

MALLA REDDY ENGINEERING COLLEGE
(Autonomous)
Department of Mechanical Engineering

Instrumentation Lab



OBSERVATION MANUAL
FOR
B.TECH II YEAR II SEMESTER

NAME OF THE STUDENT:

ROLL NO.:

SECTION:

ACADEMIC YEAR: 2019 - 20

MALLA REDDY ENGINEERING COLLEGE

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List of Experiments

1. Calibration of Pressure Gauges
2. Calibration of McLeod gauge for low pressure
3. Calibration of thermistor for temperature measurement
4. Calibration of thermocouple for temperature measurement.
5. Calibration of resistance temperature detector for temperature measurement
6. Calibration and study of LVDT transducer for displacement measurement.
7. Calibration of capacitive transducer for angular displacement.
8. Calibration of strain gauge for strain measurement.
9. Calibration and study of photo and magnetic speed pickups for the measurement of speed.
- 10.. Measurement and study of speed by using Stroboscope.
11. Calibration and study of a rotameter for flow measurement
12. Measurement of vibration amplitude of an engine bed by using Seismic pickup at various loads.

CALIBRATION OF PRESSURE GAUGE

AIM:

Calibration of pressure cell using standard pressure gauge

APPARATUS:

1. Standard pressure gauge
2. Pressure cell
3. Digital pressure indicator
4. Foot air pump

THEORY:

Pressure is defined as force per unit area and is measured in Newton per square meter (Pascal) or in terms of an equivalent head of some standard liquid (mm of mercury). A typical pressure gauge will measure the difference in pressure between two pressures. Thus a pressure gauge is connected to the hydraulic line and the gauge itself stands in atmospheric pressure. The gauge reading will be the difference between the air pressure and the atmospheric pressure and is called gauge pressure. The absolute pressure (the actual pressure within the air line) is the sum of the gauge pressure and atmospheric pressure.

Pressure transducer is basically an electro mechanical devices, especially manufactured and designed or wide range application in pressure measurement. The pressure transducer comprises of diaphragm and an inputs to facilitate pressure measurement. The strain gauges are bonded directly to the sensing member to provide excellent linearity, low hysteresis and repeatability. Fluid medium whose parameter has to be measured is allowed to deflect the diaphragm (sensing member), which is a single block material and forms an integral part of the pressure transducer. It is made up non-magnetic stainless steel and thus has the advantage of avoids the yielding effects and leakage problems. The slight deflection of the diaphragms due to the pressure provided an electrical output.

The material most commonly used for manufacture of diaphragms are steel, phosphor bronze, nickel silver and beryllium copper. The deflection generally follows a linear variation with the diaphragm thickness.

SPECIFICATIONS:

Sensor	: Strain gauges bonded on steel diaphragm for pressure measurement
Type	: Diaphragm
Range	: 10 Kg / cm ²
Excitation	: 10V D.C
Accuracy and linearity	: 1%
Display	: 3.5 Digit LED display of 200 mV FSD
Power supply	: 230 V +/- 10% 50Hz

DIAGRAM:

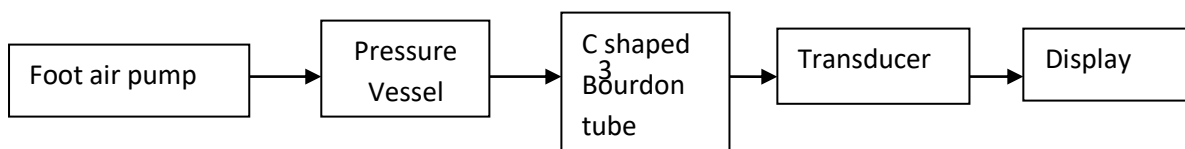
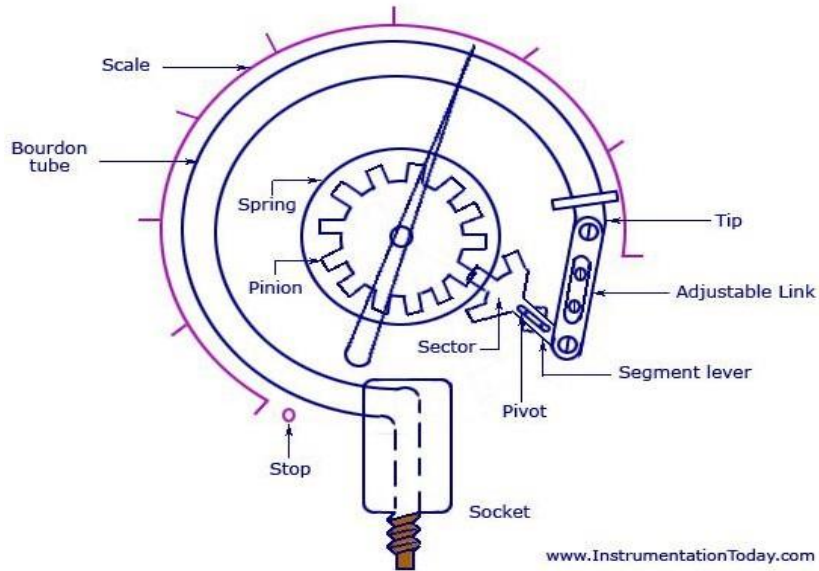


Fig: Block Diagram



Bourdon Tube Pressure Gauge

PROCEDURE:

1. Check connection made and switch ON the instrument by rocker switch at the front panel.
2. Display glows to indicate the instrument is ON.
3. Allow the instrument in ON position for 10 min for initial warm up.
4. Select the mode of display in MM through FUNCTION SELECT switch provided on the front panel
5. Adjust the ZERO potentiometer on the front panel till the display reads “000”.
6. Close the release valves fixed to the pressure vessel and apply the pressure on the sensor using foot air pump.
7. The instrument reads the pressure coming on the sensor and displays through LED. Readings can be tabulated and the % error of the instrument, linearity can be calculated.

OBSERVATION TABLE:

S.No	Actual pressure (Kg/cm ²)	Indicator reading (Kg/cm ²)	Error	% Error

GRAPHS:

Actual reading Vs indicator reading

APPLICATIONS:

It is used to measure air pressure in tyres

It is used to measure water pressure in spray ponds and etc

RESULT:

CALIBRATION OF MCLEOD GAUGE

AIM:

To calibrate the given vacuum cell. (Low Pressure Cell)

APPARATUS:

Vacuum pump
Vacuum chamber
McLeod gauge setup

THEORY:

In everyday usage, vacuum is a volume of space that is essentially empty of matter, such that its gaseous pressure is much less than atmospheric pressure. The word comes from the Latin for “empty”. A perfect vacuum would be one with no particles in it at all, which is impossible to achieve in practice. Physicists often discuss ideal test results that would occur in a perfect vacuum, which they simply call “vacuum” or “free space”, and use the term partial vacuum to refer to real vacuum. The Latin term in vacuum is also used to describe an object as being in what would otherwise be a vacuum.

Vacuum is useful in a variety of processes and devices. Its first widespread use was in the incandescent light bulb to protect the filament from chemical degradation. The chemical inertness produced by a vacuum is also useful for electron beam welding, cold welding, vacuum packing and vacuum frying. Ultra-high vacuum is used in the study of atomically clean substrates, as only a very good vacuum preserves atomic-scale clean surfaces for a reasonably long time (on the order of minutes to days). High to ultra-high vacuum removes the obstruction of air, allowing particle beams to deposit or remove materials without contamination. This is the principle behind chemical vapor deposition, physical vapor deposition, and dry etching which are essential to the fabrication of semi conductors and optical coatings, and to surface science. The reduction of convection provides the thermal insulation of thermos bottles. Deep vacuum lowers the boiling point of liquids and promotes low temperature out gassing which is used in freeze drying, adhesive preparation, distillation, metallurgy, and process purging. The electrical properties of vacuum make electron microscopes and vacuum tubes possible, including cathode ray tubes. The elimination of air friction is useful for flywheel energy storage and ultracentrifuges.

Boyle’s Law: For a fixed mass of gas at constant temperature, the volume of the gas is inversely proportional to the pressure. This is only strictly true for ideal gases (it can be derived from the ideal gas equation), but it remains a close approximation for real gases. It

is one of the earliest scientific laws, and remains useful to this day.

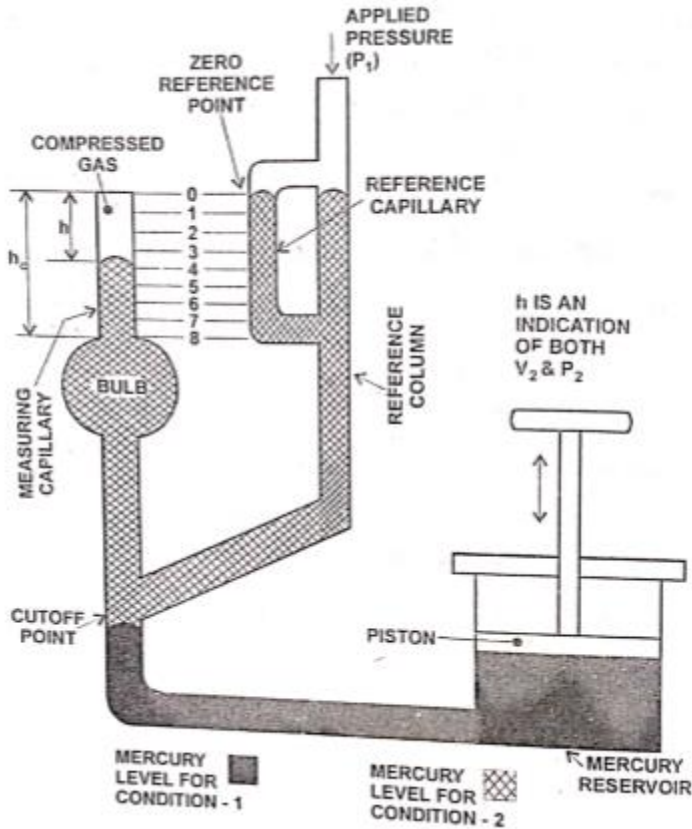


Fig: McLeod Pressure Gauge

PROCEDURE:

1. Rotate the McLeod gauge horizontally so that the mercury is collected completely inside the reservoir.
2. Connect the vacuum pump to the hose nipple provided at the back of the gauge.
3. Start the vacuum pump and it starts absorbing all the air inside the gauge.
4. Rotate the gauge slowly so that the mercury fills the two manometers. You can notice that one arm of the manometer is closed (reading end) and the other is opened to the vacuum chamber (reference end). Tilt the gauge so that the mercury level touches exactly the ZERO mark in the reference end of the manometer.

5. The mercury level in the reading end will show the vacuum built inside the vacuum chamber. Vacuum can be measured from 0.01 to 10mm Hg

RESULT:

CALIBRATION OF RESISTANCE TEMPERATURE DETECTOR FOR TEMPERATURE MEASUREMENT

AIM:

To calibrate the given RTD by using Thermometer

APPARATUS:

Temperature sensor (RTD), electrically heated kettle with water , thermometer signal conditioning and amplifying and analog to digital converter in single unit power supply

THEORY:

Resistance Temperature Detector (RTD)

Resistance thermometers, also called **resistance temperature detectors or resistive thermal devices (RTD)**, are temperature sensors that exploit the predictable change in electrical resistance of some materials with changing temperature. As they are almost invariably made of platinum, they are often called **platinum resistance thermometers (PTR)**. They are slowly replacing the use of thermocouples in many industrial applications below 600°C, due to higher accuracy and repeatability. There are many categories like carbon resistors, film and wire wound types are the most widely used.

Carbon resistors are widely available and are very inexpensive. They have very reproducible results at low temperatures. They are the most reliable from at extremely low temperatures. They generally do not suffer from significant hysteresis or strain gauge effects.

Film thermometer have a layer of platinum on a substrate, the layer may be extremely thin, perhaps one micrometer. Advantages of this type are relatively low cost and fast response. Such devices have improved performance although the different expansion rates of the substrate and platinum give “strain gauge” effects and stability problems.

Wire – wound thermometers can have greater accuracy, especially for wide temperature ranges.

Coil elements have largely replaced wire wound elements in industry. This design has a wire coil which can expand freely over temperature, held in place by some mechanical support which lets the coil keep its shape.

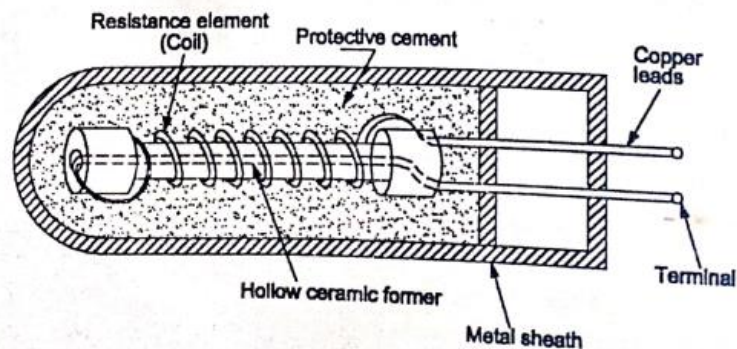


Fig: Resistance Temperature Detector

SPECIFICATIONS:

POWER: 3 pin main cable is provided with the instrument .connect the 3 pins socket to the instrument at the rear panel and to the AC main 230 V supply .

Connect the kettle to 230V supply with cable supplied .

SENSORS: connect RTD , THERMESTER and THERMO COUPLE to the connector on the rear panel .

NOTE: Before connecting ensure the voltage is 230V and power switch is in OFF position .

PROCEDURE:

1. Check connections made and switch on the instrument by rocker switch at the front panel. The display glows to indicate instrument is ON
2. Allow the instrument in ON position for 10 minutes for initial warm-up
3. Pore around $\frac{3}{4}$ full of water to the kettle and place sensor and thermometer inside the kettle
4. Note down the initial water temperature from the thermometer.
5. Select the sensor on which the experiment to be conducted through selection switch on the front panel
6. Adjust the initial set potentiometer in the front panel till the display reads initial water temperature
7. Switch on the kettle and wait till the water boils note down the reading of thermometer ans set final potentiometer till display reads boiling temperature
8. Remove the sensor from the boiling water immerse it in cold water .set the cold water temperature using initial set potentiometer.
9. Repeat the process till the display reads exact boiling water and cold water temperature.
10. Change the water in the kettle and re-heat the water .Now the display starts showing exact temperature raise in the kettle
11. Experiment can be repeated for all three sensors .Temperature in the thermometer and the indicator readings in steps of 10 degrees can be tabulated.

OBSERVATION AND TABULAR COLUMN:

RTD and Thermometer:

S.NO	THERMOMETER READING	INDICATOR READING	ERROR(3-2)	% ERROR

GRAPHS:

Draw the following graphs:

1. T_m v/s T_a
2. Correction v/s T_m
3. % Error v/s T_m

APPLICATION

- It's used for to measure the fever by using thermometer
- It's used for to measure heat in boilers etc.

RESULTS: Hence, RTD is calibrated for temperature measurement by thermometer

CALIBRATION OF THERMISTOR FOR TEMPERATURE MEASUREMENT

AIM:

To calibrate the given thermistor by using Thermometer

APPARATUS:

Temperature sensor (thermistor), Heating coil to heat water in water bath, Digital temperature Indicator & Thermometer.

THEORY:

Thermistor (semiconductor resistance sensor) when a semiconductor material is subjected to increase in temperature, its resistance decrease. A resistance thermometer which uses semiconductor as sensing element is called thermistor.

Thermistor have negative temperature coefficient of resistance in contrast to the positive temperature coefficient of resistance exhibited by RTD. The variation of resistance with temperature is exponential and is given by .

$$R = R_0 e^{\beta \left(\frac{1}{T} - \frac{1}{T_0} \right)}$$

Where

R = Resistance at Temperature T

R_0 = Resistance at the reference temperature

β = A constant which is determined experimentally

Thermistors are composed of sintered mixture of metallic oxides as manganese, nickel, cobalt, iron and uranium. These metal oxides are milled and mixed in appropriate proportions with binder and finally pressed into the desired shapes. Thermistors are commercially available in different shapes such as bead, rods, washer and discs.

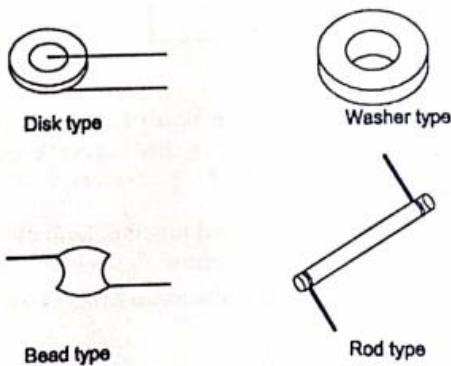


Fig: Different forms of Thermistor

In the operation, when the thermistor is subjected to a medium whose temperature is to be measured, its resistance gets changed according to the exponential law.

SPECIFICATIONS:

POWER: 3 pin main cable is provided with the instrument .connect the 3 pins socket to the instrument at the rear panel and to the AC main 230 V supply .

Connect the kettle to 230V supply with cable supplied .

SENSORS: connect RTD , THERMESTER and THERMO COUPLE to the connector on the rear panel .

NOTE: before connecting ensure the voltage is 230V and power switch is in OFF position .

PROCEDURE:

1. Check connections made and switch on the instrument by rocker switch at the front panel. The display glows to indicate instrument is ON
2. Allow the instrument in ON position for 10 minutes for initial warm-up
3. Pore around $\frac{3}{4}$ full of water to the kettle and place sensor and thermometer inside the kettle
4. Note down the initial water temperature from the thermometer.
5. Select the sensor on which the experiment to be conducted through selection switch on the front panel
6. Adjust the initial set potentiometer in the front panel till the display reads initial water temperature
7. Switch on the kettle and wait till the water boils note down the reading of thermometer ans set final potentiometer till display reads boiling temperature
8. Remove the sensor from the boiling water immerse it in cold water .set the cold water temperature using initial set potentiometer.
9. Repeat the process till the display reads exact boiling water and cold water temperature.
10. Change the water in the kettle and re-heat the water .Now the display starts showing exact temperature raise in the kettle
11. Experiment can be repeated for all three sensors .Temperature in the thermometer and the indicator readings in steps of 10 degrees can be tabulated.

OBSERVATION AND TABULAR COLUMN:

S.NO	Thermometer Reading	Thermistor Indicator Reading	Error(3-2)	% Error

RESULT: Hence Thermistor Is Calibrated For Temperature Measurement

CALIBRATION OF THERMOCOUPLE FOR TEMPERATURE MEASUREMENT

AIM:

To calibrate the given Thermocouple by using Thermometer

APPARATUS:

Temperature sensor (Thermocouple), Heating coil to heat water in water bath, Digital temperature Indicator & Thermometer.

THEORY:

A thermocouple is a sensor used to measure temperature in a number of processes. Thermocouples consist of two wire legs made from dissimilar metals which are fixed together at one end, creating a junction. When this junction experiences a change in temperature a voltage is created, this voltage can then be measured and referenced back to the temperature. Thermocouples are available in different combinations of metals, each with its own unique characteristics in terms of temperature range, durability, vibration resistance, chemical resistance, and application compatibility.

- Base metal thermocouples or type J, K, T, & E are relatively low cost and therefore the most popular thermocouples, they are commonly used in a broad range of low to medium temperature applications. (-185 to 1100°C)
- Noble metal thermocouples or type R, S, and B have greater resistance than base metal thermocouples, however they have platinum conductors, making them far more expensive. They are commonly used in high temperature applications. (Up to 1600°C)

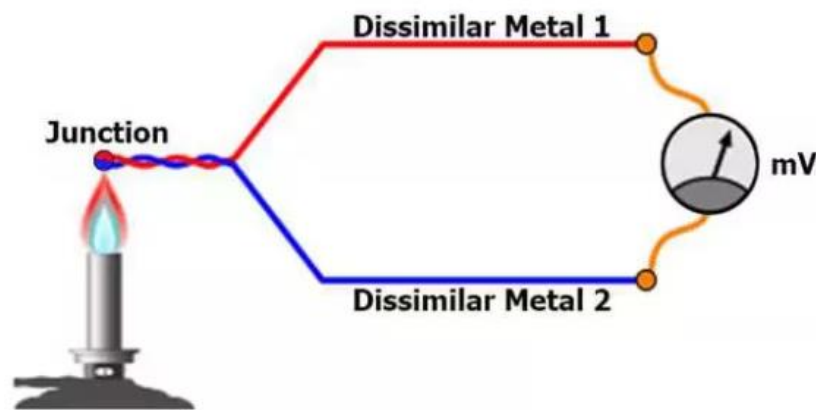


Fig: Thermo Couple

SPECIFICATIONS :

POWER : 3 pin main cable is provided with the instrument .connect the 3 pins socket to the instrument at the rear panel and to the AC main 230 V supply .

Connect the kettle to 230V supply with cable supplied .

SENSORS : connect RTD , Thermistor And Thermo Couple to the connector on the rear panel .

NOTE : before connecting ensure the voltage is 230V and power switch is in OFF position .

PROCEDURE:

1. Check connections made and switch on the instrument by rocker switch at the front panel. The display glows to indicate instrument is ON
2. Allow the instrument in ON position for 10 minutes for initial warm-up
3. Pore around $\frac{3}{4}$ full of water to the kettle and place sensor and thermometer inside the kettle
4. Note down the initial water temperature from the thermometer.
5. Select the sensor on which the experiment to be conducted through selection switch on the front panel
6. Adjust the initial set potentiometer in the front panel till the display reads initial water temperature
7. Switch on the kettle and wait till the water boils note down the reading of thermometer ans set final potentiometer till display reads boiling temperature
8. Remove the sensor from the boiling water immerse it in cold water .set the cold water temperature using initial set potentiometer.
9. Repeat the process till the display reads exact boiling water and cold water temperature.
10. Change the water in the kettle and re-heat the water .Now the display starts showing exact temperature raise in the kettle
11. Experiment can be repeated for all three sensors .Temperature in the thermometer and the indicator readings in steps of 10 degrees can be tabulated.

OBSERVATION AND TABULAR COLUMN:

S.No	Thermometer Reading	Indicator Reading	Error(3-2)	% Error

RESULT: Hence thermo couple is calibrated for temperature measurment

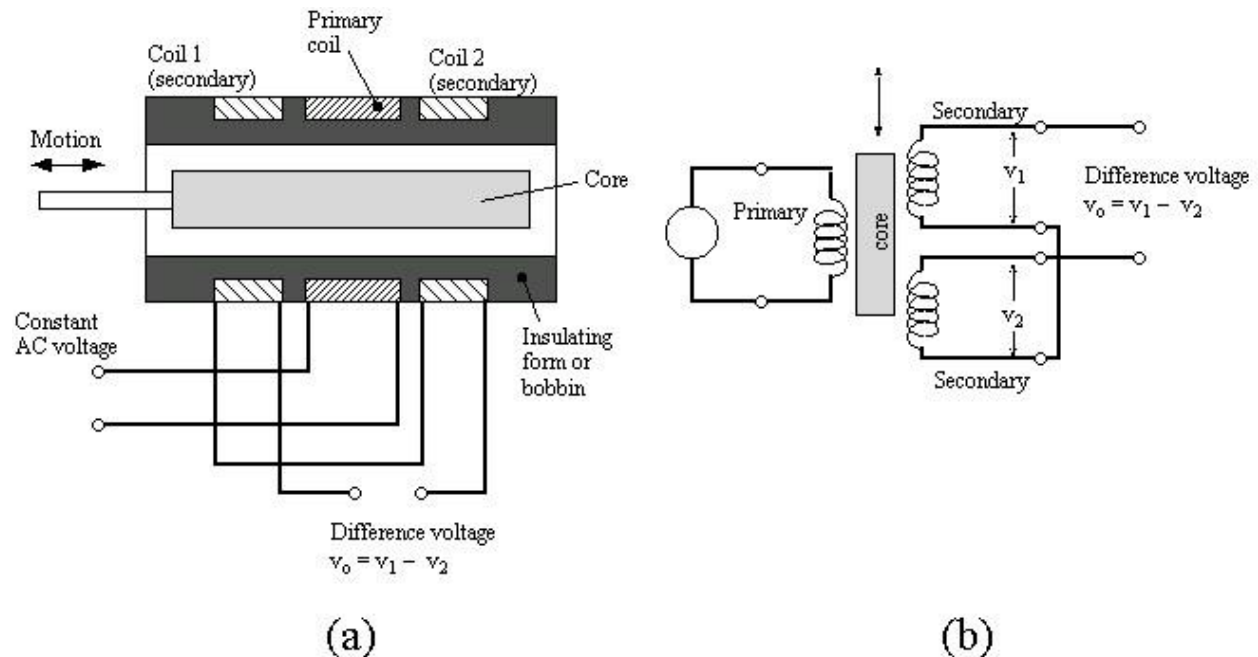
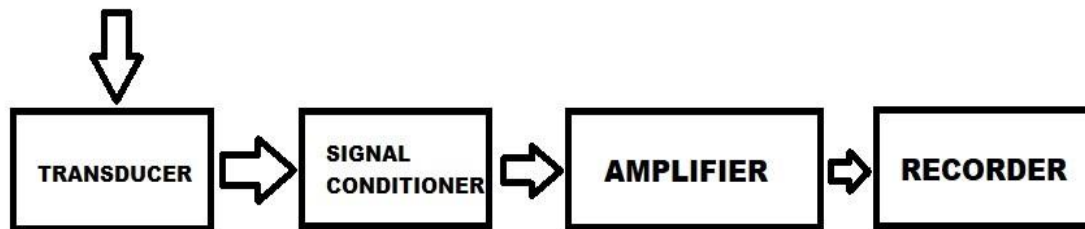
CALIBRATION OF LVDT

AIM: - Study and calibration of LVDT (linear variable differential transformer) transducer for Displacement measurement.

APPARATUS: - LVDT, Micro-meter, Frequency Generator, Signal Conditioner, Display.

THEORY: -

Differential transformer which work on a variable inductance principle or also used to measure displacement the most popular variable inductance transformer for linear displacement is the LVDT.



SPECIFICATIONS:

SENSOR:	LVDT spring loaded
RANGE:	10 mm
EXCITATION VOLTAGE :	1-4 khz
LINEARITY:	1%
OPERATING TEMP :	10-50 c
CONNECTOR :	Through 6 – core shielded cable provided along with sensor
CALIBRATION JIG :	Micrometer of 0-25mm range with least count of 0.01mm
DISPLAY:	3-DIGIT seven segment red LED display to read upto 1999 counts .200mv for full scale deflection
EXCITATION VOLTAGE:	1-1000hz
OPERATING TEMPERATURE:	10-55 c
ZERO ADJUSTMENT:	Through potentiometer
SENSITIVITY :	0.1 mm
REPEATIBILITY:	99%
CONNECTION :	Through 6- core shielded cable with DIN connector
FUSE :	250MA fast glow type
POWER:	230 v 10% ,50 hz

OPERATION PROCEDURE:-

- 3 PIN power chord is provided with an instrument connect the 3 –pin plug to 230V 50HZ power supply
- Before connecting the cable ensure that the power switch is in OFF position
- 6 Core shielded Cable is connected to the LVDT with male connector of different colors fixed to each wire. Connect the male pins sockets matching the colors
- After checking the entire connections switch on instruments by passing down the Toggle switch. The display glows to instrument is ON.
- Allow the instrument is ON position for 10 min that initial warm up rotate the micro meter to read 200mm
- Adjust the potentiometer at the Front pond so the the display reads 10.0

- Bring the micrometer back to read 20.0 once again the adjust the potentiometer to read the display 10.0 .
- Move the core in by operating the micro meter in step 1 or 2mm tabulate the reading micrometer reading will be actual reading and display will give indicator reading plot the graph between actual & indicator reading.

OBSERVATION:-

S.NO	ACTUAL READINGS IN mm	INDICATOR READINGS (mm)	ERROR	% ERROR

RESULT: - Hence LVDT is studied and calibrated.

CALIBRATION OF CAPACITIVE TRANSDUCER FOR ANGULAR DISPLACEMENT

AIM: Calibration of parallel plate capacitor for measurement of “Angular Displacement”

APPARATUS:

1. Sensor: Parallel plate capacitor/Angular plate capacitor.
2. Capacitance transducer trainer.

THEORY:

Principle of operation of capacitance transducer is based upon familiar equation for Capacitance of parallel plate capacitor

$$C = \epsilon \frac{A}{d}$$

Where,

C = Capacitance

A = Overlapping area of plates; m²

$\epsilon_0 \epsilon_r$ = Permittivity of medium; F/m

ϵ_0 = Permeability of free space = 8.85×10^{-12} F/m

ϵ_r = Relative permittivity

The capacitive transducer works on the principle of change of capacitance, which may be caused by

- i. Change in overlapping area, A
- ii. Change in distance between plates, d
- iii. Change in dielectric constant, ϵ

These changes are caused by physical variables such as displacement, pressure and force in most of the cases. The change in capacitance may be caused by change in dielectric constant as in case of measurement of liquid or gas levels. The principle of change in capacitance with change in overlapping area can be employed for measurement of Angular displacement.

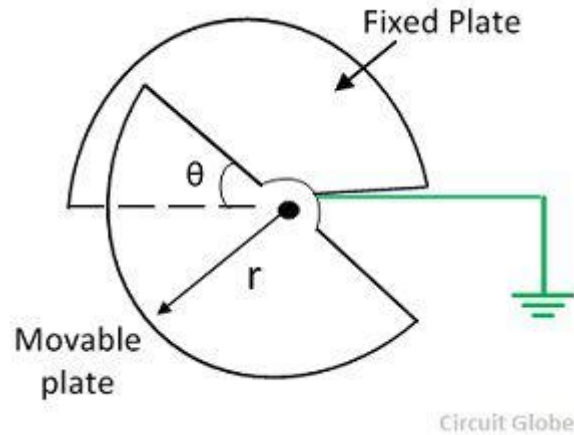


Fig: Angular displacement capacitance

SPECIFICATIONS:

SENSOR	: Angular plate capacitance
SENSOR MATERIAL	: ALLUMINIUM PLATES
DIELECTRIC MATERIAL	: AIR
DISPLACEMENT	: 0-90 DEGREE
ACCURACY	: 5-10 %
DISPLAY	: 3.5 DIGIT LED DISPLAY TO READ +/- 1999 COUNTS FOR +/- 200 MV fsd
POWER	: 230 v +/- 10 % 50 hz

PROCEDURE:

Check connection made to the instrument

Allow the instrument in ON position for 10 min for initial warm up.

Move the moving plate to zero position.

Adjust the zero potentiometer so that display reads “000”.

Move the plate in step of 5 to 10mm and note down the reading in the tabular column till 50mm.

RESULT:

The capacitance meter is calibrated for displacement and measurement.

CALIBRATION OF STRAIN GAUGE

AIM: -To find the actual strain using strain Gauge setup

APPARATUS: -Cantilever beam, weight and strain gauge indicator

THEORY: -

Transducer Converts energy from one form to another form. Strain gauge in a kind of transducer. Its used to sense strain due to load pressure vibrations etc. property of strain gauge is used to measure the strain. Gauge factor (G.F) refer to sensitivity of strain gauge. Its defined as the ratio of unique change in its resistance to unit change in its length.

$$G.F = (\Delta R/R) / (\Delta L/L).$$

Where R is original resistance of strain gauge of no strain

ΔR = change in resistance under stress

L = original length of the strain gauge

ΔL = change in length under stress $\Delta L/L$

e = strain(it has no dimensions)

v G.F. is also a dimensionless quantity.

A strain gauge of high G.F produces large change in its resistance and hence larger resultant output for a given amount of strain.

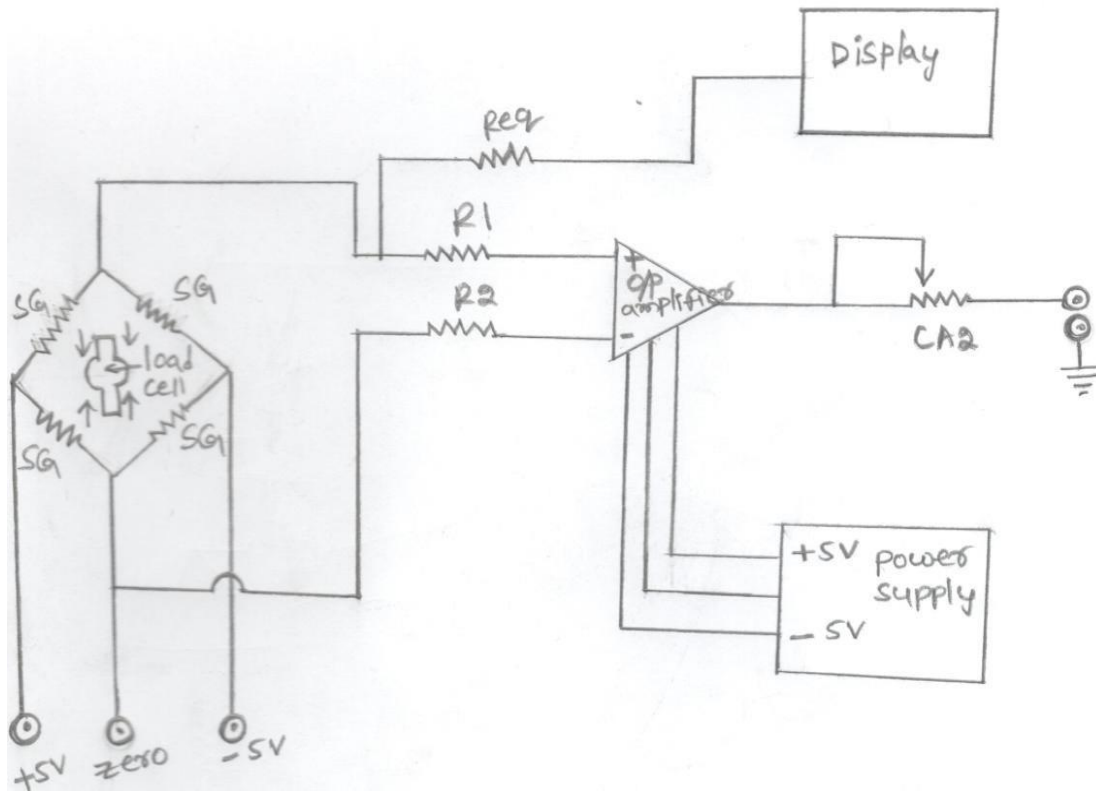
Our setup consists of a cantilever beam with a provision to load up to 1 Kg signal and a digital strain indicator. Strain indicator conditions and amplified strain gauge signal strain gauge is bounded on the cantilever beam and is connected in form of Wheatstone bridge. The strain indicator is provided with zero balancing facility through adjustable potentiometer.

Strain gauge converts mechanical quantity into electrical quantity. Wheatstone bridge converts change in resistance into change in voltage amplifier with gain 10 to 1000 are used to increase their signals to levels where they are compatible with voltage measuring devices.

RECORDER: -

They are voltage measuring devices they are used to display the measurement in a form that can be read and interpreted digital/analog voltmeter are used to measure static voltages.

DIAGRAM:-



SPECIFICATIONS: -

Cantilever beam: -

Material beam:stain steel width = 28mm

Thickness: 2.5mm

Beam length: 220mm

Youngs modulus, E type = 2×10^6 tcg/cm² or N/mm²

Gauge length = foil type 5mm

OBSERVATION:-

S.NO	LOAD in kg	MICROSTRAIN (Calculated)(a)	MICROSTRAIN (Indicated)(b)	ERROR (b-a)	% of ERROR

OPERATING PROCEDURE:

- Connect the 3-pin power supply to 230V power supply and to the instrument at the rear panel
- Connect the strain gauge the terminals at the panel as mentioned below
- Check the connections made switch ON the instruments by toggle switch at the back of panel box. The display glows to indicate the instrument is ON
- Select the bridge configuration through rotary switches on the panel
- Allow the instrument ON position for about 10min for initial warm up
- Adjust the zero potentiometer on the panel till display read '000'
- Apply the load using loading arrangement in steps of 100 gm to 11Kg
- Strain will be displayed in micro strain for full bridge total Strain will be displayed and for half bridge half of the strain will be displayed .for half bridge double the treading to get strain in micro strain
- Note down the reading in tabular form calculate the theoretical strain and find the error
- Draw the graph taking actual on x- axis, indicated on y-axis

SPECIMEN CALCULATONS:

Moment of applied load at strain gauge $M = P.L$

M.I of beam $I = bt^3/12$

$M/I = F/Yy$

Where: F is the stress

$$Y = T/2$$

$$F = (M \times Y)/I$$

$$f/e = E \Rightarrow e = pl(T/2) / bt^3 / 12 \Rightarrow e = 6pl / E. bt^2$$

$$e = 3.77 \times 100$$

$$s = 377 \text{ micro strains}$$

$$\% \text{error} = \frac{\text{indicated strain} - \text{actual strain}}{\text{actual strain}} \times 100$$

RESULT:

Calibration of strain gauge using strain gauge is calculated.

SPEED MEASUREMENT CALIBRATION OF MAGNETIC PICK UP AND PHOTO- REFLECTIVE MEASUREMENT

AIM:- Study and calibration of speed Measurement by using photo reflective and magnetic pickup.

APPARATUS:- Speed measurement Trainer consisting regulation to select the speed photo and magneto Pickup sensor LED Display digital RPM trainer Contacts/Non contact tachometers system. Works at 6VDC derived from 230V AC 50HZ

This consists of

- Sensor-magnetic Pickup/up to interpreter
- Amplifier
- Buffer
- Crystal Oscillator
- Minor/creating circuit
- Digital Counter
- Multi Planer
- LED

THEORY:-

The shaft of the tachometer is connected to the speed source. The disc starts rotating. As the disc rotates, the light passes through the hole for some time and the rest is obstructed by the opaque disc.

Hence, only when a hole is present, the light falls on the light sensor. Thus the intermittent light falling on the photocell produces voltage pulses. The frequency of this voltage pulses is a measure of the speed of the disc and hence, the speed of the light source. The output is obtained on a frequency measuring unit.

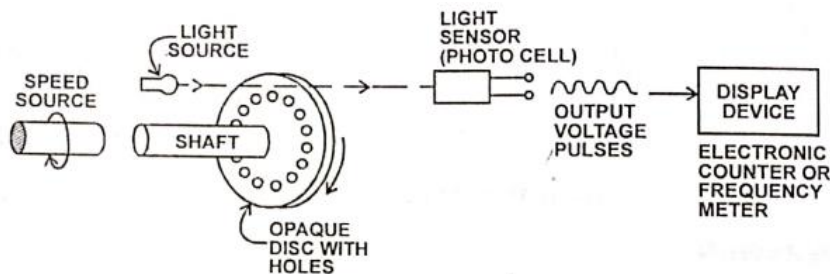


Fig: Photo reflective pickup

OBSERVATION:-

S.NO	Actual Speed of Motor Photo Reflector (RPM)	Magnetic Pickup	Error

PROCEDURE:-

- Before Switching on the Experiment Instruments Ensure that the connections are made properly.
- Switch on the Instruments by pushing down the toggle Switch provided at the rear side of the box LED display glow to indicate the Instrument is ON.
- Allow the Instrument for 10 min in ON position for Initial Warmup
- Select the sensor with the help of the toggle Switch
- Switch on the electronic regulation the fan rotates which will in turn rotates the tone wheels. The display will start indicating Exact RPM of the motor.
- Reading can be tabulated and Sensor Comparison can be made.
- Experiment can conduct by tabulating the speed indicated for both sensors at various speed. The speed can varied by using electronic regulator at the particular speed note down the display readings for both the sensors selecting through the toggle switch.

Tabulating at least through toggle switch calculating the at least 5 to 10 reading taking the photo reflective as per the RPM at the motor. Accuracy of the magnetic pickup can be calculated.

RESULT: -

Hence the error of the Photo Reflective Magneto pickup is calculated.

ROTA METER FOR FLOW MEASUREMENT

AIM : To study and calibration of a Rota meter for flow measurement.

APPARATUS REQUIRED:

1. Linear control valve
2. Rota meter
3. Pressure gauge
4. AC synchronous motor
5. Panel control
 - Potentiometer
 - Auto manual switch
 - Electro servo amplifier
 - Spin connector to control unit
6. hand valve
7. Reservoir tank
8. Pump
9. Wheel control

THEORY:

The purpose of control system is to make the process flow changes in stem point as close as possible. This operation is called “ **Servo operation** “. The disturbance doesn't change when the stem point undergoes a change . The feedback control acts in such a way as to keep the output & process close to stem point. Servo operation is typically of electrical & mechanical system & has received the most attention in tests on automatic control.



Fig: Rotameter

Specifications:

Rotameter	: Acrylic tube type
Capacity	: 15 to 160 LPH
Source Tank	: 20 Liters (approximately)
Measuring Tank	: 6 Liters
Timer	: 3 Digital timer with set point and relay control time set in Sec
Pump	: FHP Vertical Pump
Power	: 230 V 50 Hz

PROCEDURE:

- Fill the collecting tank with water till $\frac{3}{4}$ of collecting tank and make sure that pump is immersed in water fully.
- Clear the dust particles if any in the water.
- Connect the power chord to 230 V power supply.
- Switch on the instrument ON switch. The timer will switch on and indicates the previous set value. If needed alter the set value using incremental and decrement keys.
- Switch on the pump ON switch and press the start button set the flow rate for 30 LPH by using control knob provided on the rota meter.
- Press the start button the panel and the timer start counting and when it reaches zero the pump be off.

- Note down the initial water level in cms and final water level in cms for each flow rate and tabulated in the tabular column.

Area of measuring tank : $a = \frac{\pi}{4}(D)^2$

Diameter of tank $D = 9.5 \text{ cm}$

Volume $V = (a * (\text{final height} - \text{initial height})) / 1000 = \text{cc}$

Flow rate $= \text{volume} * 3600 / \text{time} = \text{lph}$

OBSERVATION TABULAR COLUMN

S.No 1	Set time sec 2	Initial water level(cm) 3	Final water Level(cm) 4	Actual water level in (cm) 5=4-3	Actual Flow rate (LPH) 6	Rotameter Reading (LPH) 7	Error 8=7-6	% Error 9

RESULT:

MEASUREMENT AND STUDY OF SPEED BY USING STROBOSCOPE.

AIM:

Calibration of stroboscope for speed measurement.

APPARATUS AND THEIR SPECIFICATIONS:

- Speed source contains a wheel with reflective mark. Rpm range; 500-2750.
- Tachometer- non-contact type. Measuring range- 100-10,000rpm
- Stroboscope; Flash tube; xenon 250mm Operating voltage; 230v, AC

THEORY

When these flashes by stroboscopes are directed onto a rotating, a reciprocating or an oscillating member, the rate of flashing is so adjusted that the reflective mark appears stationary. This apparent stopping of the motion of reflective mark occurs when illumination frequency equals to the frequency of motion of the target.

When speed measurement are to made by stroboscope methods, generally work with a single dishing mark and proceed to find the highest flash frequency at which true stationary image is seen.

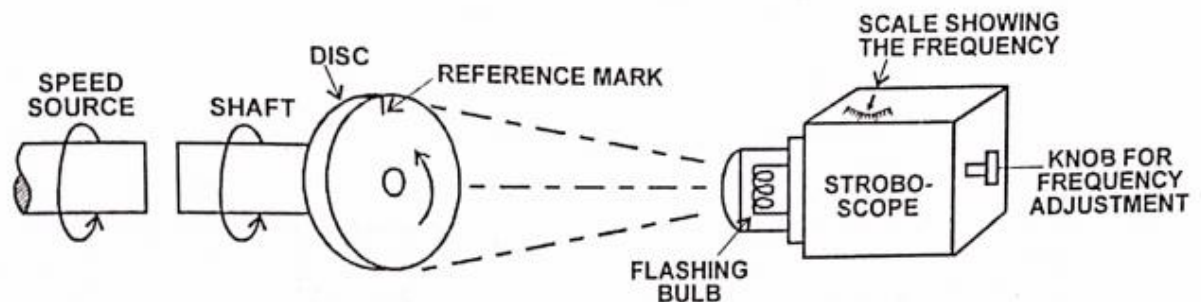


Fig: Stroboscope for speed measurement

PROCEDURE

1. The toggle switch on the battery eliminator is switched to the on position.
2. The voltage can be increased in steps of 1.5v, there by increasing the current passed to the motor and the speed of the wheel. .

3. First find out the speed of wheel with tachometer non-contact type.
4. On the stroboscope, select the range say 150-4500, or if the rpm is more than 4500. Select the button range 4500-18000.
5. Then focus on the rotating wheel and adjust the coarse and fine knobs , till the rotating object gives a stand still appearance and observe the digital read-out which displays exact rpm.
6. Repeat the above procedure for different rpm of rotating wheel.

PRECAUTIONS:

1. The stroboscope should not be used for more than 30 min continuously, and a break of 5 minute is essential between two readings.
2. Do not operate non-contact type tachometer and stroboscope at the same time, since the tachometer will pick up the flashing frequency of stroboscope and both will display the same rpm, which could be erroneous.

OBSERVATIONS:

S.NO	Voltage	Stroboscope reading in rpm	Speed = $r_1 r_n (n-1) / (r_n - r_1)$

RESULT:

Stroboscope for speed measurement was calibrated.

MEASUREMENT OF VIBRATION AMPLITUDE OF AN ENGINE BED BY USING SEISMIC PICKUP AT VARIOUS LOADS.

AIM: To study and use of seismic pickups for the measurement of vibration amplitude of an engine bed at various loads

APPARATUS:

Shaker/vibrator
Vibrator meter
Power supply

THEORY:

Vibration demo is designed as a laboratory setup which can be used to demonstrate the principles of vibration measurement. It consists of a shaker and control unit. The shaker is of a magnetic type. The control unit consists of a signal generator, power amplifier and vibration meter.

The acceleration may be attached to the spindle through M.S stud and signal output from accelerometer is connected.

PROCEDURE:

1. Connect the sensor to the instrument through the BNC socket provided in the back panel mentioned sensor
2. Connect vibration generator to the instrument through cable provided at rear panel of instrument make exciter.
3. Connect instrument to 230 v, 50 Hz supply through cable provided at rear panel.
4. Keep the frequency pot and the volt pot in the minimum position
5. Switch on the instrument, the display glows to indicate the power is ON in this position press tare button to make readings zero.
6. Turn the volt pot to maximum position.
7. Now turn frequency pot in steps of 100Hz and note down the reading of acceleration, velocity and displacement.
8. Tabulate the reading in the tabular column experiment can be repeated for different voltage levels settable through pot knob provided.

VARIATION AMPLITUDE FORMULAE:

Relation b/w acceleration, velocity and displacement

$$A = \frac{c \times 9.81}{c_1 \times 2} \text{ m/sce}^2$$

C₁ = sensitivity of a accelerometer (45-55)

With its signal conditioner (mv/g) = 50

C = charge amplitude output (mv) = 200

$$V = \frac{A \times 100}{2 \times f \sqrt{2}} \text{ cm/s}$$

Acceleration is multiplied by 100 to convert to cms

$$D = \frac{A \times 1000 \times 2}{4z \dots f^2} \text{ cm/s}$$

Acceleration is multiplied by 1000 to convert to mm

OBSERVATION TABLE

S.NO	Frequency	Calculated		Indicated		
		Velocity	Displacement	Acceleration	Velocity	Displacement

RESULT