DEPARTMENT OF PHYSICS
RV COLLEGE OF ENGINEERING®
(AUTONOMOUS INSTITUTION AFFILIATED TO VTU, BELAGAVI)

ENGINEERING PHYSICS

PRACTICAL FILE

COURSE CODE: PHY211BI / PHY211DI

2023-24

For the First Semester B.E

Name of the student	
Section, Batch	
Program	
Roll No. / USN	
Faculty In-charge	1.
	2.

DEPARTMENT OF PHYSICS

VISION

TO ENABLE ENGINEERING GRADUATES TO UNDERSTAND, LEVERAGE AND APPRECIATE THE ROLE OF PHYSICS FOR THE DEVELOPMENT OF SUSTAINABLE AND INCLUSIVE TECHNOLOGY.

MISSION

- EDUCATES THE STUDENTS WITH A PROGRAM CHARACTERIZED BY ART OF TEACHING WITH EXPERIMENTING SKILLS, PROJECT WORK/SEMINAR, SELF STUDY, EFFECTIVE COUNSELING AND AN ACTIVE INVOLVEMENT OF STUDENTS IN THEIR EXPERIENTIAL LEARNING.
- IMBIBE INQUISITIVENESS IN STUDENTS TO USE PHYSICS FOR ENGINEERING INNOVATION.
- EMPOWER THE FACULTY AND STUDENTS TO INVOLVE IN RESEARCH AND TO DEVELOP THE DEPARTMENT AS A KEY FACILITATOR FOR R&D TO ALL ENGINEERING PROGRAMS.

RV COLLEGE OF ENGINEERING®

(An Autonomous Institution, Affiliated to V.T.U, Belagavi)

Mysuru Road, Bengaluru – 560059

DEPARTMENT OF PHYSICS

CERTIFICATE

This is to certify that Mr./Ms………………………………………....... has satisfactorily completed the course of experiments in **Physics practical (PHY211BI / PHY211DI)** prescribed by the department of Physics for the I semester of BE graduate programme during the year 2023 - 2024.

Signature of Head of the Department

Date

Signature of the
faculty in-charge

50
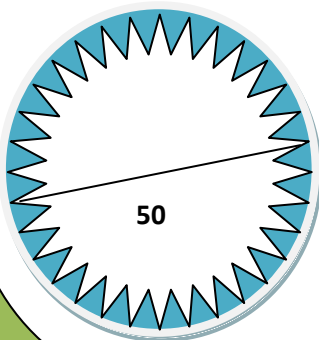
Name of the Candidate……………………………

Roll / U.S.N No……………………………………

PHYSICS FACULTY

Sl. No.	Name	Designation	Initials
01	Dr. Sudha Kamath M K	Associate Prof. & Head	SKMK
02	Dr. Bhuvaneswara Babu T	Professor	TBB
03	Dr. Avadhani D N	Associate Professor	DNA
04	Dr. Shireesha G	Associate Professor	GHS
05	Dr. Shubha S	Assistant Professor	SHBS
06	Dr. Tribikram Gupta	Assistant Professor	TG
07	Dr. Rajesh B M	Assistant Professor	BMR
08	Dr. Ramya P	Assistant Professor	RAP
09	Dr. Karthik Shastry	Assistant Professor	KAS
10	Dr. Niranjana K M	Assistant Professor	NKM
11	Dr. Dileep M S	Assistant Professor	DMS

STAFF

Sl. No.	Name	Designation	Initials
01	Eshwarachari C	Assistant Instructor	EC
02	Satheesha KS	Attender	SKS
03	Shobha B	Peon	SB

MARKS SHEET

Name :   Sec/Batch :   USN/Roll No :

SI.NO	SET NO.	LIST OF EXPERIMENTS	DATE (EXPT CONDUCTED)	DATE (EXPT SUBMITTED)	MARKS OBTAINED
1.	I	Single Cantilever			
2.	II	Interference at a Wedge			
3.	III	Torsional Pendulum			
4.		Laser Diffraction			
5.	IV	Volume Resonator			
6.		Band Gap of a Thermistor			
7.	V	Series LCR circuit (EL- expEyes17)			
8.		Spring Constant (EL-expEyes17)			
Regular experiments Average (1,2,3,4,5,6)					/30
Experiential Learning Average (7,8)					/10
Internal Marks					/10
Total Marks					/50
Signature of the faculty					

SCHEME OF EVALUATION

Particulars	Marks
Data sheet + Experimental Set up	10
Conduction of Experiment	10
Calculation & Viva-Voce	10
Lab Internal	10
Experiential Learning	10
Total Marks	50

<u>GENERAL INSTRUCTIONS TO STUDENTS</u>

1. Scan the QR code in each experiment to watch the video tutorial and read the procedure, come well prepare to the class.
2. Lab sub-batches will be allotted at the beginning of the semester.
3. Students will have to perform two experiments in one lab.
4. Every student has to perform the one/two experiments whichever is allotted to him /her, no change of experiments will be entertained.
5. While attending every laboratory session the student must bring the data sheets with all the relevant details written pertaining to the experiments.
6. **The data sheet must contain entries like** *aim of the experiment, apparatus required, circuit diagram or the diagram of the experimental setup, tabular columns,* **the necessary formulae of the experiments as given in the in the practical file except the principle and procedure.**
7. Separate data sheets should be prepared for each experiment. *The procedure and principle of the experiment must be read by the student before coming to the laboratory and it should not be written on the data sheets.*
8. Students are required to obtain the signature (entry signature) of the faculty on the data sheet before proceeding to the experiment.
9. All calculations pertaining to the two experiments should be completed in the laboratory. *The results must be shown to the batch in charge faculty and must obtain the exit signature from batch teacher before he or she leaves the laboratory.*
10. Entries of observations should be made in data sheets with pen only.
11. Substitutions and calculations should be shown explicitly in the data sheet and the practical file.
12. Submission of practical file along with necessary data sheets (to be pasted to the particular experiment once readings are transferred to practical file) in every lab session for evaluation.
13. In the event the student is unable to complete the calculations in the regular lab session, with the permission of the lab in-charge, the student should complete calculations, transfer the readings to practical file and submit the file for evaluation in the next lab session. (***In case of any difficulty in calculation, the student can consult the batch teacher within two working days after the lab).***
14. Mobile phones are not allowed to the lab. The student should wear lab coat and also bring his/her own calculator, pen, pencil, eraser, etc.
15. The experiments are to be performed by the students in the given cyclic order. This will be made clear to the student in the instructions class. If for some reason a student is absent for a practical lab session/unable to perform experiments then the student must move on to the next set in the subsequent lab session. The experiment that he or she has missed will have to be performed by him or her in the repetition lab.
16. *Please remember that practical file is evaluated during regular lab session. Therefore it is imperative that each student takes care to see that the experiments are well conducted, recorded and submitted for valuation regularly.*

17. There will be a continuous internal evaluation (CIE) in the laboratory. An internal test will be conducted at the end of the semester. The total internal assessment marks are for a maximum of 50.

Note: Stamp of rubrics for evaluation on the first page of data sheet is mandatory for each Experiment.

RUBRICS FOR EVALUATION

Particulars	Maximum Marks	Excellent	Very Good	Good	Satisfactory
Data sheet + Experimental Set up	10	10	08	07	04
Conduction of Experiment	10	10	08	07	04
Substitution, Calculation & Accuracy	10	10	08	07	04
Experiential Learning	10	10	08	07	04

*All students are strictly required to adhere to the Do's and Don'ts in the laboratory:*

✓ **Do's**	✗ **Don'ts**
✓ Come prepared to the lab.	✗ Come late to the lab and leave the lab early.
✓ Wear lab coat in the lab.	✗ Carry mobile phones to the lab
✓ Maintain discipline in the lab.	✗ Touch un-insulated electrical wires.
✓ Handle the apparatus with care.	✗ Use switch if broken.
✓ Confine to your table while doing the experiment.	✗ Overload the electrical meters.
✓ Return the apparatus after completing the experiment.	✗ Talk with other students in the lab.
✓ Switch off the power supply after completing the experiment	✗ Make the circuit connection when the power supply is on.
✓ Switch off the electrical circuit breaker if there is burning of insulation.	
✓ Utilize the First Aid box in emergency situation.	
✓ Keep the lab clean and neat.	

MEASUREMENTS

To conduct various experiments in the Physics Laboratory, we need to learn measurement of dimensions and other physical quantities using instruments. Measurements of various dimensions of object using Vernier Calipers, Screw gauge, Multi metre etc are discussed here.

Vernier Callipers

Vernier Callipers is used to measure dimensions like length, breadth, diameter of solid and hollow etc accurately.

Main Scale
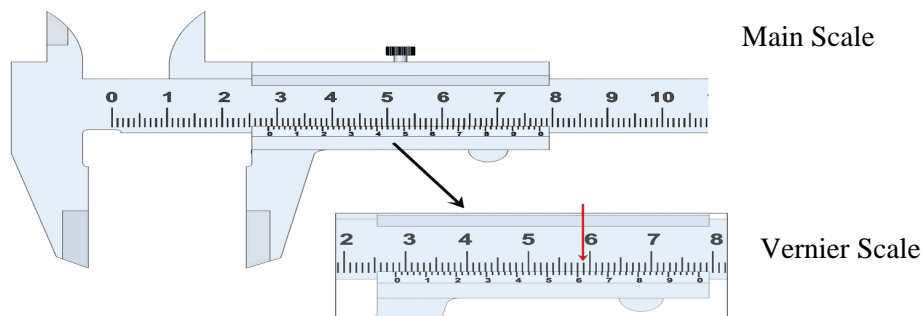
Vernier Scale

Least count of vernier calipers

The vernier caliper has two scales – main scale and vernier scale. The main scale is graduated in cm while the vernier scale has no units. The vernier scale is not marked with numerals, what is shown above is for the clarity only.

Least count (LC) of the vernier calipers is the ratio of the value of 1 main scale division (MSD) to the total number of vernier scale divisions (VSD).

Example:

Value of 10 main scale divisions (MSDs) = 1cm

Value of 1 MSD = 0.1cm

Total number of VSD = 10   Therefore LC = 0.1cm/10 =0.01cm

To take readings using the calipers

  (1) First see if the 0 of the vernier scale coincides with a main scale reading. If it coincides then the reading at the zero of the vernier is the main scale reading (MSR).
  (2) **If the 0 of the vernier scale does not coincide with any main scale division then the division just behind the zero of the vernier is the main scale reading (MSR).**
  (3) Then see which **vernier division** coincides with **a main scale division**. This division of the **vernier scale** is noted as the coinciding vernier scale division (CVD).
  (4) The total reading is given by TR = MSR + VSR,   TR = MSR + (CVD x LC)

Example:
If MSR = 1cm, CVD = 6, then TR = MSR + (CVD x LC) = 1cm + (6 x 0.01) cm = 1.06cm

Screw gauge:

Screw gauge is used to find the dimensions of small objects and it has a pitch scale and a head scale. The pitch scale is graduated in mm while the head scale has no units.

The least count for this type of instruments is given by

$$\text{Least Count} = \frac{\text{pitch}}{\text{No. of head scale divisions}}$$

The pitch of the screw gauge is the distance moved on the pitch scale for one complete rotation of the head. To find pitch give some known number of rotations to the pitch scale and note the distance moved by the head scale.

Pitch = distance moved on the pitch scale /No. of rotations given to head scale

Usually the pitch is 1mm, the head scale is divided into 100 divisions.

LC = pitch /No. of head scale divisions = 1/100 mm =0.01mm

In the screw gauge the head is rotated until the plane faces of metal plug A and screw head B touch each other. If the pitch scale reading is zero and the zero of the head scale coincides with the pitch line then there is no zero error, otherwise there is a zero error(ZE). Determination of zero error is shown in the following figure.

If the pitch line is in the positive side of the HS then ZE is +ve
If the pitch line is in the negative side of the HS then ZE is –ve

(a)	(b)	(c)
No zero error	Positive zero error	Negative zero error
ZE = 0	ZE = +2	ZE = -4
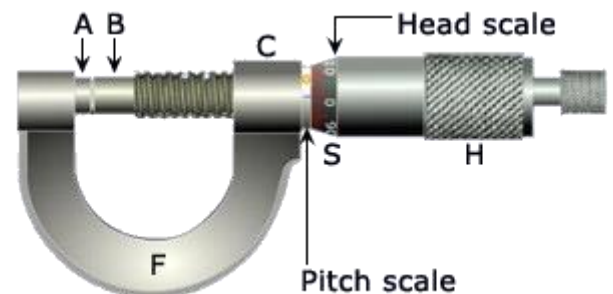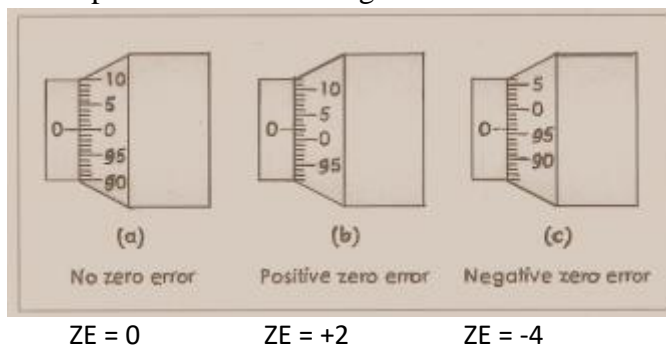
Pitch scale reading PSR : The reading on the pitch scale, at the edge of the head scale or behind the edge of the head scale.
Head scale reading HSR : The reading on the head scale that coinciding with the pitch line i.e horizontal line on the pitch scale or below the pitch line

The total reading is calculated using the formula: **TR=PSR+{(HSD - ZE)×LC} mm**

Travelling Microscope

Least count of the traveling microscope (T.M)
The scales on the travelling microscope are similar to those in vernier callipers. The difference being that the value of 1 main scale reading is 0.05cm and the number of divisions on the vernier is 50.

Value of 1msd = 1cm/20 = 0.05cm

Number of VSDs = 50.

The least count (LC) of the instrument = 1MSD / Total number of vernier scale divisions

L.C = 0.05cm/50 = 0.001cm.

The procedure for taking readings is the same as for vernier callipers.

   (1) First see if the 0 of the vernier scale coincides with a main scale reading. If it coincides then take it as the main scale reading (MSR).

   (2) **If the 0 of the vernier scale does not coincide with any main scale division then the division just behind the zero of the vernier is the main scale reading (MSR).**

   (3) Then see which **vernier division** coincides with **a main scale reading**. This division of the **vernier scale** is noted as the coinciding vernier scale division (CVD).

   (4) The total reading is given by TR = MSR + VSR, TR = MSR + (CVD x LC)

   Example:
   If MSR = 1.05cm, CVD = 19, then TR = MSR + (CVD x LC) = 1.05 + (19 x 0.001) = 1.069cm

NOTE. Ignore the numbering on the vernier scale and read the divisions from 0 to 50

expEYES -17 (expEriments for Young Engineers & Scientists)

INTRODUCTION:

Science is the study of the physical world by systematic observations and experiments. However, almost everywhere science is mostly taught from the text books without giving importance to experiments, partly due to lack of equipment. As a result, most of the students fail to correlate their classroom experience to problems encountered in daily life. To some extent this can be corrected by learning science based on exploration and experimenting. The advent of personal computers and their easy availability has opened up a new path for making laboratory equipment. Addition of some hardware to an ordinary computer can convert it into a science laboratory.

The simple and open architecture of expEYES (see the figure given below) allows the users to develop new experiments, without getting into the details of electronics or computer programming.

1. About the device:

ExpEYES-17 is interfaced and powered by the USB port of the computer, and it is programmable in Python. expEYES can run on any computer having a Python Interpreter and required modules. The USB interface is handled by device driver program that presents the USB port as a Serial port to the Python programs. It can function as a low frequency oscilloscope, function generator, programmable voltage source, frequency counter and data logger etc.

Figure: ExpEyes-17

External connections:

The functions of the external connections briefly explained below. All the black coloured terminals are at ground potential, all other voltages are measured with respect to it.

Outputs:

Constant Current Source (CCS):

The constant current source can be switched ON and OFF under software control. The nominal value is 1.1 mA but may vary from unit to unit, due to component tolerances.

Programmable Voltage (PV1):

Can be set, from software, to any value in the -5V to +5V range. The resolution is 12 bits, implies a minimum voltage step of around 2.5 mill volts.

Programmable Voltage (PV2):

Can be set, from software, to any value in the -3.3V to +3.3V range. The resolution is 12 bits.

Square Wave SQ1:

Output swings from 0 to 5 volts and frequency can be varied 4Hz to 100 kHz. The duty cycle of the output is programmable. Setting frequency to 0Hz will make the output HIGH and setting it to −1 will make it LOW, in both cases the wave generation is disabled. SQR1 output has a 100Ω series resistor inside so that it can drive LEDs directly.

Square Wave SQ2:

Output swings from 0 to 5 volts and frequency can be varied 4Hz to 100 kHz. All intermediate values of frequency are not possible. The duty cycle of the output is programmable. SQR2 is not available when WG is active.

Digital Output (OD1):

The voltage at OD1 can be set to 0 or 5 volts, using software.

Sine/Triangular Wave WG:

Frequency can be varied from 5Hz to 5 kHz. The peak value of the amplitude can be set to 3 volts, 1.0 volt or 80 mV. Shape of the output waveform is programmable. Using the GUI sine or triangular can be selected. WG bar is inverted WG.

Inputs:

Capacitance meter IN1:

Capacitance connected between IN1 and Ground can be measured. It works better for lower capacitance values, up to 10 nano Farads, results may not be very accurate beyond that.

Frequency Counter IN2:

It is capable of measuring frequency up to several MHz.

Resistive Sensor Input (SEN):

This is mainly meant for sensors like Light Dependent Resistor, Thermistor, Photo-transistor etc. SEN is internally connected to 3.3 volts through a 5.1kΩ resistor.

±16V Analog Inputs, A1 & A2:

It can measure the voltage within the range of ±16 volts. The input voltage range can be selected from 0.5V to 16V full scale. Voltage at these terminals can be displayed as a function of time, giving the functionality of a low frequency oscilloscope. The maximum sampling rate is 1 Msps /channel. Both have an input impedance of 1M Ω.

±3.3V Analog Input A3:

It can measure voltage within the ±3.3 volts range. The input can be amplified by connecting a resistor from Rg to Ground, $gain = 1 + \frac{1}{10000}$. This enables displaying very small amplitude signals.

The input impedance of A3 is 10M Ω.

±6V /10mA Power supply:

The VR+ and VR- are regulated power outputs. They can supply very little current, but good enough to power an Op-Amp.

How to Use expEYES-17:

Connect the device through a USB port and start the expEYES-17 program from the menu. The default window shows **Transistor experiment screen**. Graphical User Interface for various experiments can be selected from the pull down menu. The user should browse the RVCE tab on the screen then select the Physics 1st year experiments.

SINGLE CANTILEVER

OBSERVATIONS:

Experimental Setup:
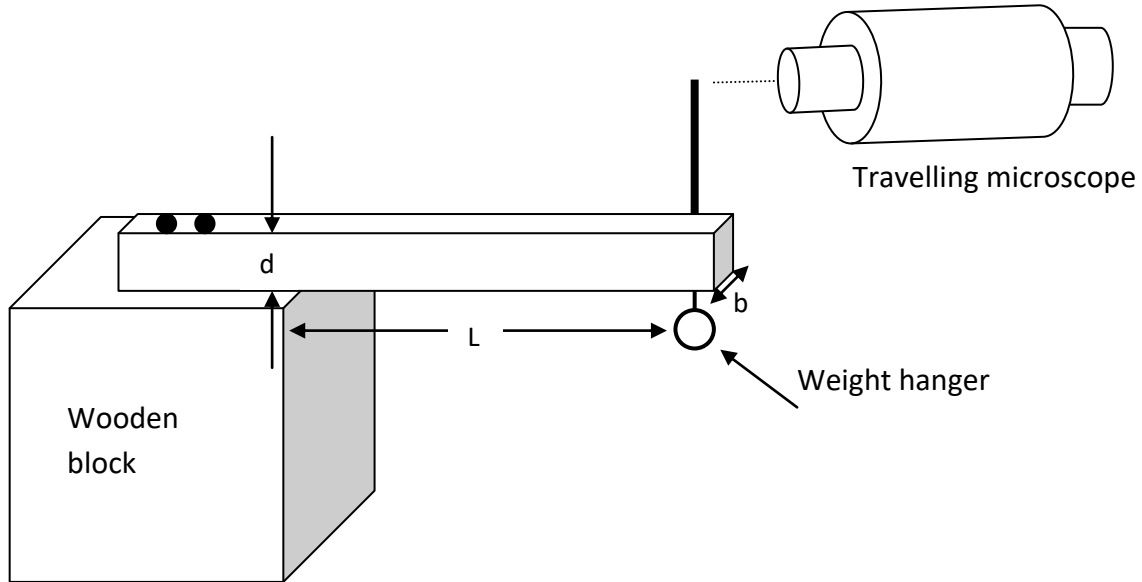
Travelling microscope

Wooden block

Weight hanger

Formula:

The Young's modulus of the material of the cantilever is calculated using the formula;

$$q = \frac{4mgL^3}{bd^3\delta_{mean}} \quad Nm^{-2}$$

Where, m = mass for which depression produced is 0.04 kg (40 gm),

L is the length of the cantilever in metre

b is the breadth of the cantilever in metre

d is the thickness of the cantilevering metre

δ is the mean depression for 40g in metre

g is the acceleration due to gravity = 9.8 m/s

Least count of the travelling microscope

$$L.C = \frac{\text{Value of 1 main scale division}}{\text{Total number of vernier scale divisions}} = \text{——} = \text{\_\_\_\_\_ c m}$$

Department of Physics, RVCE

SINGLE CANTILEVER

Experiment No: Date:

Aim: To determine the Young's modulus of the material of the given metal strip.

Apparatus: Thick rectangular metallic strip (cantilever), slotted weights with hanger, travelling microscope, screw gauge, Vernier callipers and metre scale etc.

Principle: Young's modulus, which is one of the elastic constants, is defined as the ratio of longitudinal stress to the longitudinal strain within elastic limit. For a given strip, the depression produced at the loaded end of the cantilever depends on the load and on the distance from the fixed end. This is measured to calculate the Young's modulus (q) of the material.

Formula:

The Young's modulus of the material of the cantilever is calculated using the formula;

$$q = \frac{4mgL^3}{bd^3\delta_{mean}} \ Nm^{-2}$$

Where, m = mass for which depression produced is 0.04 kg (40 gm),

L is the length of the cantilever in metre

b is the breadth of the cantilever in metre

d is the thickness of the cantilevering metre

δ is the mean depression for 40g in metre

g is the acceleration due to gravity = 9.8 m/s

Procedure:
- Suspend the weight hanger with mass W, at the bottom of the free end of the metallic strip (into a metal loop fixed below the pin).

- Adjust the vertical traverse of travelling microscope to focus the tip of the pin with the horizontal cross wire or the point of the intersection of cross wires.

- Note down the reading of the travelling microscope on the vertical scale when the load is W in table 1.

- Now add a mass of 10 g to the weight hanger and adjust the travelling microscope using the fine motion screw (vertical motion) to focus the tip of the pin with the point of intersection of cross wires. Note down the travelling microscope reading (for a load of W+10).

Table 1: Travelling microscope readings for the load increasing.

Load (g)	MSR(cm)	CVD	TR= MSR + (CVD x LC) (cm)
W			
W + 10			
W + 20			
W + 30			
W + 40			
W + 50			
W + 60			
W + 70			

Table 2: Travelling microscope readings for the load decreasing.

Load (g)	MSR(cm)	CVD	TR= MSR + (CVD x LC) (cm)
W + 70			
W + 60			
W + 50			
W + 40			
W + 30			
W + 20			
W + 10			
W			

Table 3: Mean depression and depression for a load of 40g (difference column)

Load (g)	TM reading (cm) Load increasing R_1	Load Decreasing R_2	Mean TMR $R_L = (R_1 + R_2)/2$	Load (g)	TM readings (cm) Load Increasing R_3	Load decreasing R_4	Mean TMR $R_R = (R_3 + R_4)/2$	Depression δ for 40g (δ= $R_L \sim R_R$) cm
W				W + 40				
W + 10				W + 50				
W + 20				W + 60				
W + 30				W + 70				

Mean depression for a load of 40 g = δ = _____ cm.

Paste the data sheets here

- Repeat the procedure by increasing the load in the weight hanger in steps of 10g up to a maximum load of W+70.

- Repeat the same by decreasing the load in steps of 10g and note down the readings for W+70, W+60 up to W and enter the readings in table 2.

- Tabulate the readings of increasing and decreasing loads in table 3. Compute the mean value of the reading corresponding to each load and find the depression 'δ' for a load of 40 g (m) by a difference column method.

- Measure the length 'L' of the cantilever from the edge of the wooden block to the position of the pin using a metre scale.

- Determine the breadth 'b' of the cantilever using vernier callipers at four different places on the metal strip and calculate the mean breadth.

- Determine the thickness 'd' of the cantilever using screw gauge at four different places on the metal strip and find the mean thickness.

- Compute the Young's modulus of the material of the cantilever by substituting the values of m, L, b, d and δ in the given formula.

Note:
1. Level the travelling microscope using a spirit level.
2. Once you start the experiment do not shake or lean on the table, as this will disturb the focusing and affect the reading.
3. Add/ remove the weights gently on to/from the weight hanger
4. While performing the experiment care is to be taken to rotate the fine motion screw in only one direction so as to avoid backlash error.

Length of the cantilever,   L   = _____ cm.

Table 4: Breadth of the cantilever using vernier callipers

$$\text{L.C} = \frac{\text{Value of 1 main scale division}}{\text{Total number of vernier scale divisions}} = \frac{}{} = \underline{\hspace{1cm}}\text{cm}$$

Trial No.	MSR(cm)	CVD	TR = MSR + (CVD x LC) (cm)
1			
2			
3			
4			

Mean Breadth b =_____cm

Table 5: Thickness (d) of the cantilever using screw gauge.

Least Count of Screw Gauge:

$$\text{Pitch} = \frac{\text{Distance moved on the pitch scale}}{\text{Total number of rotations given to screwhead}} = \frac{}{} = \underline{\hspace{1cm}}\text{mm}$$

$$\text{L.C} = \frac{\text{Pitch of the screw gauge}}{\text{Total number of head scale divisions}} = \frac{}{} = \underline{\hspace{1cm}}\text{mm}$$

Zero error (ZE) =

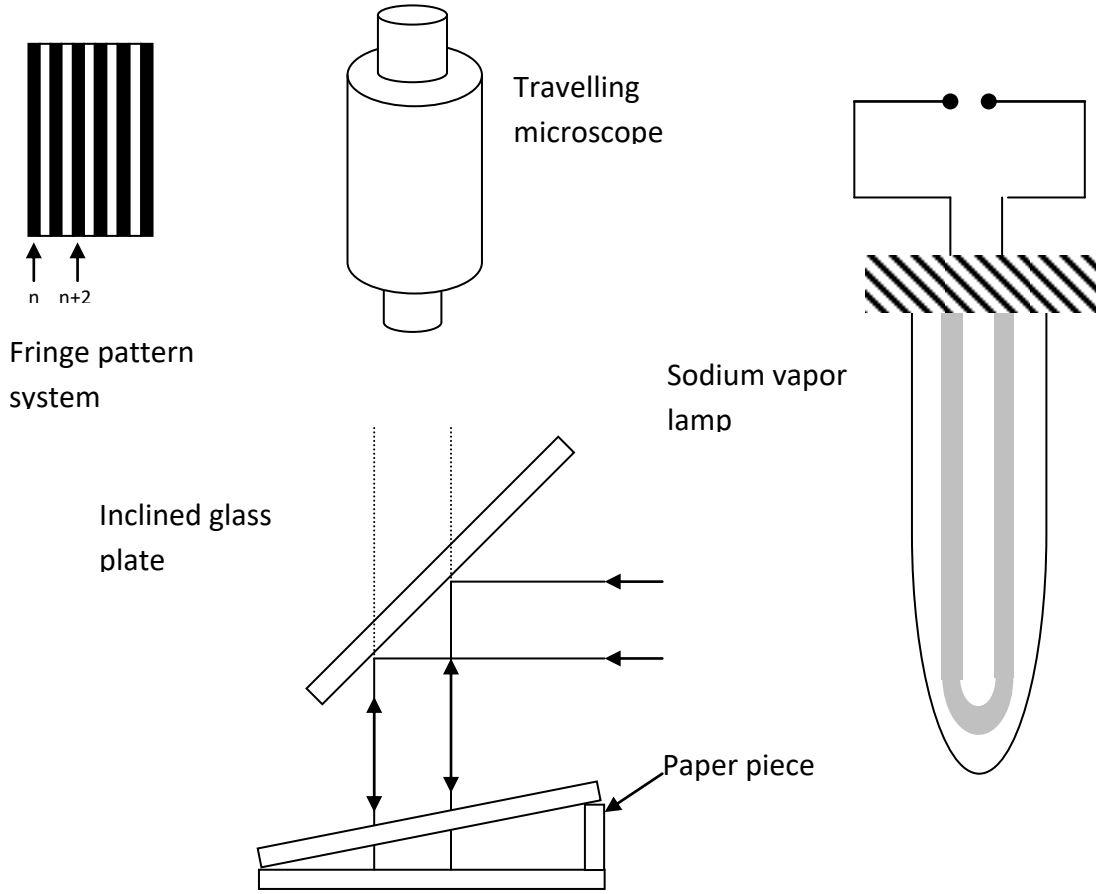| Trial No.	PSR(mm)	HSD	TR= PSR + (HSD- ZE)LC (mm)
1			
2			
3			
4			

Mean thickness, d = _____mm

Result: Young's modulus of the given material is found to be _____ N m^{-2}

CALCULATIONS:

Result: Young's modulus of the given material is found to be _____ N m^{-2}

INTERFERENCE AT A WEDGE

OBSERVATIONS

Fringe pattern system

Travelling microscope

Inclined glass plate

Paper piece

Sodium vapor lamp

Least count of the travelling microscope

$$LC = \frac{\text{Value of 1 main scale division}}{\text{Total number of vernier scale divisions}} = \quad cm$$

Tabular column 1

Fringe number	TM readings, MSR + (CVD x LC)	Total reading (cm)
N		
n + 2		
n + 4		
n + 6		
n + 8		
n + 10		
n + 12		
n + 14		
n + 16		
n + 18		
n + 20		
n + 22		

Department of Physics, RVCE

INTERFERENCE AT A WEDGE

Experiment No.   Date:

Aim: To determine the thickness of a thin paper piece by setting up interference fringes at an air wedge.

Apparatus: Two (optically flat) thick glass plates, sodium vapour lamp, travelling microscope (bridge type), a thin paper piece, reflecting glass plate, reading lens and a scale.

Principle: When a piece of paper is placed between two optically plane glass plates, a wedge shaped air film is formed between the two plates. If a parallel beam of monochromatic light is made to incident normally on the wedge (upper glass plate), the beam gets refracted through the upper glass plate. Two reflected rays from the upper and lower positions of the air film form two coherent sources. As the two portions in the reflected beam, are derived from the same incident beam and have path difference, they produce interference. The interference pattern, when viewed through a travelling microscope, appears as equally spaced alternate dark and bright straight fringes, parallel to the edge of the wedge.

Procedure:

a) Experimental Setup

   The given optically plane glass plates and the reflecting glass plate are cleaned well by using muslin cloth before starting the experiment. The optically plane glass plates are kept one above the other. A thin rectangular paper piece is inserted between the glass plates at one extreme end, such that the piece of paper is perpendicular to the length of the glass plate. Now a wedge shaped air film is formed in between the plates. The thickness of the air film gradually increases, from the point of contact of glass plate, till the inner edge of the paper piece.

   Now illuminate the air wedge by a parallel beam of sodium light using reflecting glass plate by making an angle of inclination 45˚ to the horizontal as shown in the diagram. The whole setup is kept below the objective of the travelling microscope such that the illuminated portion of the air wedge comes under the field of view of travelling microscope. Then focus the travelling microscope using rack and pinion screw such that the alternate dark and bright interference fringes are clearly seen.

b) Measurement of fringe width

   The least count of travelling microscope is determined by finding the ratio of the value of one main scale division to the total number of vernier scale divisions.
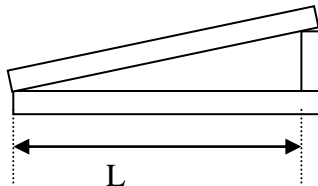
Tabular column 2

Fringe No.	TM Reading (cm)	Fringe No.	TM Reading (cm)	Width of 12 fringes (cm)
N		n + 12		
n + 2		n + 14		
n + 4		n + 16		
n + 6		n + 18		
n + 8		n + 20		
n + 10		n + 22		

Average width of 12 fringes, x =_____m

The fringe width, β, is x/12 = _____m.

To measure the length, L, of the air wedge

L =_____m

The thickness of the paper is calculated by using the formula

$$t = \frac{\lambda L}{2\beta} = \underline{\hspace{2cm}} m$$

Here
t is the thickness of the paper ---------- m
L is the length of the air wedge ------------ m
λ is the wavelength of sodium light = 589.3nm
β is the fringe width ---------m

The vertical cross wire is adjusted to be at the center of any one of the dark fringes. The reading on the main scale and the coinciding vernier scale division are noted. Let this fringe be the nth dark fringe.

Next the reading corresponding to the dark fringes n+2, n+4, n+6 up to n+22 are noted. The microscope may be moved either to the left or the right side for this purpose.

The readings are tabulated in the observation column and the width of 12 dark fringes is calculated. The average width of 12 dark fringes and hence the fringe width, β, is calculated.

The length of the air wedge between the point of contact of the glass plates and the inner edge of the paper piece is measured using traveling microscope / scale.
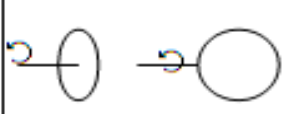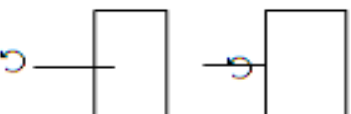
The thickness of the given paper is calculated using the formula.

$$t = \frac{\lambda L}{2\beta} \ m$$

Result:

The thickness of the given paper = _____m.

TORSION PENDULUM – OBSERVATIONS

Body	M (Kg)	Dimension (m)	Axis	Moment of Inertia I (Kgm^2)	Time for 10 osc. (s)	Mean time 't' for 10 oscillation. (s)	Period $T=t/10$ (s)	$\dfrac{I}{T^2}$ (Kgm^{2}s^{-2})
Circular plate		Radius =		$I_1 = \dfrac{MR^2}{2}$ =	1. 2. 3.		$T_1 =$	$\dfrac{I_1}{T_1^2} =$
				$I_2 = \dfrac{MR^2}{4}$ =	1. 2. 3.		$T_2 =$	$\dfrac{I_2}{T_2^2} =$
Rectangular plate		Length, L =		$I_3 = \dfrac{M(L^2 + B^2)}{12}$ =	1. 2. 3.		$T_3 =$	$\dfrac{I_3}{T_3^2} =$
				$I_4 = \dfrac{ML^2}{12}$ =	1. 2. 3.		$T_4 =$	$\dfrac{I_4}{T_4^2}$
		Breadth, B =		$I_5 = \dfrac{MB^2}{12}$ =	1. 2. 3.		$T_5 =$	$\dfrac{I_5}{T_5^2}$

$$\left(\dfrac{I}{T^2}\right)_{mean} = \underline{\hspace{3cm}} \text{ Kgm}^2\text{s}^{-2}$$

TORSION PENDULUM

Experiment No: Date:

Aim: To determine the moment of inertia of the given irregular body and Rigidity modulus of the material of the give wire.

Apparatus and other materials required: Rectangular, circular and irregularly shaped plates, steel or brass wire, chuck nuts, stop clock, pointer, metre scale, Screw gauge weight box.

Principle:

Torsion pendulum is an angular harmonic oscillation. Moment of Inertia of a body is the reluctance to change its state of rest or uniform circular motion. A body whose moment of inertia I about an axis is known, is made to oscillate about the same axis, corresponding period T is noted. The ratio $\dfrac{I}{T^2}$ is a constant for different bodies and different axes **as long as the dimension of the suspension wire remains the same.** For a torsion pendulum $T = 2\pi\sqrt{\dfrac{I}{C}}$

where C is the couple per unit twist of the wire and it is a constant. Hence, $I/T^2 = C/4\pi^2$ is a constant and $C = 8\pi n r^4/2L$

Formula:

(a) Moment of inertia of irregular body about the axis through the CG and perpendicular to its plane, I'
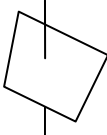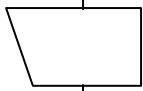
$$I_\alpha = \left(\frac{I}{T^2}\right)_{mean} \times T_\alpha^2 = \underline{\hspace{2cm}} Kgm^2$$

(b) Moment of inertia of the irregular body about the axis through the CG and parallel to its plane

$$I_\beta = \left(\frac{I}{T^2}\right)_{mean} \times T_\beta^2 = \underline{\hspace{2cm}} Kgm^2$$

(c) Rigidity modulus $n = \left(\dfrac{8\pi L}{r^4}\right)\left(\dfrac{I}{T^2}\right)$ where r is the radius and L is the length of the wire.

Axis through CG	Time for 10 sec. (s)	Mean time(t) for 10 oscillations in s	Period T=t/10 s
	1. 2. 3.		$T_\alpha =$
	1. 2. 3.		$T_\beta =$

Determination of Moment of Inertia of Irregular body

Formulae:

(a) Moment of inertia of irregular body about the axis through the CG and perpendicular to its plane, I$^{'}$

$$I_\alpha = \left(\frac{I}{T^2} \right)_{mean} \times T_\alpha^2 \quad Kgm^2$$

(b) Moment of inertia of the irregular body about the axis through the CG and parallel to its plane

$$I_\beta = \left(\frac{I}{T^2} \right)_{mean} \times T_\beta^2 \quad Kgm^2$$

Determination of rigidity modulus of the material of the wire

Radius of the wire (r) using screw gauge**.**

$$Pitch = \frac{Distance\ moved\ on\ the\ pitch\ scale}{Total\ number\ of\ rotations\ given\ to\ screwhead} = \frac{\ \ }{\ \ } = \_\_\_\_\_ mm$$

$$L.C = \frac{Pitch\ of\ the\ screw\ gauge}{Total\ number\ of\ head\ scale\ divisions} = \frac{\ \ }{\ \ } = \_\_\_\_ mm$$

Zero error (ZE) = _____.

Procedure:

- Measure the dimensions of the given circular and rectangular discs.

- Clamp one end of the wire through the chuck nut to a regular disc and other end to the top end of the retard stand.

- Twist the wire through a small angle and then let free so that the body executes torsional oscillations **(The oscillations should be in a horizontal plane. Arrest the side ward movement or wobbling if any)**.

- For each configuration of the pendulum, note down the time taken for 10 oscillations and repeat the process thrice. Tabulate this in table 1.

- Calculate mean time (t) for 10 oscillations and hence the time period T then find $\dfrac{I}{T^2}$ for each axis.

- Follow the same procedure for two different axes of the irregular body, determine the average period of oscillation for two different axes and tabulate values in table 2.

- Find out the moment of inertia of irregular body using given formulae.

- Measure the diameter of the wire using screw gauge and enter the readings in the tabular column.

- Calculate the average diameter and radius of the wire.

- Measure the length L of the wire between the check nuts.

- Calculate the rigidity modulus of the material of the wire using the given formula.

Trial No.	PSR(mm)	HSD	TR= PSR + (HSD- ZE)LC (mm)
1			
2			
3			
4			

Mean diameter of the wire, $d =$ _____mm _____ m

Mean Radius of the wire, $r =$ _____m

Length of the wire, $L =$ _____m

Rigidity modulus $n=\left(\dfrac{8\pi L}{r^4}\right)\left(\dfrac{I}{T^2}\right)$

Result:

1. The moment of inertia of irregular body about an axis perpendicular to the plane
   $I_\alpha =$ _____Kgm^2.

2. The moment of inertia of irregular body about an axis parallel to the plane

   $I_\beta =$ _____Kgm^2.

3. Rigidity modulus of the material of the wire 'n' = _____N/m^2

CALCULATIONS:

Result:

1. The moment of inertia of irregular body about an axis perpendicular to the plane
   $I_\alpha =$_____Kgm^2.

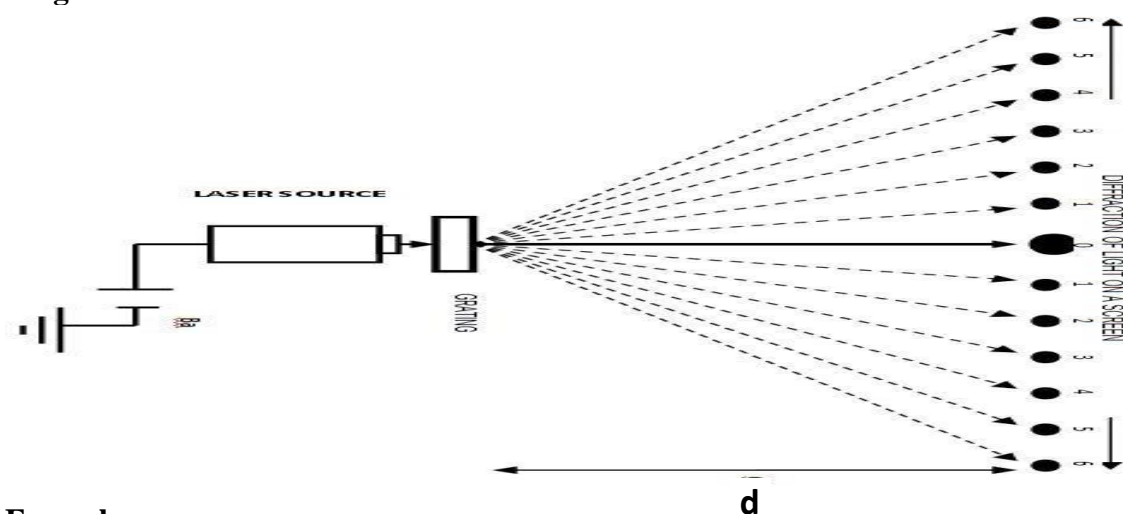2. The moment of inertia of irregular body about an axis parallel to the plane
   $I_\beta =$_____Kgm^2.

1. Rigidity modulus of the material of the wire 'n' =____ _____N/m^2

LASER DIFFRACTION

OBSERVATIONS:

Diagram:

Formula:

Wavelength of Laser source $\lambda = \dfrac{C\sin\theta_n}{n}$ ……. m

Where C is the grating constant, n is the order of the maximum, θ is the angle of diffraction

Grating Constant: $C = \dfrac{1\,\text{inch}}{\text{No. of lines (N) per inch}} = \dfrac{2.54 \times 10^{-2}\,m}{500} = 5.08 \times 10^{-5}\,m$

Distance between the grating and the screen, d = _____m

Table:

Diffraction order (n)	Distance $2X_n$(cm)	Distance X_n(cm)	Diffraction angle (θ_n) $\theta_n = \tan^{-1}\left(\dfrac{X_n}{d}\right)$	Wavelength λ $\lambda = \dfrac{C\sin\theta_n}{n}$
1.				nm
2.				nm
3.				nm
4.				nm
5.				nm
6.				nm

CALCULATIONS:

Result: The wavelength of laser light is found to be……………………………..nm

LASER DIFFRACTION

Experiment No: Date:

Aim: To determine the wavelength of a given laser beam

Apparatus and other required materials:
Laser source, Grating, Optical bench with accessories and metre scale etc.,

Principle: laser is a device, which gives a strong beam of coherent photons by stimulated emissions. The laser beam is highly monochromatic, coherent, directional and intense. The directionality of a laser beam is expressed in terms of full angle beam divergence. Divergence of a laser beam is defined as its spread with distance.

Formula:

Wavelength of Laser source, $\lambda = \dfrac{C \sin\theta_n}{n}$ ……   m

Where C is the grating constant: Distance between successive lines on the grating, n is the order of the maximum, θ is the angle of diffraction,

Procedure:
- Mount the laser on an upright and fix the upright at one end of the optical bench. Mount a screen on another upright and fix it at the other end of the optical bench.
- Mark four quadrants on a graph with 'O' as the origin and fix the graph sheet on the screen using pins. Place a laser source in front of the grating and adjust the position of the graph sheet, so that the centre of the laser spot coincides with the origin.
- Mount the grating on the grating stand such that the length of the grating is on the grating stand and move the stand closer to the laser source. Adjust the grating plane such that the diffraction pattern is along the horizontal on the screen with the central maximum is at the origin. Note down the distance 'd' between grating and the screen.
- Mark the centres of the central maximum and secondary maxima on the graph sheet using pencil and remove the graph sheet from the stand. Measure the distance between the first order maxima on either side of the central maximum as $2X_1$, for the 2nd order maxima measure the distance as $2X_2$, continue this up to 4th order maxima.
- By using the grating constant C and the angle of diffraction θ_n, calculate the wavelength of laser light for all the orders. Finally find the average value of wavelength.

   Result: The wavelength of laser light is found to be………………………….nm
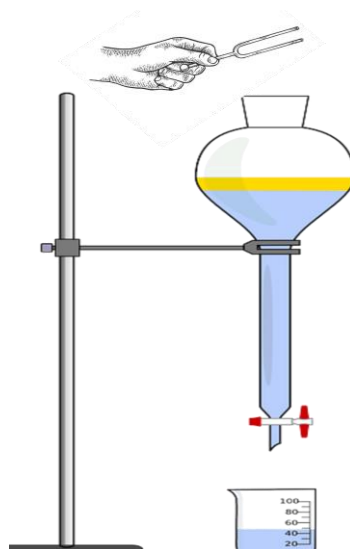
OBSERVATIONS

Experimental setup:

Table:

Serial Number	Frequency of the tuning fork f in Hz	Volume of resonating air 'V' in m^3			f^2V in m^{3}s^{-2}	$(f^2V)_{avg}$
		Trial 1	Trial 2	Mean		
1.						
2.						
3.						
4.	Unknown			$V_x = ...$		

Formulae: The unknown frequency of a tuning fork is given by,

$$f_x = \sqrt{\frac{(f^2V)\,avg}{V_x}} = ...Hz$$

Where, f_x = unknown frequency of the tuning fork, f = Known frequency of the tuning fork, V = volume of air resonating with the fork of known frequency, V_x = volume of air resonating with the fork of unknown frequency.

Calculations:

Experiment No: Date:

Aim: To determine the frequency of a tuning fork using volume resonator.

Apparatus: Aspirator bottle, tuning forks, rubber pad, beaker, measuring jar.

Principle: A resonator is a device used to analyse complex note of sound i.e. to determine particular frequencies present in the given note. The resonator is a large cylindrical vessel made of glass with a narrow neck through which a stream of air is set vibrating by running in and out of it. When a tuning fork of particular frequency is excited and held near the mouth of the resonator. The resonator exhibits a sharp resonance, when cavity of air with an opening which resonates at a natural frequency when the air is excited. The relationship of the resonate frequency to the volume of the cavity is given by the following equation.

$$f_x = \sqrt{\frac{\left(f^2 V\right)_{avg}}{V_x}} Hz$$

Where, f_x = unknown frequency of the tuning fork, f = Known frequency of the tuning fork, V = volume of air resonating with the fork of known frequency, V_x = volume of air resonating with the fork of unknown frequency.

Procedure: The aspirator bottle is filled with water. The tuning fork of known frequency is excited and it is held above the mouth of the aspirator bottle as shown in the figure. At the same time, water in the bottle is allowed to run out of aspirator bottle by opening the pinch cock attached to the out let tube. Water is allowed to flow out till the air in the resonator is in resonance with the tuning fork used. In the correct position of resonance, a note of maximum intensity will be heard. At the same moment the flow of water should be stopped using the pinch cock. The volume 'V' of water is collected in a beaker and measured using measuring jar. The volume is equal to the volume of air in the resonator, which is in resonance with the tuning fork, when vibrated. The experiment is repeated for the same tuning fork and the mean value of volume 'V ' is found and hence $f^2 V$ is calculated.

The experiment is repeated for different tuning fork as above and average $f^2 V$ is calculated. The volume of air V_x is found out with the fork of unknown frequency f_x and unknown frequency of the tuning fork is calculated using the above formula.
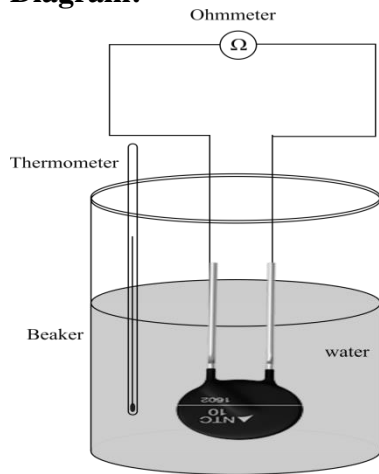
Result: The unknown frequency of given tuning fork = _____Hz.

Note: Start the experiment by choosing higher frequency tuning fork and proceed the experiment in decreasing order of their frequencies.
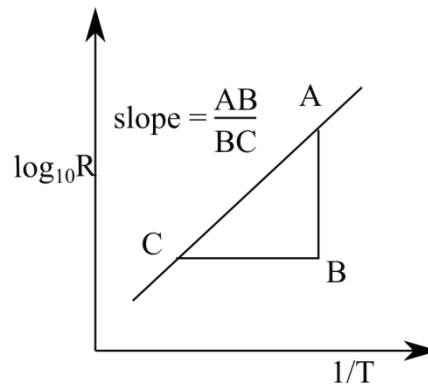
BAND GAP OF A THERMISTOR

OBSERVATIONS:

Diagram:

Model Graph:

Formula: $E_g = \dfrac{4.606 \times k \times m}{1.6 \times 10^{-19}}$ eV

Where E_g = Energy gap of a given thermistor in eV

k = Boltzmann constant = 1.381 x 10^{-23} J/K

m = Slope of the graph

Table:

Sl. No	Temp t °C	Temp T(K)	R (Ω)	log R	1/T (×10^{-3} K^{-1})
Room Temp					
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

CALCULATIONS:

Result: The energy gap (band gap) of the given thermistor is _____ eV.

Paste the data sheets here

BAND GAP OF A THERMISTOR

Experiment No: Date:

Aim: To determine the energy gap (E_g) of a Thermistor.

Apparatus: Glass beaker, Thermistor, Multi meter, Thermometer.

Principle: A thermistor is a thermally sensitive resistor. Thermistors are made of semiconducting materials such as oxides of Nickel, Cobalt, Manganese and Zinc. They are available in the form of beads, rods and discs.

The variation of resistance of thermistor is given by $R = a\, e^{\frac{b}{T}}$ where 'a' and 'b' are constants for a given thermistor, b is a measure of the band gap. The resistance of thermistor decreases exponentially with rise in temperature. At absolute zero all the electrons in the thermistor are in valence band and conduction band is empty. As the temperature increases electrons jump to conduction band and the conductivity increases and hence resistance decreases. By measuring the resistance of thermistor at different temperatures the energy gap is determined.

Formula: $E_g = \dfrac{4.606 \times k \times m}{1.6 \times 10^{-19}} eV$

Where, E_g = Energy gap of a given thermistor in eV, k = Boltzmann constant = 1.381 x 10^{-23} J/K .

m = Slope of the graph of log R vs 1/T.

Procedure:
- Make the circuit connection as shown in the figure.
- Keep the multi meter in resistance mode (200 Ω range).
- Insert the thermometer in a beaker containing tap water, thermistor and note down the resistance at room temperature.
- Immerse the thermistor in hot water at about 90°C.
- Note down the resistance of the thermistor for every decrement of 1°C in the beginning and a decrement of 2^0 up to 60°C.
- Plot the graph of log R versus 1/T and calculate the slope 'm'.
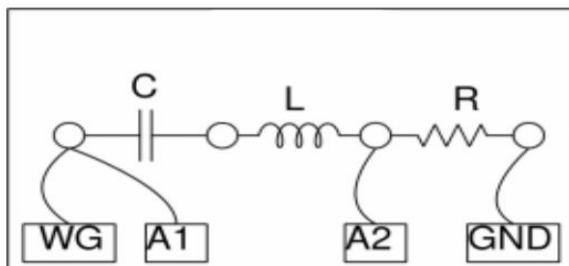- Calculate the energy gap of a given thermistor using relevant formula.

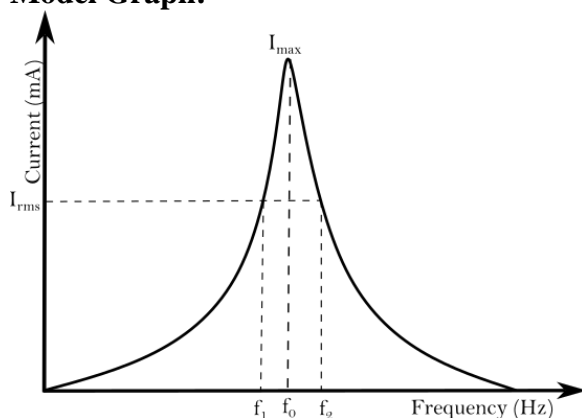**Result:** The energy gap (band gap) of the given thermistor is _____eV.

SERIES L-C-R CIRCUIT

OBSERVATIONS:

Circuit:

Model Graph:

Graph plotting with GNUPLOT

Go to respective folder in which the file is saved.

Right click at the empty area, select **'open in terminal'** and Run the following commands:

```
set timestamp
set title 'Series LCR circuit-Raj'
set xlabel 'Frequency in Hz'
set ylabel 'Current in mA'
plot 'lcr.txt' w lp
```

Marking points on the graph

- Take the cursor to the tip of the curve
- Press the scroll button on the mouse
- Note down the resonant frequency and I_{max}
- Find out I_{RMS}
- Press the scroll button on the mouse at I_{RMS}
- (Both at left and right side of the curve)
- Note down f_1 and f_2
- Export the file as PDF

Formulae

I_{max}		=	mA
$I_{rms} = I_{max}/\sqrt 2$		=	mA
Resonant Frequency f_0	=		Hz
Lower Cut off frequency $f_1 =$			Hz
Upper Cut off frequency $f_2 =$			Hz
Band width $\Delta f = f_2 - f_1$		=	Hz
Quality Factor $Q = f_0/\Delta f$	=		
Capacitance C		=	nF

$$L = \frac{1}{4\pi^2 f_0{}^2 C} = \qquad = \qquad H$$

Calculations:

Result:

1.	Resonant frequency of the circuit f_0	Hz
2.	Self-inductance of the given coil L	H
3.	Quality factor from graph Q	
4.	Band width $\Delta f = f_2 - f_1$	Hz

SERIES L-C-R CIRCUIT

Experiment No: Date:

Aim: To study the frequency response of LCR circuit and determination of a) Self-inductance of the given coil, b) Quality factor (Q- value) and c) Band-width

Apparatus: expEYES-17 kit, Resistance box, Capacitor, Inductor

Principle: In a series LCR circuit, as the frequency increases inductive reactance X_L of the circuit increases and capacitive reactance X_c decreases. At resonant frequency f_0. The inductive reactance and capacitive reactance are equal hence the total impedance of the circuit is minimum and there by the current is maximum. Therefore, at resonance $X_l = X_C$,
$2\pi f_0 L = 1/2\pi f_0 C \rightarrow L = 1/4\pi^2 f_0^2 C$

Where f_0 is the resonant frequency, L is the inductance of the coil and C is the value of capacitance.
The property of a reactive circuit to store energy is expressed in terms of quality factor or 'Q' factor. It is a figure of merit that enables us to compare different coils. It is defined as follows
$Q = \omega_0$ x energy stored / average power dissipated. $[Q = f_0/f_2 - f_1]$
The band width Δf is the difference in frequencies corresponding to current $I_{max}/\sqrt{2}$

Procedure:
1. Make the connections as per the circuit diagram.
2. Select the frequency range in the right side of GUI window.
3. Enter the value of resistance in the box (keys unplugged in the resistance box).
4. Enter the frequency interval steps in the GUI window.
5. Click on START button to plot the current versus frequency.
6. Save the data by clicking on the Sava Data button.
7. A graph of frequency versus current is plotted using GNUPLOT software, this graph is called frequency response of the L C R circuit.
8. The frequency corresponding to maximum current I_{max} is called resonant frequency and is denoted by f_0. Corresponding to a current $I = I_{max}/\sqrt{2}$ from the current axis, a horizontal line is drawn such that it cuts the graph at points A and B. From the points A and B vertical lines are drawn to cut the frequency axis at f_1 and f_2 respectively. These frequencies are lower cut off and upper cut off frequencies (or half power frequencies). The frequencies f_0, f_1 and f_2 are noted. Self-inductance of the given coil, Quality factor and Band width Δf are calculated using the relevant formulae.
9. Note down the data points from the txt file.
10. Plot the graph on the graph sheet using the data points and find out f_1, f_0 and f_2.
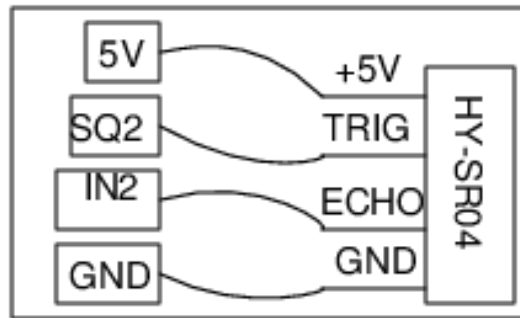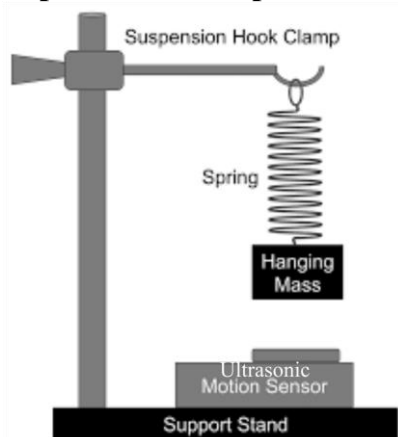
SPRING CONSTANT

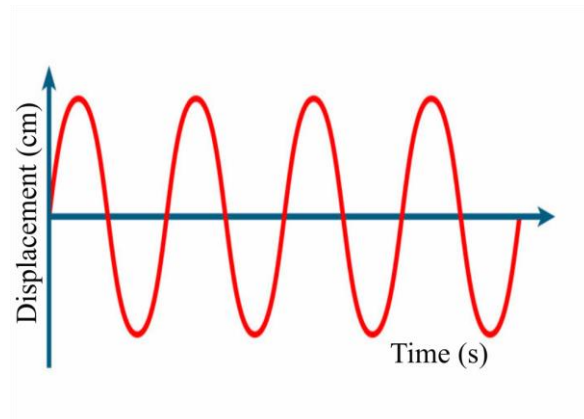## OBSERVATIONS

Ultrasonic sensor (HC-SR04)

Connections with Exp-eyes device

Experimental setup

Model graph

Formula: Spring constant is given by

$$K = 4\pi^2 \frac{m}{T^2} \ \ N/m$$

Where, *m* is the mass of the load (kg). T is the time period (s) and K is the spring constant N/m.

Graph plotting with GNUPLOT

Go to respective folder in which the file is saved.

Right click at the empty area, select **'open in terminal'** and Run the following commands:

```
set timestamp
set title 'Spring Constant-Raj'
set xlabel 'Time in S'
set ylabel 'Displacement in cm'
set multiplot layout 2,2 columns
plot 'spring1.txt' w lp
plot 'spring2.txt' w lp
plot 'springseries.txt' w lp
plot 'springparallel.txt' w lp
```

SPRING CONSTANT USING ULTRASONIC SENSOR

Experiment No: Date:

Aim: Determine spring constant for the given spring using ultrasonic sensor.

Apparatus: springs, weight hanger, slotted weights, stop watch.

Principle: Spring constant (or force constant) of a spring is given by $K = \dfrac{\text{Restoring Force}}{\text{Extension}} \text{N/m}$

Spring constant is the restoring force per unit extension in the spring. Its value is determined by the elastic properties of the spring. Elastic materials are those which retain their original dimensions after the removal of deforming forces. When material is subjected to stress, strain is produced. The restoring force is always directed opposite to the displacement. When the mass is displaced through a small distance and then released, it undergoes simple harmonic motion.

The time period **T** of oscillations of a spring is given by the relation,

$$\mathbf{T = 2\pi \sqrt{\dfrac{m}{K}} \ s}$$

By finding the time period (T) spring constant K can be determined.

Procedure:

1. Suspend one end of the given spring to a rigid support and add the slotted weights at the other end. And note down the mass of added slotted weights and weight hanger (m_1).
2. Below the load, Place an ultrasonic sensor (HC-SR04) after making the connections with the expEYES-17 hardware.
3. Keep the distance between the ultrasonic sensor and the load as 6cm.
4. Interface the experimental circuit with the CPU and click on mechanics tab and select distance by HC-SR04 echo module experiment.
5. On the screen enter the y axis value as 10cm and time as 10 seconds.
6. Pull the load slightly downwards and then release it gently so that it is set into oscillations in a vertical plane about its mean position.
7. Click on the start button. The graph will be generated on the screen.
8. Click on the 'fit curve using sine' button to generate a sine curve on the existing graph.
9. Note down the frequency in Hz and find time period of the oscillation. And then compute the spring constant value (K_1) for the load (m_1).
10. Repeat the same procedure for another identical spring (K_2) for the load (m_2)
11. Connect two springs in series combination and repeat the above activity and find K_S value. Calculate K_{eff} for series and compute the error.
12. Connect two springs in parallel combination and repeat the above activity and find K_P value. Calculate K_{eff} for parallel and compute the error

SPRING CONSTANT

OBSERVATIONS

Table 1: Spring constant K_1 for the given material

(Mass of the hanger + Mass of the slotted weights) = m_1 =_____Kg

Trial No	Frequency(Hz)	Time for one osc T_1 (s)	T_1^2	Spring constant $K_1 = 4\pi^2 \dfrac{m_1}{T_1^2}$ (N/m)
1				

Table2: Spring constant K_2 for the given material

(Mass of the hanger + Mass of the slotted weights) = m_2 =_____Kg

Trial No	Frequency(Hz)	Time for one osc T_2 (s)	T_2^2	Spring constant $K_2 = 4\pi^2 \dfrac{m_2}{T_2^2}$ (N/m)
1				

Table 3: Spring constant K_S in series combination for the given material

(Mass of the hanger + Mass of the slotted weights) = m_s =_____Kg

Trial No	Frequency(Hz)	Time for one osc T_S (s)	T_S^2	Spring constant $K_S = 4\pi^2 \dfrac{m_s}{T_s^2}$ (N/m)	$K_{eff} = \dfrac{K_1 K_2}{K_1 + K_2}$ (N/m)	Error = $K_{eff} \sim K_S$ (N/m)
1						

Table 4: Spring constant K_P in parallel combination for the given material

(Mass of the Scale + Mass of the hanger + Mass of the slotted weights) = m_P= _____Kg

Trial No	Frequency(Hz)	Time for one osc T_P (s)	T_P^2	Spring constant $K_P = 4\pi^2 \dfrac{m_p}{T_P^2}$ (N/m)	$K_P = K_1 + K_2$ (N/m)	Error= $K_{eff} \sim K_P$ (N/m)
1						

Results:

a)	The spring constant for the given springs are	K_1= _____N/m K_2=_____N/m
b)	The spring constant in series combination is	K_s= _____N/m
c)	The spring constant in parallel combination is	K_p=_____N/m

About hardware and software:
The circuit consists of a microcontroller system, an ultrasonic sensor, Expeyes hardware and a spring mass system. A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. An ultrasonic sensor measures the distance of an object using sound waves. The ultrasonic sensor consists of 4 pins (Voltage pin, Trigger Pin, ECHO pin, GND pin).Connections are made as shown in the figure, voltage pin is connected to +5V of the expEYES-17; the trig pin of the sensor is connected to the SQ2 of the expEYES-17; the echo pin is connected to the IN2; GND pin is connected to the GND of the expeyes-17. The expeyes-17 interfaced with CPU of the computer. It combines the real-time measurement capability of micro-controllers with the ease and flexibility of Python programming language for data analysis and visualization.

CALCULATIONS:

SINGLE CANTILEVER

1. State Hooke's law if elasticity.
    Stress is proportional to strain within elastic limits.
2. Supposing the breadth, length and the thickness of the cantilever are altered, is there a variation in the Young's modulus?
    No, because it is a constant for a given material.
3. In the plot of stress versus strain, at a particular value of the applied force the material passes from an elastic state to the plastic state. What is this point called?
    Yield point.
4. What is stress?
    Restoring force per unit area
5. Does the modulus of elasticity change with increase in temperature?
    Yes
6. What is the dimension of strain?
    It is a dimensionless quantity
7. What is a cantilever?
    It is a homogenous beam whose length is more compared to its transverse dimensions.

INTERFERENCE AT A WEDGE

1. What is an air wedge?
    When a monochromatic light is made to fall normally on the optical flat consisting of a thin paper piece between the two optical flats which forms an air film in wedge shape is called air wedge.
2. Name the phenomena on which this experiment is based.
    Interference of Light.
3. Define Interference
    Interference is the phenomenon of superposition of two or more light waves which are coherent in nature and coming from a monochromatic source (sodium vapour lamp).
4. What is the necessity of keeping the inclined glass plate at an angle 45^0.
    To make the light to fall normally on the air wedge apparatus. When the rays fall normally, the angle of incidence and angle of reflection are equal to zero. This done for the convenience of the experiment.
5. How are the straight fringes are formed?
    Straight fringes are formed due to the interference in thin air film formed between the lower surface of the upper glass plate (optical flat) and upper surface of the lower glass plate (optical flat).
6. What are the applications of the air wedge experiment?
    i.   It is used to determine the wavelength of the monochromatic source
    ii. it is used to determine the thickness of a thin paper.

TORSION PENDULUM

1. What is meant by Torsion Pendulum?
    A pendulum in which the oscillations are due to the torsion in the suspension wire.
2. Describe Torsion pendulum?
    It consists of a rigid body (disc, rod, etc.,) attached to the lower end of the wire, whose top end is fixed to the rigid support and it is subjected to rotational oscillations.

3. Define moment of inertia?

It is the opposition for the rotational motion. When rigid body rotates about an axis, it has tendency to oppose the change in its state of rest or of uniform rotation about its axis. This tendency is called moment of inertia of a body about the axis of rotation. Quantitatively it is the product of the mass and radius of gyration.

4. Define inertia of a body. What is the measure of the inertia of a body?

The property of a body by virtue of which every body tries to stay in its state of rest or uniform motion along a straight line unless compelled by an external force. Mass is the measure of the inertia of a body.

5. What are the factors on which moment of inertia of a body depend?

Moment of inertia depends on a) mass of the body b) The distribution of mass about the axis of rotation.

6. Why (I/T^2) is a constant for a given wire?

For a torsion pendulum, the period of torsion oscillation is $T=2\pi\sqrt{\dfrac{I}{C}}$ Where I = the moment of inertia about its axis, C = couple per unit twist of the suspended wire.

Rearranging $(I/T^2) = (C)/(4\Pi^2)$

Since "C" (couple per unit twist) is a constant for a given wire; I/T^2 is a constant.

LASER DIFFRACTION

1. What is meant by diffraction?

Bending of waves round the edges of an obstacle is called diffraction.

2. What is the condition for diffraction?

Size of the obstacle should be comparable with that of the wave length of the light source. Since grating constant and wave length are of the same order (10^{-6}metre), diffraction takes place within the grating.

3. Distinguish between diffraction and dispersion?

Diffraction: Bending of light round the edges of an obstacle is called diffraction. In this case lower the wave length lesser will be the deviation.

Dispersion: When white light passes through a prism it splits into its constituent colors. This phenomenon is called dispersion. In this case lower the wave length higher will be the deviation.

4. Distinguish between polychromatic & monochromatic source.

Polychromatic source a source having different wave lengths. Ex. Mercury vapour lamp. Monochromatic source is a source having single wave length. Ex Sodium vapour lamp.

5. What does LASER stands for?

The term LASER stands for Light Amplification by Stimulated Emission of Radiation.

6. What are the characteristics of laser radiation?

Laser radiations have high intensity, high coherence, high monochromaticity and high directionality with less divergence.

7. What is population inversion?

When the number of atoms are more in higher energy state than in the lower energy state, this condition is known as population inversion, it is essential for stimulated emission.

8. What is pumping in a laser?

It is the process in which atoms are excited to higher energy states by continuously supplying energy.

9. What is meant by the term coherence?

The state of vibration, same phase or constant phase difference is known as coherence.

10. What is an active medium?
    A solid, liquid, or gaseous medium in which population inversion can be achieved is called an active medium.
11. What is the action of an optical resonator?
    It gives the directionality to the laser beam and amplifies the laser beam.

VOLUME RESONATOR

1. What type of waves are produced in the air column?
   Longitudinal or compressional stationary waves.
2. An open end is a node or antinode?
   An antinode.
3. Is there a node or antinode at the close end of water level?
   A node.
4. Where resonance is produced?
   In the air column.
5. What is an echo?
   Echo is the effect produced when sound wave is reflected on striking a solid obstacle like wall or rock.

SERIES RESONANCE (LCR)

1. What is an Inductor?
   A non resistive coil of wire in which there will be an opposing emf when there is varying current is passing through it. It is a passive component used to store energy in the form of magnetic field.
2. What is Resistance?
   The resistance of a conductor is the opposition offered by the conductor to the flow of electric current through it. The opposition is due to the collision of electrons with ion cores of the conductor. It is independent of frequency.
3. What is Impedance?
   Impedance measure the effective opposition to the flow of current due to the reactance and resistance. It is frequency dependent.

4. What is Inductive reactance?
   The opposition offered by the inductor to the flow of AC is called inductive reactance (X_L). $X_L = \omega_L = 2\pi f L$.
5. What is capacitive reactance?
   The opposition offered by the capacitor to the flow of AC is called capacitive reactance (X_C). $X_C == 1/\omega_C = 1/C2\pi f$
6. What do you mean by resonance in LCR series circuit?
   The condition at which the current is maximum due to the matching of inductive and capacitive reactance's.
7. What is Quality factor? Explain the variation of quality factor with change in resistance of the circuit.
   It is defined as the ratio of resonant frequency to the bandwidth of the circuit. Quality factor measures the sharpness of resonance $Q = 1/R (sqrt(L/C)$

8. The smaller the value of resistance, the greater is the current at resonance and the resonance curve is sharper. As the resistance is increased, the sharpness of resonance decreases and the circuit becomes less selective.
9. What is Bandwidth?
   It is the difference between upper and lower cut off frequencies. Bandwidth is the applicable range of frequencies.
10. What are the applications of LCR resonant circuits?
    They are used as tuning circuits in radio and television receivers.

SPRING CONSTANT

1. What is Oscillatory motion?
   When a body executes back and forth motion which repeats over and again about a mean position, then the body is said to have Vibrational/oscillatory motion.
2. What is Simple Harmonic Motion?
   A body is said to be undergoing Simple Harmonic Motion (SHM) when the acceleration of the body is always proportional to its displacement and is directed towards its equilibrium or mean position.
3. What is time period?
   The time taken by the particle executing simple harmonic motion to complete one oscillation is called the time period.
4. What is frequency?
   The number of oscillations that a body completes in one second is called the frequency.
5. What is spring constant?
   Spring constant is the restoring force per unit extension in the spring.
6. For what applications should parallel springs be used and why?
   $K = K_1 + K_2 + \ldots\ldots + K_n$. This will ensure that the overall spring constant will be high, and therefore this configuration is used whenever we need a very high spring constant. (Good Shock absorbers in vehicles)
7. Why should springs be used in series?
   $1/K = 1/K_1 + 1/K_2 + \ldots\ldots + 1/K_n$. This ensures that, the overall spring constant K is lower than each individual spring constant. This will increase the amplitude of oscillations. Which can be used in sensors.
8. What determines the value of the spring constant for a particular material?
   It depends on the elastic properties of the material.