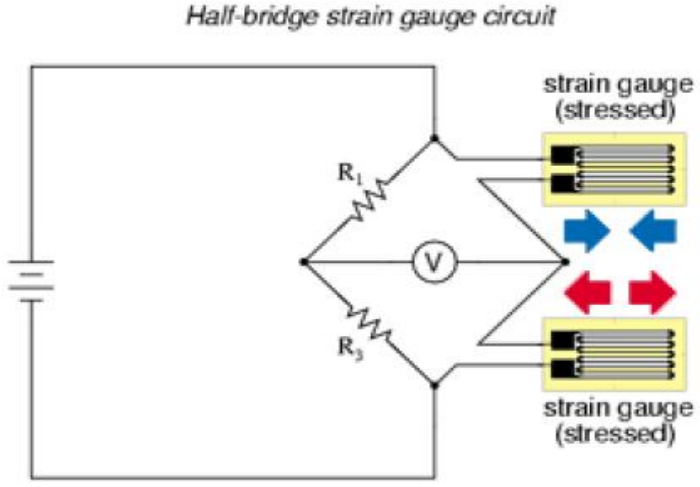

Figure No 2 Half wave Strain Gauge Circuit

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Strain measurement Trainer	Type : Strain gauge based., Range : 10 Kg. ,Gauge Resistance : 350 ohms., Max Excitation : 12 Volt DC., Insulation Resistance : 1000 mega ohms @ 25 degrees, measured at 30 volt DC., Combined Error : + or – 0.5 % of the F.5.,Operating Temperature: 0 degree to 50 degree., Safe overload : 10 % of the rated load	1

X Precautions to be Followed

1. Avoid improper handling of kit

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XI Procedure

- Connect sensor connector to the measuring unit
- Switch 'ON' the supply
- Adjust zero load using potentiometer
- Add load over pan
- Note down readings
- Add load for 5 readings
- Note down the reading for loading and unloading

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Sr No	Loading			Unloading		
	Weight applied (grams)	**Measured Strain (mV)**	**Strain Gauge Reading (Kg)**	**Weight applied (grams)**	**Measured Strain (mV)**	**Strain Gauge Reading (Kg)**
1						
2						
3						
4						
5						

XVI Results

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XVII Interpretation of Results

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Plot graph of Measured Strain V/S weight applied

XVIII Conclusions

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XIX Practical Related Questions

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

1. State the Necessity of Strain Measurement.
2. Enlist main requirements for of strain gauge.

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?v=o0LLV5GP6Ow
2. https://www.youtube.com/watch?v=nkCeEM1H2gA
3. www.youtube.com/watch?v=3xB2wZTNn_I

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …….
2. …….
3. …….
4. ……

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

Practical No. 15: Use Psychrometer to measure Air properties

I Practical Significance

A psychrometer is a type of hygrometer and is used exclusively to determine the relative humidity or moisture content in the air. Psychrometer represent an older humidity measurement form and electronic sensors that depend on changes in electrical resistance and capacitance rather than condensation temperature have widely replaced them. However, psychrometer are still found in many industrial environments and are available in both stationary and mobile versions.

II Relevant Program Outcomes (POs)

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

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

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use Measurement and control of Relevant Equipment'***:

1. Use relevant measuring instrument for measuring various mechanical properties of machine complements

IV Relevant Course Outcome(s)

- Use relevant instrument for humidity measurement

V Practical Outcome

- Use Sling Psychrometer to measure air properties

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VII Minimum Theoretical Background

Psychrometer consists of two thermometers, one dry and one wet. The wet thermometer is encased in a sock or cloth that has been saturated with distilled water. The idea is that the wet thermometer is always slightly colder than the dry thermometer due to evaporation. The two thermometers' temperature readings are compared and the difference between them is used to calculate the relative humidity in the air.

Psychrometer measure the humidity in a general environment's or specific area's (such as a chamber or structure) air. Psychrometer is generally used in laboratory settings in order to determine precise measurements for experiments and chemical reactions. A stationary psychrometer is the most common and is used in some forms of industrial equipment, while a mobile psychrometer, known as a sling psychrometer, consists of two thermometers attached to a handle and is spun in the air for several minutes in order to calculate the relative humidity in the field.

VIII Experimental setup

Figure No. 1

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Digital r	1. Humidity Sensor & Air Temperature Sensor 2. Triple LCD Display 3. ON/OFF button 4. T1-T2/Dew Point/T1 button 5. °F/°C select 6. MIN/MAX/RESET button 7. T2-DP/Wet Bulb/T2 button 8. HOLD button 9. T2 Probe Jack	1

X Precautions to be Followed

1. Avoid improper handling of flow control valve
2. Don't apply excessive pressure on tips of Transducer .

XI Procedure

- Switch 'ON' Psychrometer
- Hold it in the air
- Note down the Dry bulb temperature and relative Humidity
- Take five more reading at different locations
- Locate the readings on 'Psychometric Chart

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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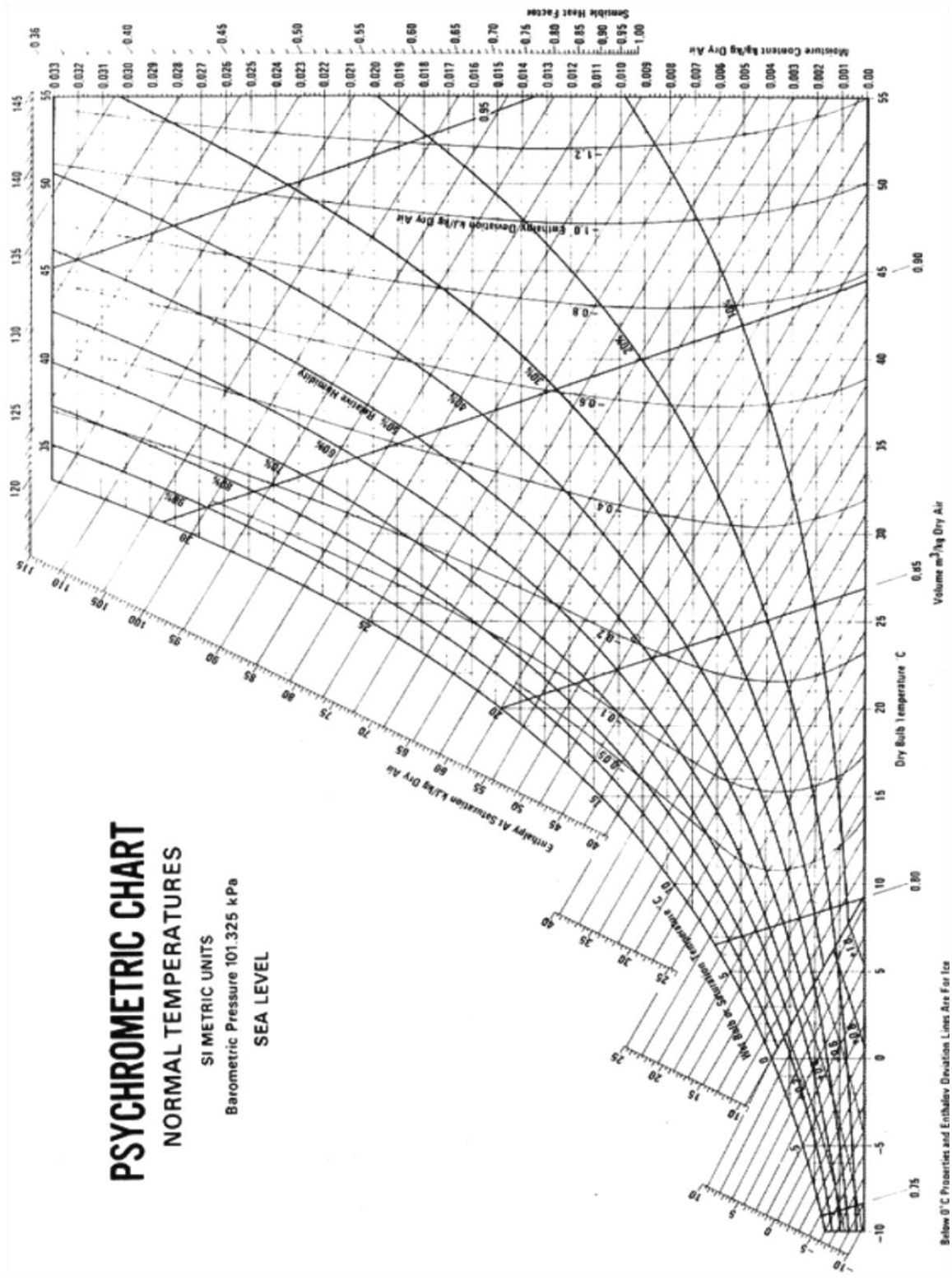
XV Observations and Calculations

S. No.	Name of Location	Dry Bulb Temperature (DBT)	Relative Humidity (%)	Wet Bulb Temp (^{0}C)	Specific Humidity Kg/Kg of dry air	Sp. Volume m^3/Kg
1						
2						
3						
4						
5						


PSYCHROMETRIC CHART
NORMAL TEMPERATURES
SI METRIC UNITS
Barometric Pressure 101.325 kPa
SEA LEVEL
Dry Bulb Temperature C
Volume m³/kg Dry Air
Below 0°C Properties and Enthalpy Deviation Lines Are For Ice

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. Define 'Psychrometry'.
2. State the purpose of measurement of air properties..

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?v=D66uqsKURs4
2. www.youtube.com/watch?v=mB9VTmQ5V4o
3. www.youtube.com/watch?v=TGWoRG4Rx80
4. www.youtube.com/watch?v=PECbPxQ1cF0
5. www.youtube.com/watch?v=2265UNflXT4

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

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

Practical No.16: Use Sound Meter to measure sound level of a given system

I Practical Significance

A sound level meter is a measuring device that measures the strength of sound in decibels. There are different types of these meters, but all of them contain 3 main parts; the microphone, which is used to capture the sound. Then there is the processing section which is self-explanatory; the area where the sound is processed. Last but not least we have the unit that contains the read out, which is digital and lets you know the outcome.

II Relevant Program Outcomes (POs)

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

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

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use Measurement and control of Relevant Equipment'***:

1. Use relevant measuring instrument for measuring various mechanical properties of machine complements
2. Use of Sound Measuring Instruments

IV Relevant Course Outcome(s)

- Use relevant instrument for sound level measurement

V Practical Outcome

- Use sound meter to measure sound level

VI Relative Affective Domain-

- Follow safety practices.
- Practice good housekeeping.
- Practice energy conservation.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VII Minimum Theoretical Background

Sound level meter is used for acoustic (sound that travels through air) measurements. It is commonly a hand-held instrument with a microphone. The diaphragm of the microphone responds to changes in air pressure caused by sound waves. That is why the instrument is sometimes referred to as a Sound Pressure Level (SPL) Meter. This movement of the diaphragm, i.e. the sound pressure deviation (pascal Pa), is converted into an electrical signal (volts V).A microphone is distinguishable by the voltage value

produced when a known, constant sound pressure is applied. This is known as the microphone sensitivity. The instrument needs to know the sensitivity of the particular microphone being used. Using this information, the instrument is able to accurately convert the electrical signal back to a sound pressure, and display the resulting sound pressure level (decibels dB SPL).Sound level meters are commonly used in noise pollution studies for the quantification of different kinds of noise, especially for industrial, environmental and aircraft noise. The current international standard that specifies sound level meter functionality and performances is the IEC 61672-1:2013.

VIII Experimental setup

Figure No.1

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Sound level Meter	• Standard applied- IEC 651 type 2, ANSI 1.4 type 2 • Dynamic Range- 50 dB • Resolution-0.1 dB • Time Weighting- FAST (125mS), SLOW (1 sec) • Frequency range-31.5 Hz ~ 4kHz • Measuring level range- 40 ~ 130db (40 ~ 80dB, 50-90dB, 60-100dB, 70-110dB, 90 ~ 130db)	1

X Precautions to be Followed

1. Avoid improper handling of flow control valve
2. Don't apply excessive pressure on tips of Transducer .

XI Procedure

- Switch 'ON' Sound level Meter
- Take the probe nearer to the machine whose sound is to be measured (distance should not less than 25 mm)
- Note down the reading
- Compare reading with standard value
- Take five different readings

XII Resources Used

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

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

S. No.	Name of System	API Standard Value (dB)	Noise meter Reading (dB)	Remark
1	Electric Motor	65		
2	Automobile Car	85		
3	Window air conditioner	68		
4	Lathe Machine	100		
5	Ceiling fan	35		

6	Air compressor	78		
7				
8				
9				

XVI Results

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XVII Interpretation of Results

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XVIII Conclusions

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XIX Practical Related Questions

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

1. State the effect of sound on Human being.
2. As per API, list sound level limit of maximum ten machinery..

[Space for Answer]

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XX References / Suggestions for Further Reading

1. www.youtube.com/watch?v=j3hFRNyHZW8
2. www.youtube.com/watch?v=6DPdVsFboQM
3. www.youtube.com/watch?v=dyvAg6XKNB4

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the measuring Instruments	20%
2	Calculation of final readings	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

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

List Of Laboratory Manuals Developed by MSBTE

First Semester:

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

Second Semester:

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

Third Semester:

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

Fourth Semester:

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

Fifth Semester:

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

Sixth Semester:

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

Pharmacy Lab Manual

First Year:

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

Second Year:

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

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