



Vidya Jyothi Institute of Technology

(An Autonomous Institution)

(Accredited by NAAC, Approved by AICTE New Delhi & Permanently Affiliated to JNTUH)
Aziz Nagar Gate, C.B. Post, Hyderabad-500 075

Department of Humanities and Sciences

Course Name : Engineering Physics Lab

Course Code : A22085

Course Designation : Laboratory work

Prerequisites : Basic practical knowledge of physics

I B Tech II Semester

(2018-2019)


Course instructor


HoD



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Engineering Physics Lab Syllabus

1. Torsional pendulum: Determination of Rigidity modulus of a material.
2. Fly-wheel: Determination of moment of Inertia.
3. Melde's experiment: Determination of frequency of electrically maintained tuning fork.
4. Sonometer: Determination of velocity of transverse wave in a string.
5. Newton's rings: Determination of the radius of curvature of the given lens by forming Newton's rings.
6. Diffraction grating: Determination of wavelength of given light using diffraction grating.
7. Dispersive power: Determination of dispersive power of prism material by using spectrometer
8. Single Slit Diffraction using Lasers- Determination of wavelength of a Monochromatic Source (LASER).
9. Stewart & Gee's experiment - Determination of magnetic field along the axis of current carrying coil
10. LCR Circuit-Determination of the Resonance frequency of forced electrical oscillator
11. RC- Circuit -Determination of the time constant of RC-circuit
12. Optical fiber: Determination of the Numerical aperture of Optical fiber.

Note: Any 10 experiments are to be performed.



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Course outcomes

Lab Code	CO	Statement (At the end of the course the student is able to)
A22085	CO 1	Characterize the mechanical properties of a given material.
	CO 2	Demonstrate various types of oscillatory and rotatory motion to determine the mechanical properties.
	CO 3	Identify the magnetic induction along the axis of current carrying coil.
	CO 4	Apply the optical phenomena to characterize optical sources and components.
	CO 5	Describe the electrical characteristics of LCR and RC circuits.



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Lab assessment rubrics

S.No.	Name of the experiment	Continuous Evaluation				
		Observation	Experiment	Viva	Record	Total
1.	Newton's rings	3	5	3	4	15
2.	Diffraction grating	3	5	3	4	15
3.	Dispersive power of Prism	3	5	3	4	15
4.	Single slit diffraction using Laser	3	5	3	4	15
5.	Melde's experiment	3	5	3	4	15
6.	Sonometer	3	5	3	4	15
7.	Torsional pendulum	3	5	3	4	15
8.	Fly-wheel	3	5	3	4	15
9.	Stewart and Gee's experiment	3	5	3	4	15
10.	LCR circuit	3	5	3	4	15
11.	RC circuit	3	5	3	4	15
12.	Numerical aperture of optical fiber	3	5	3	4	15

VIDYA JYOTHI INSTITUTE OF TECHNOLOGY

I B.TECH II SEM
BRANCH - ME-B

DEPARTMENT OF HUMANITIES AND SCIENCES
AY:2018-19

SUBJECT-Engineering Physics Lab

CONTINUOUS EVALUATION

S.No	Roll No	28-Dec	4-Jan	11-Jan	18-Jan	25-Jan	1-Feb	8-Feb	15-Feb	22-Feb	1-Mar	15-Mar	29-Mar	Total	Avg
23	18911A0368	5	9	9	12	12	11	10	12	12	10	11	11	124	10
24	18911A0369	14	15	15	15	15	15	15	15	14	15	15	15	178	15
25	18911A0371	0	10	11	12	12	10	11	12	10	11	12	10	121	10
26	18911A0372	13	12	14	14	12	14	14	14	13	14	14	14	162	14
27	18911A0373	9	7	10	11	12	13	13	13	12	13	13	12	138	12
28	18911A0374	14	15	15	15	14	15	15	15	15	15	15	15	178	15
29	18911A0375	14	15	15	15	15	15	15	15	15	14	15	15	178	15
30	18911A0376	12	14	12	14	12	14	14	14	14	14	14	15	163	14
31	18911A0377	7	8	9	10	11	12	9	12	12	12	12	12	126	11
32	18911A0378	0	10	11	12	11	10	12	10	12	12	13	12	125	10
33	18911A0379	14	15	15	15	15	15	15	15	14	15	15	15	178	15
34	18911A0380	0	9	11	12	12	11	12	12	11	12	11	10	123	10
35	18911A0381	12	14	12	14	12	14	14	14	14	14	14	15	163	14
36	18911A0382	9	7	10	11	12	13	13	13	12	13	13	12	138	12
37	18911A0383	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	18911A0384	11	12	13	14	14	14	12	14	13	13	13	13	156	13
39	18911A0385	9	7	10	11	12	13	13	13	12	13	13	12	138	12
40	18911A0386	7	10	9	12	11	13	12	13	13	12	13	13	138	12
41	18911A0387	7	8	9	10	11	12	9	12	12	12	12	12	126	11
42	18911A0388	12	14	12	14	12	14	14	14	14	14	14	15	163	14
43	18911A0389	14	15	15	15	14	15	15	15	15	15	15	15	178	15
44	18911A0390	12	14	14	14	14	13	13	12	14	14	14	14	162	14

Signature of the Faculty:

HOD - H&S



Department of Humanities and Sciences
Vidya Jyothi Institute of Technology(Autonomous)
(Accredited by NAAC& NBA Approved By A.I.C.T.E., New Delhi, Permanently Affiliated to JNTU, Hyd)
 (Aziz Nagar, C.B.Post, Hyderabad -500075)
I B.Tech-II Semester Continuous Evaluation Sheet

Academic Year: 2018-2019
 Course Name: Engineering physics Lab
 Name of the Faculty: Dr. M.Lakshmi

Regulation: R18
 Course Code: A22085
 Branch: ME-B

S.No	Roll No	Date :28/12/18					Date :4/1/19					Date :11/1/19					Date :18/1/19					Date :25/1/19					Date :1/2/19				
		O	E	V	R	T	O	E	V	R	T	O	E	V	R	T	O	E	V	R	T	O	E	V	R	T	O	E	V	R	T
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S.No	Roll No	Date :8/2/19					Date :15/2/19					Date :22/2/19					Date :01/3/19					Date :15/3/19					Date :29/3/19				
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O-Observation (3M),V-Viva (3M), R-Record (4M),E-Experiment(5M),T-Total(15M)


Course Instructor



ANURAG INSTITUTIONS

Name of the College : VIDYA JYOTHI INSTITUTE OF TECHNOLOGY

Certificate

This is to certify that the bonafide record of the practical work carried out by

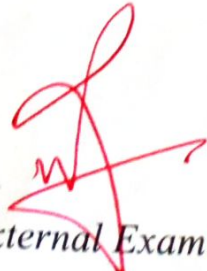
Mr/Miss... M. Rajesh kumar Roll No... 18911A0369

of Class... Mechanical - B in the Engineering physics LAB

Laboratory during the academic year 2018 - 2019


Faculty In-charge


Head of the Dept.


External Examiner

Head
Department of Humanities & Sciences
Vidya Jyothi Institute of Technology
Hyderabad - 500 075.

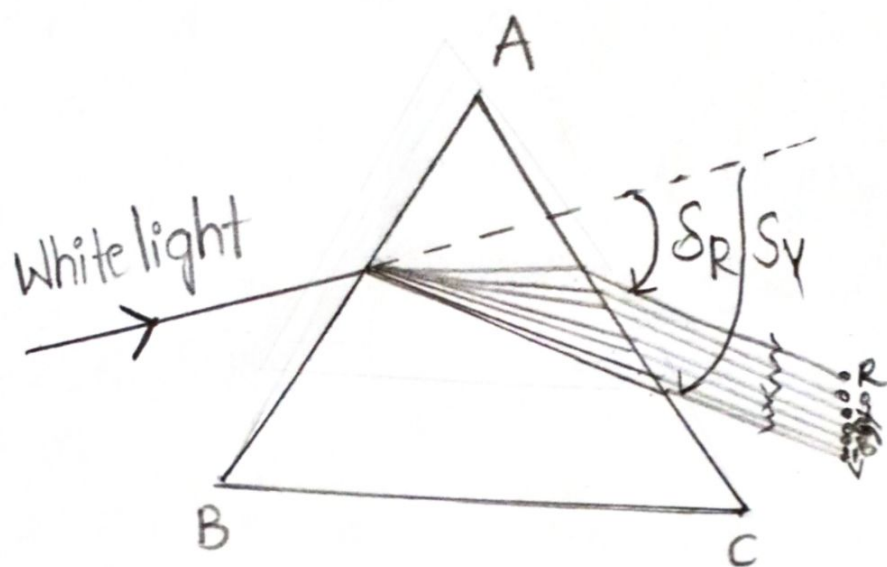
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S. No.	Date	Name of the Experiment	Page No.	Remarks
1	21/12/18	Dispersive power	01-04	Done 28/12/18
2	28/12/18	Torsional pendulum	05-07	Done 4/1/19
3	04/01/19	Moment of Inertia of Flywheel	08-13	Done 11/1/19
4	18/01/19	Newton's Ring's	14-16	Done 25/1/19
5	25/01/19	Melde's Experiment	17-19	Done 1/2/19
6	01/02/19	Frequency of A.C supply- SONOMETER	20-23	Done 15/2/19
7	15/02/19	R-circuit	24-26	Done 8/3/19
8	22/02/19	L-C-R circuit	27-31	Done 15/3/19
9	01/03/19	Numerical aperture of an optical fiber.	32-34	Done 22/3/19
10	15/03/19	Diffraction Grating	35-39	Done 22/3/19

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11	22/03/19	Stewart & Geel's Experiment	40-46	Specy 29/3/19

Diagram



Dispersion of white light by a glass prism



Aim : To determine the dispersive power of the Material of a prism.

Apparatus : Spectrometer, prism, mercury vapour Lamp and reading Lens.

principle :

The refractive index of the prism $\mu = \frac{\sin \left\{ \frac{A + D_m}{2} \right\}}{\sin \frac{A}{2}}$

A = Angle of the prism

D_m = Angle of minimum deviation

The Dispersive power of a medium is given by

$$w = \frac{\mu_v - \mu_r}{\mu - 1}$$

Here $\mu = \frac{\mu_v + \mu_r}{2}$

μ_v = Refractive Index for violet colour

μ_r = Refractive Index for red colour

Description :

Adjustment of the spectrometer :

Eye piece :

Turn the telescope towards a white surface and move the eye piece in or out until the cross

Wires are distinctly seen.

Telescope:

Adjust the telescope to get a clear image of a distant object collimator

The slit of the collimator is fixed vertically and is illuminated by a mercury vapour lamp. Bring the telescope in line with the collimator and adjust the distance of the slit from the collimator lens until a clear image of the slit with defined edges is formed in the plane of the cross wires without any parallax

procedure:

The prism table is released and the vernier table is clamped. The prism is placed on the prism table with the ground surface of the prism on the left (or) right side of collimator. The ray of light passing through collimator strikes one of the surface of prism and undergoes deviation and emerges out of the prism from the other side looking at the spectrum through the telescope the prism table is turned slowly

Observation Table

colour	Maximum deviation (a)			Direct ray position		a ~ b		Angle of minimum deviation	Refractive Index
	verine 1	verine 2	verine 3	verine 1	verine 2	V ₁	V ₂		
Yellow	MSR=38 VC=22 TR=38.36	MSR=219 VC=22 TR=219.36	0	180	180	38.36	39.36	38.86	1.5
Violet	MSR=40 VC=20 TR=40.33	MSR=221 VC=19 TR=221.3	0	180	180	40.33	41.31	40.82	1.54

$$\mu = \frac{\mu_v + \mu_y}{2} = \frac{1.5 + 1.54}{2} = \frac{3.04}{2} = 1.52$$

In such a direction that the spectrum moves toward direct path of beam. The process is continued until the prism spectrum changes its direction of motion, even though the prism table is turned in the same direction as before. In this limiting position of the spectrum, deviation of the beam is minimum.

Now the telescope is fixed on violet colour and readings on vernier-1 and vernier-2 are taken. Similarly, the readings for red colour are also taken. The prism is removed and direct ray reading is taken. Using formula given the refractive index and dispersive power are calculated.

precautions:

- 1) Care should be taken while handling the electrical connection of the source
- 2) Spectrometer telescope and collimator should be properly adjusted to produce and receive parallel beam of light rays
- 3) The slit width should be sufficiently narrow.
- 4) Prism should be placed exactly at the centre of prism table

$$\mu_y = \frac{\sin\left(\frac{60+38.86}{2}\right)}{\sin 30} \Rightarrow \mu_y = \frac{\sin(49.43)}{\sin 30} = \frac{0.75}{0.5} = 1.5$$

$$\mu_v = \frac{\sin\left(\frac{60+40.82}{2}\right)}{\sin 30} = \frac{\sin(50.41)}{\sin 30} = \frac{0.77}{0.5} = 1.54$$

The dispersive power of a medium (ω) = $\frac{\mu_v - \mu_y}{\mu - 1}$

$$\omega = \frac{1.54 - 1.5}{1.52 - 1}$$

$$\omega = 0.076$$

Title :

Date :

Page No.: 04

Result :

The dispersive power of the given material is found as 0.076

of Jeeva
28/12/20

14

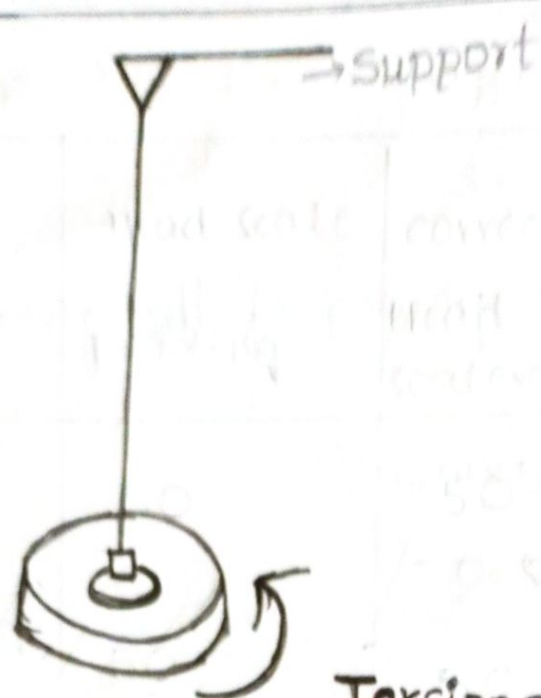
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ANURAG



Engineering Engineers

Diagram -



Torsional pendulum

Observation:

* Diameter of wire -

Sl. No	pitch scale reading a (mm)	Head scale reading	Corrected Head scale reading	L.C x corrected Head scale reading b (mm)	Diameter a+b (mm)
1)	0	50	50	$0.01 \times 50 = 0.5$	0.5 mm
2)	0	50	50	$0.01 \times 50 = 0.5$	0.5 mm

* Diameter of the disc -

Sl. No	Main scale reading	vernier coincidence	least count * vernier coincidence	Diameter (a+b) cm
1)	12.1	6	$0.1 \times 6 = 0.6$	12.7 cm
2)	12.1	6	$0.1 \times 6 = 0.6$	12.7 cm

Aim : To find the rigidity Modulus of material of the given wire

Apparatus : wire, metal disc, screw guage, vernier calliper, stop clock, meter scale.

procedure :

A circular metal disc is suspended by means of the wire as shown in the figure. The length of the wire the check is measured using a meter scale and adjusted to maximum length. The disc is slightly displaced angularly (rotated) about its axis. This produces restoring force in the wire thus establishing angular oscillations of the disc about the axis. This produces restoring a small angular displacement about the axis is produced to the disc. The disc is set to oscillate slowly by turning it through a small angle when the disc, the disc is set to oscillate the time taken for 10 oscillations is noted with the help of stop clock and the observations are

S.No	length of wire (cm)	Time for 10 oscillations			Time for one oscillation	T^2	$\frac{l}{T^2}$ (cm)
		Trial 1	Trial 2	mean +			
1)	40	94	92	93	9.3	86.49	0.462
2)	50	106	105	105.5	10.55	111.3025	0.448
3)	60	116	116	116	11.6	134.56	0.445

calculations:

Radius of the wire (a) = 0.25 mm = 0.025 cm

Mass of the disc (M) = 926 GM

Radius of disc (R) = 6.35 cm

Moment of inertia (I) = $\frac{MR^2}{2}$

$$\eta = \frac{8\pi I \cdot l}{a^4 \cdot T^2}$$

$$\eta = \frac{4 \cdot 3.14 \times 926 \times (6.35)^2 \cdot (0.452)}{(0.025)^4}$$

$$\eta = \frac{211975.9115}{(0.025)^4}$$

$$\eta = 5.431 \times 10^{11} \text{ dynes/cm}^2$$

tabulated. The procedure is repeated by decreasing the length of wire in steps of 20cm. Radius and Mass of the disc are to be found with vernier calliper and a rough balance. The mean of $\frac{1}{T^2}$ is substituted and the value of the rigidity Modulus is calculated by using Formula

Rigidity Modulus is given by

$$\eta = \frac{8\pi I}{a^4} \cdot \frac{l}{T^2} \text{ dynes/cm}^2 \quad (\because I = \frac{MR^2}{2})$$

$$\eta = \frac{4\pi MR^2}{a^4} \left(\frac{l}{T^2} \right)$$

Where

l = length of the wire between the chucks

T = Time period of oscillation

I = Moment of inertia of the disc

a = Radius of the wire

precautions :

- 1) The amplitude of oscillations should be small
- 2) The wire should be firmly fitted to the support.

Title :

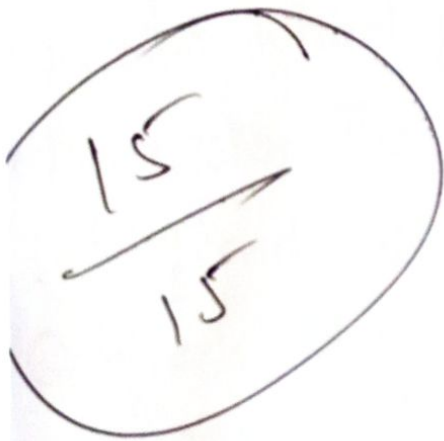
Date :

Page No. : 07

5) Time period of oscillation should be note accurately

Result :

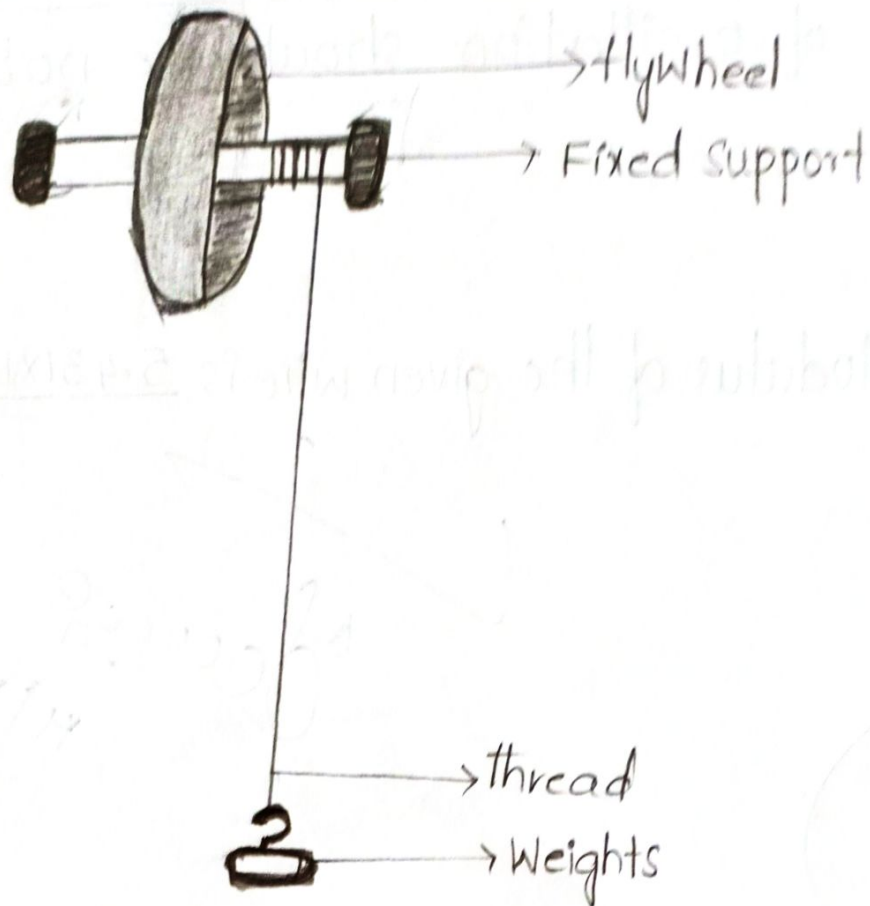
Rigidity Modulus of the given wire is 5.43×10^{11} dynes/cm²



✓
of Jeeva
4/1/19.



Diagram-



FLYWHEEL

Aim : To determine the moment of inertia of a flywheel

Apparatus: Flywheel, weight hanger, slotted weights, stop watch, metrescale.

Theory :

The flywheel consists of a heavy circular disc / massive wheel fitted with a strong axle projecting on either side. The axle is mounted on ball bearings on two fixed supports. There is a small peg on the axle. One end of a cord is looped around the peg and its other end carries the weight-hanger.

Let " m " be the mass of the weight hanger and hanging rings (weight assembly). When the mass " m " descends through a height " h ", the loss in potential energy is

$$P_{\text{loss}} = mgh$$

The resulting gain of kinetic energy in the rotating Flywheel assembly (flywheel and axle) is

$$K_{\text{flywheel}} = \frac{1}{2} I \omega^2$$

Observation:

Diameter of Axle:

S.No	MSR	VC	Total reading
1.	1.9	$5 \times 0.01 = 0.05$	1.95

Radius of Axle (r) = 0.975 cm

S.No	Mass Suspended m (gm)	Height above the ground h (cm)	No. of revolution		Time taken for N rotation t (sec)	Mean angular velocity (ω)	Moment of Inertia (I) (gm $\cdot$ cm 2)
			n	N			
1>	200	39	3	12	23.5	6.41	297510.29
2>	200	53.5	5	18	25.5	7.88	257183.76
3>	400	39	3	21	30.5	8.64	358061.71
4>	400	53.5	5	32	37.5	10.71	315927.4

case-I

$$I_1 = \frac{Nm}{N+n} \left(\frac{2gh}{\omega^2} - r^2 \right)$$

$$I_1 = \frac{12 \times 200}{12+3} \left(\frac{2 \times 980 \times 39}{(6.41)^2} - (0.975)^2 \right)$$

Where

I - moment of inertia of the flywheel assembly
 ω - angular velocity at the instant the weight assembly touches the ground.

The gain of kinetic energy in the descending weight assembly is,

$$K_{\text{weight}} = \frac{1}{2}mv^2$$

Where v is the velocity at the instant the weight assembly touches the ground.

The work done in overcoming the friction of the bearings supporting the flywheel assembly is

$$W_{\text{friction}} = nW_f$$

Where

n - number of times the cord is wrapped around the axle.

W_f - work done to overcome the frictional torque in rotating the flywheel assembly completely
Once

$$I_1 = 297510.269 \text{ gmcm}^2$$

case-2

$$I_2 = \frac{Nm}{N+n} \left(\frac{2gh}{\omega^2} - r^2 \right)$$

$$I_2 = \frac{16 \times 200}{5+16} \left(\frac{2 \times 980 \times 53.5}{(7.88)^2} - (0.975)^2 \right)$$

$$I_2 = 257183.76 \text{ gmcm}^2$$

case-3:

$$I = \frac{Nm}{N+n} \left(\frac{2gh}{\omega^2} - r^2 \right)$$

$$I_3 = \frac{21 \times 400}{21+3} \left(\frac{2 \times 980 \times 39}{(8.64)^2} - (0.925)^2 \right)$$

$$I_3 = 358061.7 \text{ gmcm}^2$$

case-4:

$$I = \frac{Nm}{N+n} \left(\frac{2gh}{\omega^2} - r^2 \right)$$

$$I_4 = \frac{32 \times 400}{32+5} \left(\frac{2 \times 980 \times 53.5}{(10.71)^2} - (0.925)^2 \right)$$

$$I_4 = 315927.41 \text{ gmcm}^2$$

Therefore from the Law of conservation of energy we get

$$P_{\text{loss}} = K_{\text{flywheel}} + K_{\text{weight}} + W_{\text{friction}} \text{ --- ①}$$

On substituting the values we get

$$mgh = \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2 + nW_f \text{ --- ②}$$

Now the kinetic energy of the flywheel assembly is expended in rotating N times against the same frictional torque. Therefore

$$NW_f = \frac{1}{2}I\omega^2 \text{ and } W_f = \frac{1}{2N}I\omega^2$$

If r is the radius of the axle, then velocity v of the weight assembly is related to r by the equation

$$v = \omega r$$

Substituting the values of v and W_f we get

$$mgh = \frac{1}{2}I\omega^2 + \frac{1}{2}mr^2\omega^2 + \frac{n}{N} \times \frac{1}{2}I\omega^2 \text{ --- ③}$$

Now solving the above equation for I

$$I = \frac{Nm}{N+n} \left(\frac{2gh}{\omega^2} - r^2 \right)$$

Mean value of Moment of inertia

$$I = \frac{I_1 + I_2 + I_3 + I_4}{4}$$

$$I = \frac{297510.269 + 257183.76 + 358061.7 + 31592.7}{4}$$

$$I = \underline{307170.7848 \text{ gmcm}^2}$$

Where, I = Moment of inertia of the flywheel assembly
 N = Number of rotation of the flywheel before it stopped.

m = mass of the rings (gms)

n = number of windings of the string on the axle

g = Acceleration due to gravity (cm/s^2)

h = Height of the weight assembly from the ground (cm)

r = radius of the axle (cm)

Now we begin to count the number of rotations, N until the flywheel stops and also note the duration of time t for N rotation. Therefore we can calculate the average angular velocity

ω_{average} in radians per second.

$$\omega_{\text{average}} = \frac{2\pi N}{t}$$

Since we are assuming that the torsional friction W_f is constant over time and angular velocity is simply twice the average angular velocity

$$\omega = \frac{4\pi N}{t} \quad \text{--- (5)}$$

procedure :

- 1) The length of the cord is carefully adjusted, so that when the weight-hanger just touches the ground, the loop slips off the peg.
- 2) A suitable weight is placed in the weight hanger
- 3) A chalk mark is made on the rim so that it is against the pointer when the weight hanger just touches the ground.
- 4) The other end of the cord is loosely looped around the peg keeping the weight hanger just touching the ground.
- 5) The flywheel is given a suitable number (n) of rotation so that the cord is wound round the axle without overlapping.
- 6) The height (h) of the weight hanger from the ground is measured.
- 7) The Flywheel is released.
- 8) The weight hanger descends and the flywheel rotates
- 9) The cord slips off from the peg when the weight hanger just touches the ground. By this time

The flywheel would have made n rotations.

- 10) A stop clock is started just when the weight hanger touches the ground.
- 11) The time taken by the flywheel to come to a stop is determined as t seconds.
- 12) The number of rotations (N) made by the flywheel during this interval is counted.
- 13) The experiment is repeated by changing the value of n and m .
- 14) From these values the moment of inertia of the flywheel is calculated using equation

$$I = \frac{Nm}{N+n} \left[\frac{2gh}{\omega^2} - r^2 \right]$$

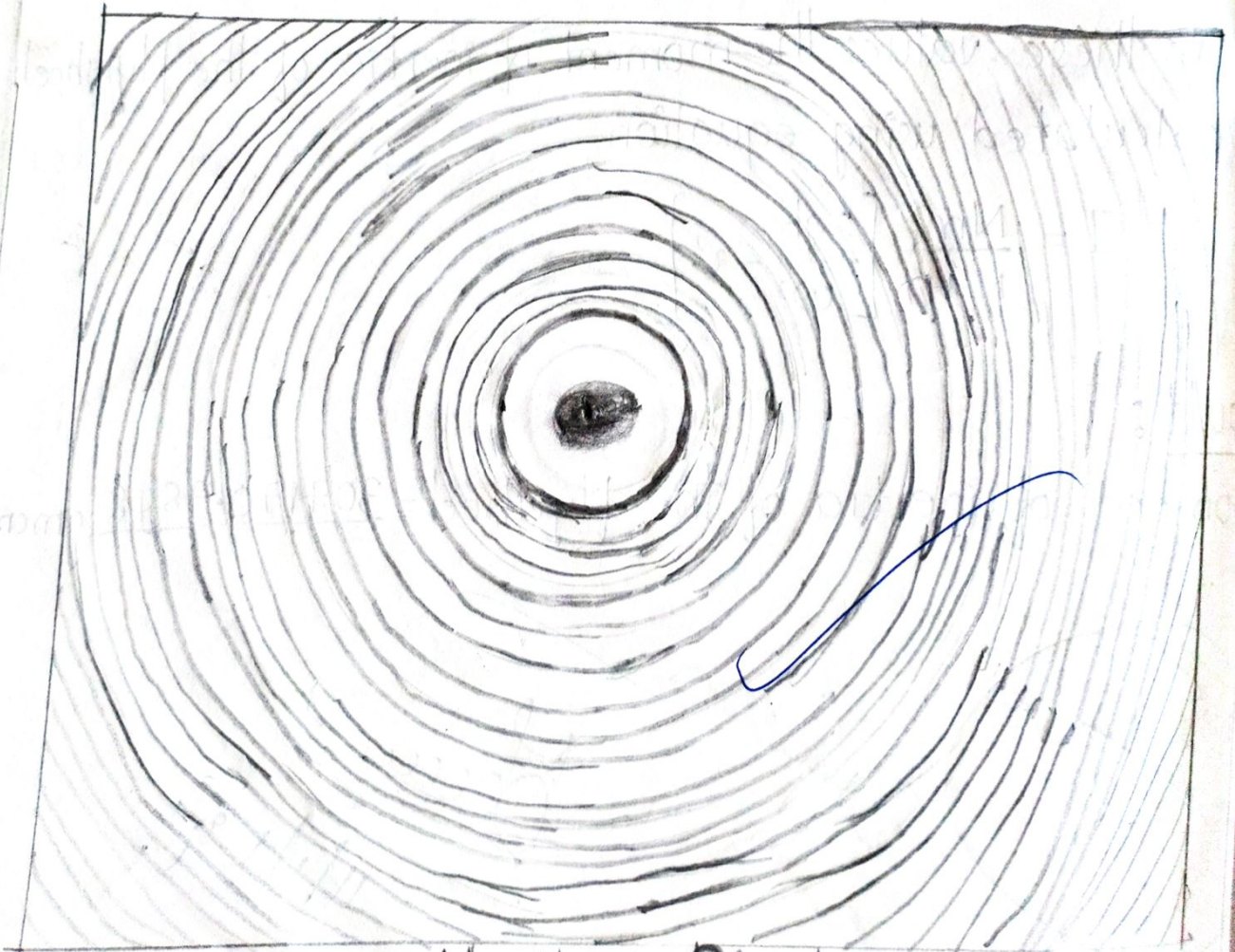
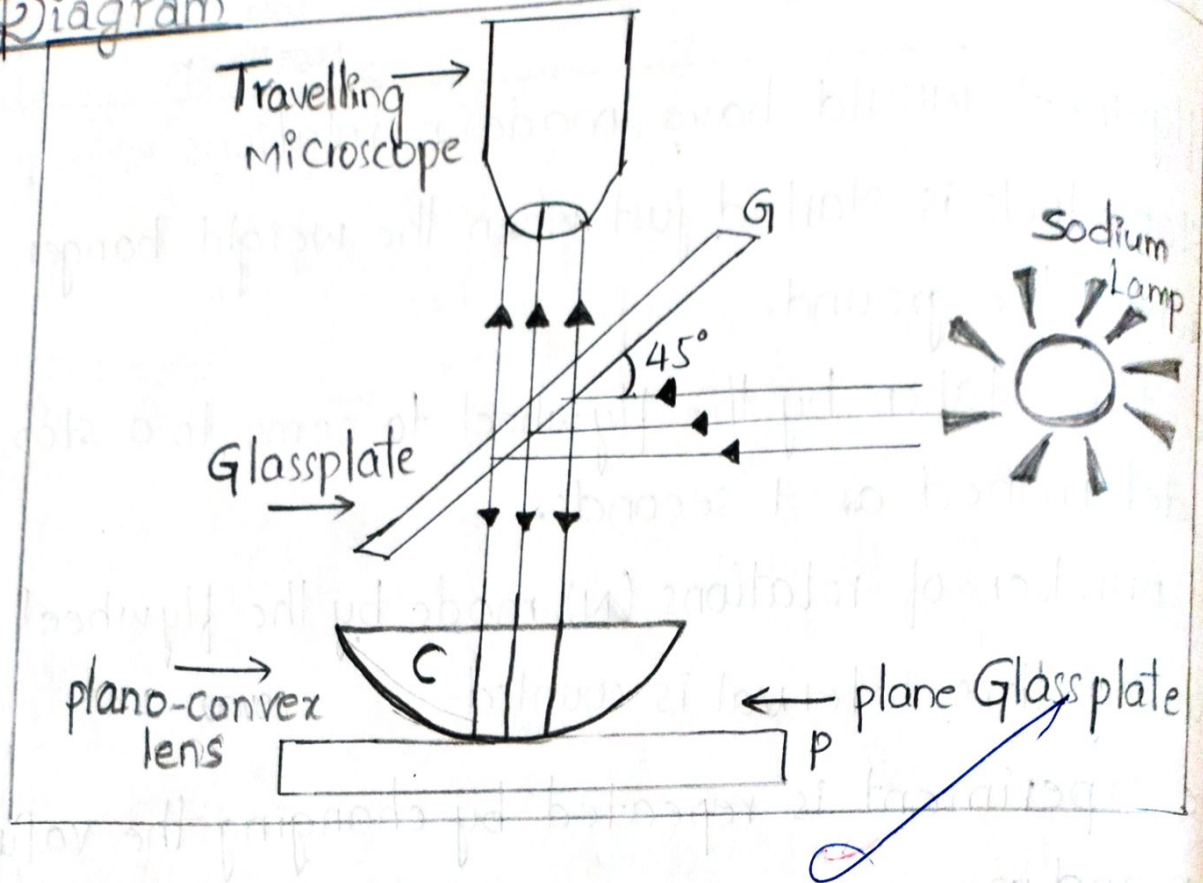
Result:

Moment of inertia of the flywheel = 307170.7848 gmcm²



Deven?
11/1/19.

Diagram



Newton's Rings

Title: Newton's Rings

Date : 18/01/19
Page No. : 14

Aim : To determine the radius of curvature of a plano convex lens using Newton's rings

Apparatus : A plano convex lens, two glass plates, sodium lamp, travelling microscope, reading lens and black paper

principle :

$$\text{Radius of curvature } R = \frac{D_m^2 - D_n^2}{4\lambda(m-n)} \text{ cm}$$

D_m = Diameter of the m th ring

D_n = Diameter of the n th ring

R = Radius of curvature of the lens (cm).

λ = Wavelength of monochromatic light ($5893\text{\AA}$)

procedure :

A glass plate (P) is placed on a black paper which kept below the microscope. A plano convex lens (C) is placed on the glass such that its curved surface touches the plane glass plate. On the glass plate the given plano convex lens is placed, the curved surface touching the glass plate as shown in fig. The glass plate (G) is kept at angle of 45° to the incident beam coming from the sodium lamp. Due to

Table-1-				
Fringe number	Microscope Reading		Diameter of the i^{th} ring $D_i = (a-b)$	D_i^2
	left (a)	Right (b)		
5	7.201	6.836	0.365	0.12
10	7.264	6.773	0.49	0.24
15	7.312	6.713	0.60 (~ 0.599)	0.36

Table-2-

Frings No	Left			Right		
	MSR	VC X LC	T	MSR	VC X LC	T
15	7.3	12×0.001 $= 0.012$	7.312	6.7	13×0.001 $= 0.013$	6.713
10	7.25	14×0.001 $= 0.014$	7.264	6.75	24×0.001 $= 0.024$	6.773
5	7.2	10×0.001 $= 0.01$	7.201	6.8	36×0.001 $= 0.036$	6.836

In case-1

$$R = \frac{D_m^2 - D_n^2}{4\lambda(m-n)} \text{ cm}$$

$$R = \frac{0.24 - 0.12}{4 \times 5890 \times 10^{-8} \times 5}$$

$$R = \frac{0.12}{20 \times 5890 \times 10^{-8}}$$

$$R = 101.8675 \text{ cm}$$

Interference of light concentric rings from as shown in the diagram which are clearly visible in the travelling Microscope. The microscope is then adjusted until the rings are in sharp focus. The point of intersection of the cross wires is brought to the centre of the rings system. Starting from the centre of the rings system the microscope is moved to left across the field of view counting the number of rings. Then the cross wires of the microscope may be set tangential to the rings. Now the reading on the horizontal scale are noted for 5th, 10th and 20th fringes. Similarly, the microscope is moved in the opposite direction say right and corresponding reading for the 5th, 10th, 15th and 20th fringes are noted. Finally, the diameters of the fringes are calculated.

Precautions:

- 1) Electric Connections of the light source should be carefully handled.
- 2) Travelling Microscope cross-wires should be

Case-2 -

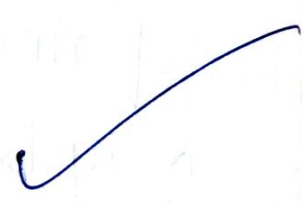
$$R = \frac{D_m^2 - D_n^2}{4 \times 5890 \times 10^{-8}}$$

$$R = \frac{0.36 - 0.24}{20 \times 5890 \times 10^{-8}}$$

$$R = \frac{0.12}{20 \times 5890 \times 10^{-8}}$$

$$R = 101.8675 \text{ cm}$$

$$\text{Average} = \frac{101.8675 + 101.8675}{2}$$

$$R = \underline{101.8675 \text{ cm}}$$


properly adjusted.

- 3> Trav-Vernier coincidence should be found without parallax error.
- 4> Travelling microscope must be moved in one direction only to avoid back lack error

Result:

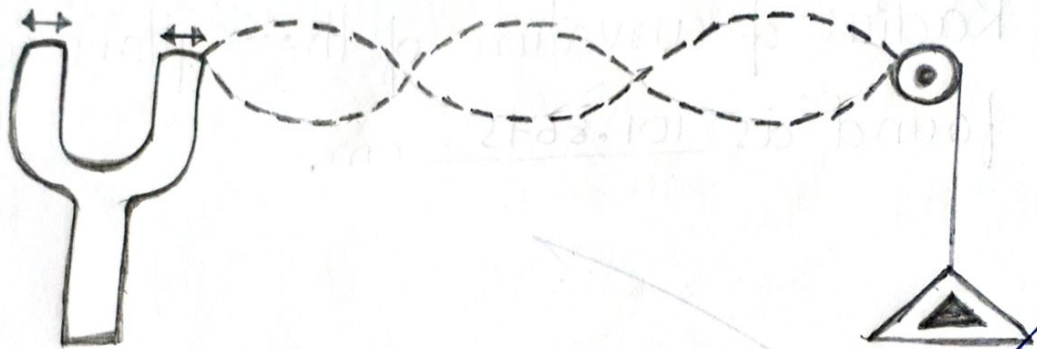
The Radius of curvature of the plano convex lens is found as 101.8675 cm.



ANIRAG
Engineering Engineers
25/1/19.



Transverse mode



Longitudinal mode

Transverse Mode ; $g = 980 \text{ gm/cm}^2$; $m = \text{Mass of the}$

S. NO	Load M (gm)	Tension $T = (M+m)g$ (dynes)	No of loops	Length of string L (cm)	Length of each Loop l (cm)	n (Hz)
1	50	$(50+17)980$ $= 65660$	10	180	$\frac{180}{10} = 18$	123.90
2.	100	$(100+17)980$ $= 114660$	8	180	$\frac{180}{8} = 22.5$	127.44 127.44

Aim -

To determine the frequency of a tuning fork in longitudinal and transverse mode of vibration

Apparatus -

Electrically maintained Tuning fork, a string, a pan, weight box and meter scale

principle -

Frequency of the tuning fork is given by

In transverse mode

$$n_T = \frac{1}{2l} \sqrt{\frac{T}{\mu}} \text{ Hertz}$$

In Longitudinal mode

$$n_L = \frac{1}{l} \sqrt{\frac{T}{\mu}} \text{ Hertz}$$

Where

T = Tension in the string (dyne)

μ = Linear density of the string (gm/cm).

n = Frequency

l = length of one loop (cm)

Longitudinal Mode -

S.No	Load M (gm)	Tension $T = (M+m)g$ (dynes)	No of loops	length of string L (cm)	length of each loop l (cm)	n (Hz)
1	50	$(50+17) 980$ $= 65660$	5	182	$182/5$ $= 36.4$	122.54
2	100	$(100+17) 980$ $= 114660$	4	182	$182/4$ $= 45.5$	129.5
						126.02

procedure :

Transverse Mode

The apparatus is first arranged in transverse mode of vibration. The Load in the pan is adjusted until convenient number of loops with well defined nodes and antinodes are formed in the string between the pulley and fork.

Length of each loop is calculated and the observations are tabulated. The experiment is repeated for different values of weights. Next the fork is arranged in longitudinal mode of vibration. The procedure is repeated as above and the observations are tabulated. The mass of pan (m), is noted. The frequency of the tuning fork in both vibration modes is calculated using the above given formula.

precautions-

- 1) Care should be taken to avoid electric shock.
- 2) Electrically maintained tuning fork should be placed properly aligned so that either only transverse or longitudinal waves propagate through the string.
- 3) Readings should be taken only when the amplitude of the stationary wave is considerable

Result-

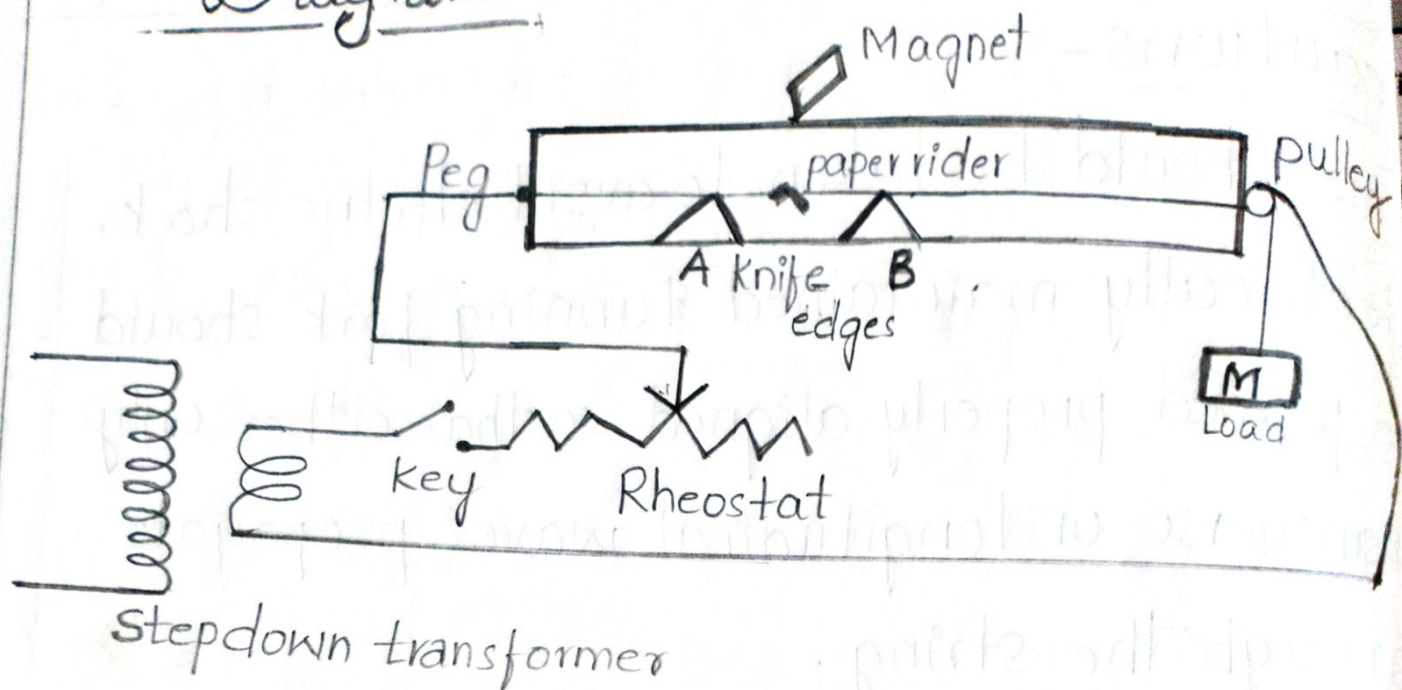
The frequency of tuning fork in transverse mode is 127.44 Hz ✓

The frequency of tuning fork in longitudinal mode is 126.02 Hz



✓
S. Jeyaraj
11/2/19.

Diagram



Title: FREQUENCY OF A.C SUPPLY -
SONOMETER

Date : 01/02/2019
Page No. : 10

Aim - To determine the frequency of A.C mains using Sonometer.

Apparatus - Brass wire, Magnet, Rheostat, step-down Transformer, Connecting wires, Loads, Screw Gauge.

Theory -

A sonometer consists of a wire stretched over a hollow rectangular box, called sounding box.

One end of the wire is fixed to a peg, situated at one end of the sounding box. The wire is stretched tight over two wedge shaped bridges A & B.

The other end of the wire after passing over the wedges shaped bridges passes over a smooth pulley, to which tension ' T ' is applied by suspending a mass ' M '.

An alternating current from a step down transformer of frequency ' n ' is passed through the sonometer kept under magnetic field perpendicular to the length of wire. Then the Fleming's Left hand rule, Mechanical force acts on the

Observation -

① To determine the frequency of A.C mains.

S.No	Load applied (M)	Length of the vibrating Loop l (cm)	Tension $T = Mg$	Frequency of A.C. mains $n = \frac{1}{2l} \sqrt{\frac{T}{m}}$
①	100	$73 - 34 = 39 \text{ cm}$	$100 \times 980 = 98000$	47.53
②	200	$78.12 - 26 = 55.12$	$200 \times 980 = 196000$	47.66
③	300	$88.52 - 21 = 67.52$	$300 \times 980 = 2,94,000$	47.551
④	400	$92 - 14 = 78$	$400 \times 980 = 392000$	47.53

Wire and pull it up and down as the sinusoidal current varies from a positive to a negative value.

If the natural frequency of sinusoidal wire is equal to the frequency of A.c waves, then resonance takes place.

procedure-

- ① One of the output terminals of a step down transformer is connected to one end of the sonometer wire.
- ② The other end of the output terminal of the step down transformer is connected to the second end of sonometer wire through plug key and a rheostat.
- ③ A Magnetic field is applied perpendicular to the length of the wire.
- ④ Tension in the wire and the length between the bridges is adjusted till the wire vibrates with Maximum amplitude. The length ' l ' of the vibrating loop is noted.

② Finding the diameter of the wire using screw gauge

S.No	P.S.R	H.S.R	L.C	correction (c)	H.S.R $\pm$ correction (c)	$D = \text{PSR} + (\text{HSR} \times \text{L.C})$
①	0	30	0.01	4	34	$0 + (34 \times 0.01)$ $= 0.34$

Here $D = 0.34 \text{ mm}$
 $D = 0.034 \text{ cm}$

Calculation -

$$m = \frac{\pi \rho D^2}{4}$$

$$m = \frac{22}{7} \times 7.85 \times \frac{(0.034)^2}{4}$$

$$m = 7.13004 \times 10^{-3}$$

case-1

$$\eta = \frac{1}{2l} \sqrt{\frac{I}{m}}$$

$$\eta = \frac{1}{2 \times 39} \sqrt{\frac{98,000}{7.13004 \times 10^{-3}}}$$

$$\eta = 47.53 \text{ Hz}$$

case-2

$$\eta = \frac{1}{2 \times 55.12} \sqrt{\frac{196000}{7.13004 \times 10^{-3}}}$$

$$\eta = 47.66 \text{ Hz}$$

- ⑤ The experiment is repeated by changing T and corresponding ' l '.
- ⑥ Using screw gauge, the diameter of the wire is noted at different places and the average diameter of the wire is noted.

The density of the wire material of the wire ' ρ ' is taken from standard table and ' m ' is calculated.

$$\text{Frequency of A.C (n)} = \frac{1}{2l} \sqrt{\frac{T}{m}}$$

$$T = mg$$

M = mass suspended to the wire.

$$m = \text{linear mass density} = \pi \rho \frac{D^2}{4}$$

D = diameter of the wire

ρ = density of wire

precautions-

- ① The pulley should be smooth.
- ② The Loads applied should be within limits

Case-3 -

$$\eta = \frac{1}{2 \times 67.52} \sqrt{\frac{294000}{7.13004 \times 10^{-3}}}$$

$$\eta = 47.551 \text{ Hz}$$

Case-4 -

$$\eta = \frac{1}{2 \times 78} \sqrt{\frac{392000}{7.13004 \times 10^{-3}}}$$

$$\eta = 47.53 \text{ Hz}$$

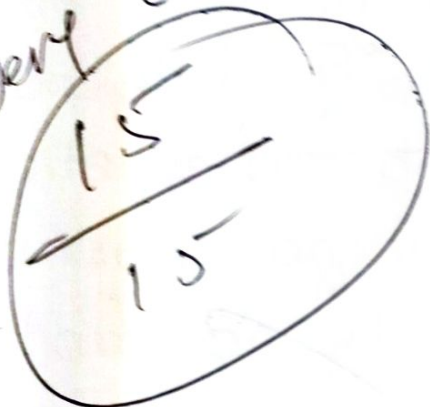
$$\text{Average } (\eta) = \frac{47.53 + 47.66 + 47.55 + 47.53}{4}$$

$$\eta = 47.56 \text{ Hz}$$

Result

Frequency of A.c mains is found to be 47.56 Hz

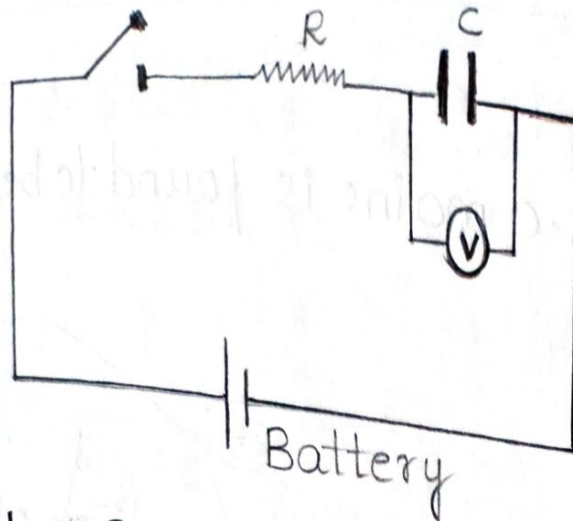
very Good



of degree
15/2/22



Circuit Diagram -



$$t_c = R \times C$$

Where $R = 10k\Omega = 10 \times 10^3\Omega$

$$C = 4700\mu F = 4700 \times 10^{-6}F$$

$$t_c = R \times C$$

$$t_c = 10 \times 10^3 \times 4700 \times 10^{-6}$$

$$= 10^4 \times 47 \times 10^2 \times 10^{-6}$$

$$t_c = \underline{47 \text{ sec}}$$

S. NO	charging		Discharging	
	Time (sec)	voltage (volts)	Time (sec)	voltage (volt)
①	0	0	0	8.8
②	5	0.9	5	8.3
③	10	1.8	10	7.33
④	15	2.4	15	6.7
⑤	20	3.1	20	6.0
⑥	25	3.6	25	5.36

Aim - To study the exponential decay of charge in R-C circuit and to determine Rc time constant.

Apparatus - Fixed power supply, switch, stop watch, voltmeter, connecting wires, combinations of Resistor and capacitors.

Theory -

When a battery is connected to a circuit consisting of elements like resistor and capacitors, voltages can develop across those elements and current can flow through them. capacitors store charge and develop a voltage drop (v) across them proportional to the amount of charge (Q) that they have stored, such that $v = \frac{Q}{C}$. The constant of proportionality (C) is called capacitance

(Measured in Farad = $\frac{\text{Coulomb}}{\text{volt}}$)

i) charging - The voltage across the capacitor during the charging phase,

$$V = V_0 (1 - e^{-t/Rc})$$

Where (V_0) is the peak voltage to which the capacitor is charged and (t) is the time

S.No	charging		discharging	
	Time (sec)	voltage	Time (sec)	Voltage (voltage)
⑦	30	4.2	30.	4.81
⑧	35	4.7	35	4.20
⑨	40	5.1	40	3.86
⑩	45	5.5	45	3.4
⑪	50	5.9	50	3.1
⑫	55	6.2	55	2.8
⑬	60	6.4	60	2.5
⑭	65	6.6	65	2.3
⑮	70	6.9	70	2.0
⑯	75	7.1	75	1.8
⑰	80	7.3	80	1.6
⑱	85	7.4	85	1.53
⑲	90	7.6	90	1.3
	95	7.7	95	1.2
	100	7.89	100	1.0
	105	8.01	105	0.9
	110	8.3	110	0.8
	115	8.5	115	0.7
	120	8.9	120	0.6

At time $t = RC$

$$V = V_0 \left(1 - \frac{1}{e}\right)$$

$$V = 0.63V_0$$

⇒ Discharging - The voltage across the capacitor, during the discharging phase,

$$V = V_0 \left(e^{-\frac{t}{RC}}\right)$$

Where (V_0) is the peak voltage to which the capacitor is charged and (t) is the time.

At time $t = RC$

$$V = V_0 \left(\frac{1}{e}\right)$$

$$\text{or } V = 0.37V_0$$

procedure:

- ① The circuit is connected as shown in figure.
- ② Taking one set of resistor and capacitor, the capacitor is charged with the help of switch 'S' till the deflection in the voltmeter is maximum and the switch 'S' is released.
- ③ The capacitor starts discharging through the Resistance 'R' and deflections decreases steadily.
- ④ The stop clock is started at suitable initial point then the deflections are noted at suitable

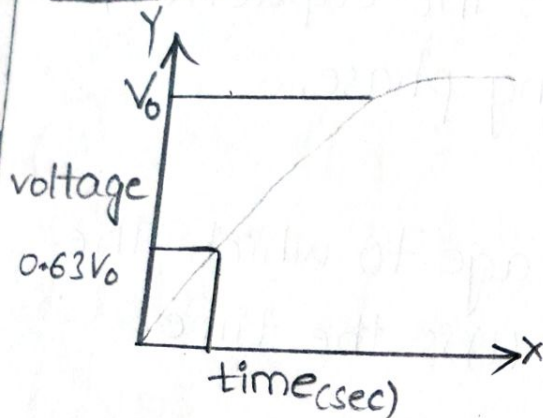
charging -

$$V = V_0 0.63 = 0.63 \times 8.9 = 5.6$$

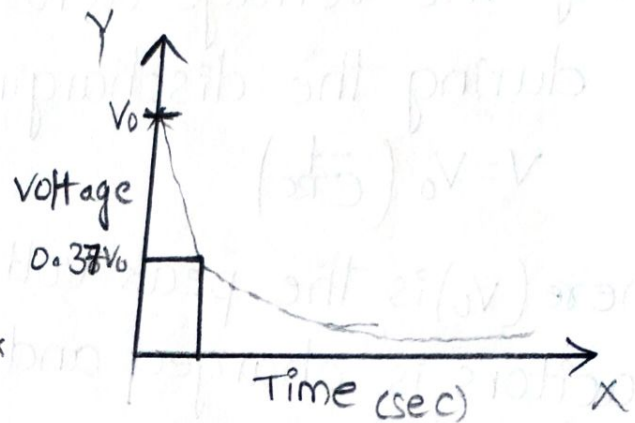
discharging -

$$V = 0.37 V_0 = 0.37 \times 8.9 = 3.3$$

Graph -



Growth of charge



Decay of charge

From Graph $t_c = 47$ sec

Intervals of time say (5 sec).

- ⑤ It is continued till the deflections fall below 0.36% of initial value.
- ⑥ The Experiment is repeated for the different values of R and C.
- ⑦ The observations are tabulated and the time constant is calculated theoretically from the values of R and C used and also from the graph.

Precautions:

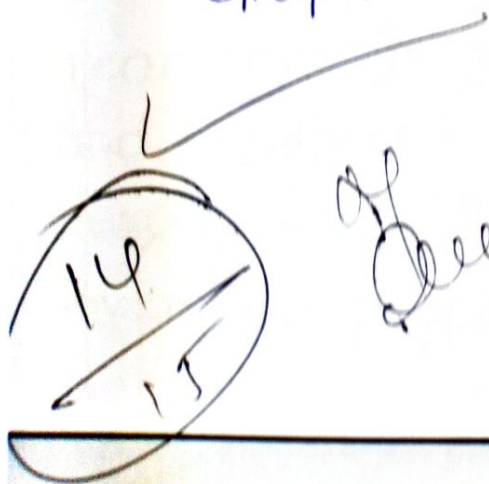
- i) Readings should be taken without parallax error.
- ii) Loose contact are avoided.
- iii) Care should be taken while handling high voltage or power cords.

Result -

The time constant of RC circuit is found as follows

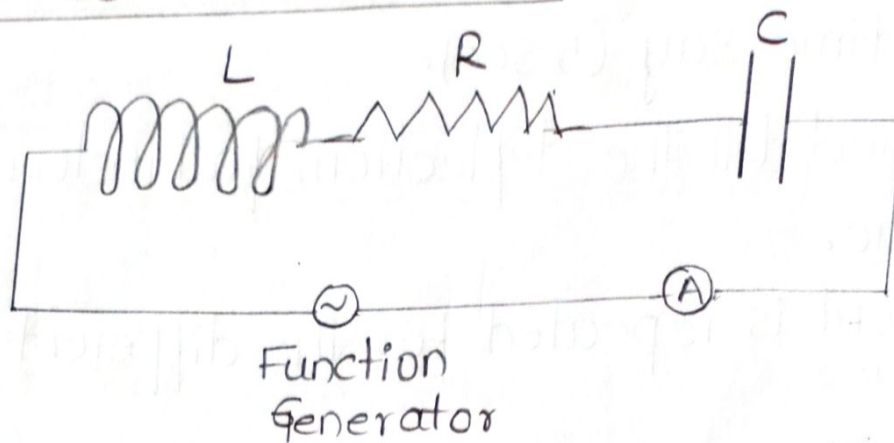
Theoretical value = 47 sec

Graphical value = 47 sec



Shreyas

Series Resonance-



Observation-

S. NO	Frequency (Hz)	Current (mA)
①	1 x 2K	1.4
②	2 x 2K	3.2
③	3 x 2K	5.8
④	4 x 2K	7.8
⑤	5 x 2K	10
⑥	6 x 2K	9.4
⑦	7 x 2K	8.8
⑧	8 x 2K	8.2
⑨	9 x 2K	7.1
⑩	10 x 2K	6

$$f_0 = 10,065.84 \text{ Hz}$$

Band width $\Delta f = f_2 - f_1$

$$\Delta f = 9.1 - 3.6$$

$$\Delta f = 5.5 \text{ Hz}$$

Aim - To draw the characteristics of a LCR series and parallel circuits and determine the band width.

Apparatus required -

Inductors, capacitors, resistors, function Generator, Ac ammeter, plug key and connecting wires.

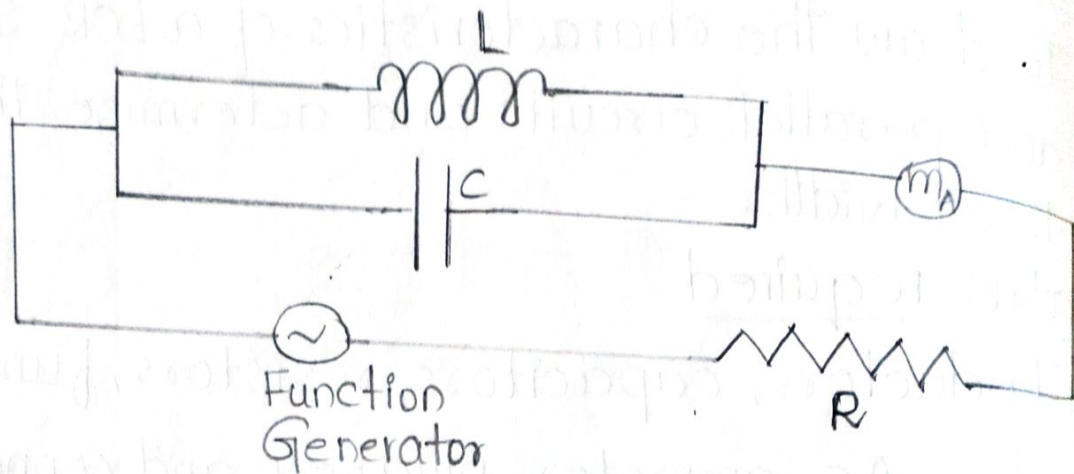
Description -

The circuit containing a capacitance C , Inductance L and resistance R , connected in series and parallel as shown in fig.1 and fig.3 respectively. When an alternating emf is applied to the circuit an alternate current flows in the circuit. The impedance of the circuit is given by

$$|Z| = \sqrt{R^2 + (X_L - X_C)^2}$$

The effective reactance is inductive or capacitive depends upon the $X_L > X_C$ or $X_L < X_C$. The inductive reactance is proportional to the frequency and increases as the frequency increases from zero onwards. The capacitive reactance is inversely proportional to the frequency, decreases from infinity value downwards.

Parallel Resonance -



Observation -

S. No	Frequency (Hz)	Current (mA)
①	1x2K	10
②	2x2K	9.1
③	3x2K	7.2
④	4x2K	4.4
⑤	5x2K	1.2
⑥	6x2K	2.3
⑦	7x2K	2.6
⑧	8x2K	3.8
⑨	9x2K	4.4
⑩	10x2K	5

$$f_0 = 10,065.84 \text{ Hz}$$

At certain frequency both reactances become equal and this frequency is called the resonant frequency. At resonance the impedance is minimum and is equal to the resistance. Under these conditions, the current $I = V/R$ and $\cos\phi = 1$ or $\phi = 0$. That is, the current and the voltage are in phase. Such a circuit is called an acceptor circuit.

In parallel resonant circuit, at resonance, the circuit does not allow the current to flow and works as perfect choke for AC. Such a circuit is called Rejecter circuit.

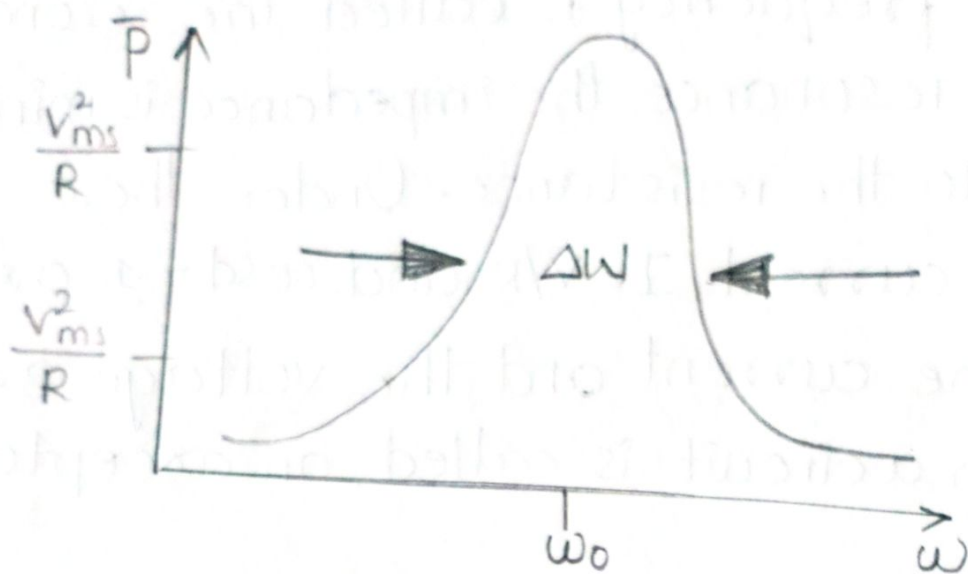
Theory -

In a series LCR circuit (Resonant), the impedance of an inductance and a capacitor are equal in magnitude and are in opposite directions, hence, the impedance of the circuit is only the resistance. Therefore, the current is maximum at the resonant frequency. The resonant frequency is given by

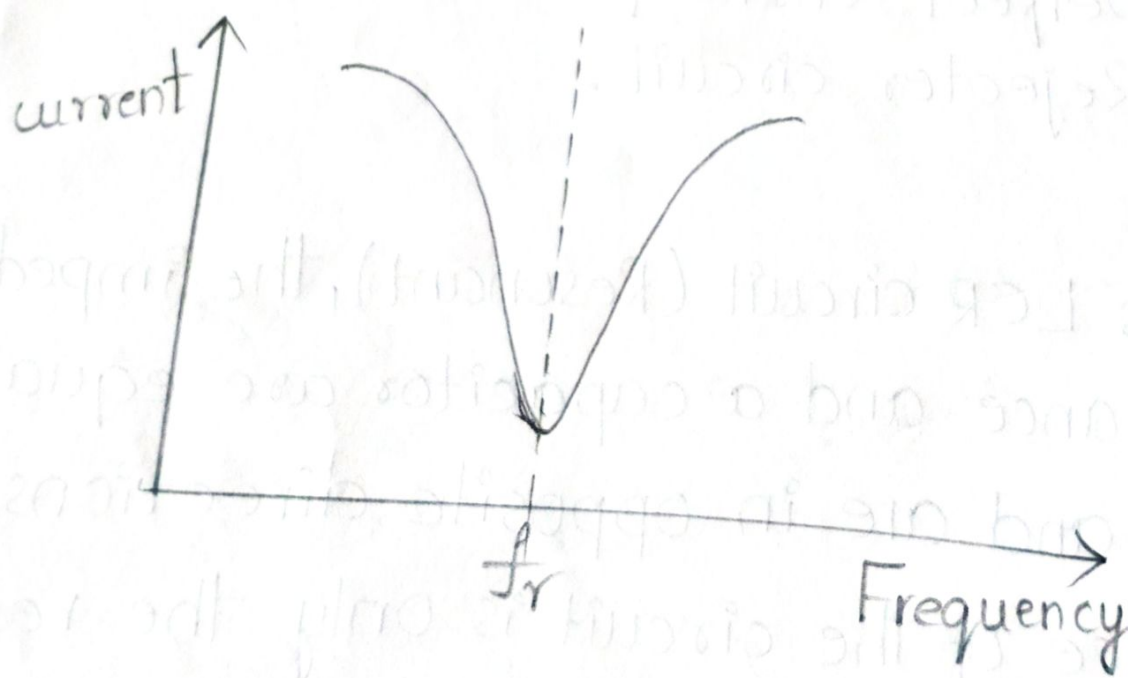
$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

Graphs -

Series Resonance -



parallel Resonance -



In a parallel LCR circuit, the impedance is maximum at the resonant frequency and the current is minimum.

The resonant frequency for parallel circuit is given by $f_0 = \frac{1}{2\pi\sqrt{LC}}$

The bandwidth of the circuit is defined as the difference in half power frequencies. These can be determined by drawing a half power line on the characteristic curve at 70.7% of the resonant or the maximum value of the curve.

procedure -

① Series Resonance -

The circuit is connected as shown in fig 1.

A fixed amplitude of a voltage at all frequencies is applied to the circuit through a function generator. By changing the frequency, the current in the circuit is noted. The readings are tabulated in table 1. A graph is drawn between frequency (x-axis) and the current (y-axis). The shape of the curve is shown in fig 2.

Band width $\Delta f = (f_2 - f_1) \text{ Hz}$

Resonant frequency $f_0 = \frac{1}{2\pi\sqrt{LC}}$

1) parallel Resonance

The circuit for the parallel resonance is shown in fig. 3. A constant amplitude of voltage at all frequencies is to be applied to the circuit through the function generator. By changing the frequency in steps, the current in the circuit is noted. The readings are tabulated in table 2 and a graph is drawn between frequency on (x-axis) and the current on (y-axis). The nature of the curve is shown in figure 4. In the graph i is the magnitude of current.

Resonant frequency $f_0 = \frac{1}{2\pi\sqrt{LC}}$

precautions

Reading should to be taken carefully to avoid parallax error

1. Amplitude, Once fixed, should not be changed in midst of the experiment.
2. Apparatus should be handled carefully as they are sophisticated appliances.

Result-Series Resonance-

1. Resonant Frequency

a) Experimental value = 10,000 Hz

b) Theoretical value = 10,065 Hz

2. Band width = 5.5 Hz

parallel Resonance -

a) Experimental value = 10,000 Hz

b) Theoretical value = 10,065 Hz



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Figure-1:

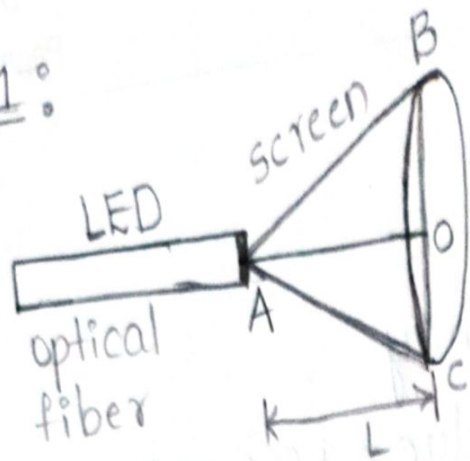
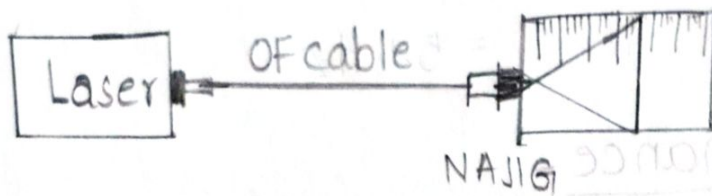


Figure-2:



Observation-

S. NO	L in mm	W in mm	NA	θ
①	8mm	10mm	0.529	31.93°
②	16mm	20mm	0.529	31.93°
③	24mm	30mm	0.529	31.93°
④	32mm	40mm	0.529	31.93°
⑤	40mm	50mm	0.529	31.93
			0.529	31.93

Aim - To determine the numerical aperture of the given optical fiber

Apparatus - One or two meters of the step index fiber, fiber optics kit and scale

Theory -

The light collecting capacity of optical fiber is called as Numerical aperture. It is defined as the product of refractive index of surrounding medium and sine of maximum acceptance angle.

$$\text{Numerical aperture (NA)} = n_0 \sin \theta_{\max} \text{ --- (1)}$$

For air as Surrounding medium $n_0 = 1$

$$\text{And } \text{NA} = \sin \theta_{\max} \text{ --- (2)}$$

For step index Fiber, NA is given by $\text{NA} = (n_1^2 - n_2^2)^{1/2}$ --- (3)
Where n_1 and n_2 are refractive indices of core and cladding materials

Let w be the diameter of a concentric ring and the distance between fiber and screen $AO = L$
(From the triangle AOB)

$$\sin \theta_{\max} = \frac{OB}{AB}$$

$$\sin \theta_{\max} = \frac{W}{(4L^2 + W^2)^{1/2}}$$

$$\sin \theta_{\max} = \frac{(W/2)}{\left(L^2 + \frac{W^2}{4}\right)^{1/2}}$$

$$NA = \sin \theta_{\max} = \frac{(W/2)}{\left(L^2 + \frac{W^2}{4}\right)^{1/2}}$$

$$NA = \sin \theta_{\max} = \frac{W}{(4L^2 + W^2)^{1/2}} \quad \text{--- (4)}$$

Knowing W and L , the NA can be calculated and substituting this NA value in eqn (2) the acceptance angle can be calculated.

procedure-

Connect one end of the optical fiber cable to po and another end to the NA jig.

- (1.) plug the AC mains, red light should appear at the end of the fiber on the NA jig. To set Maximum output turn the set po knob clock wise. The red light intensity should increase.
- (2.) Hold the acrylic white screen which has printed scale at a distance of 5mm (L) from the emitting

Fiber and you will view the red spot on the Screen. Measure the diameter W of the spot. Substitute the Measured values of L and W in the formula.

$$NA = \sin \theta_{\max} = \frac{W}{(4L^2 + W^2)^{1/2}}$$

and calculate the value of the NA of the given Fiber.

Repeat the experiment for various distances

precautions-

1. Surroundings should be perfectly dark
2. Fiber should be coupled smoothly to the connector

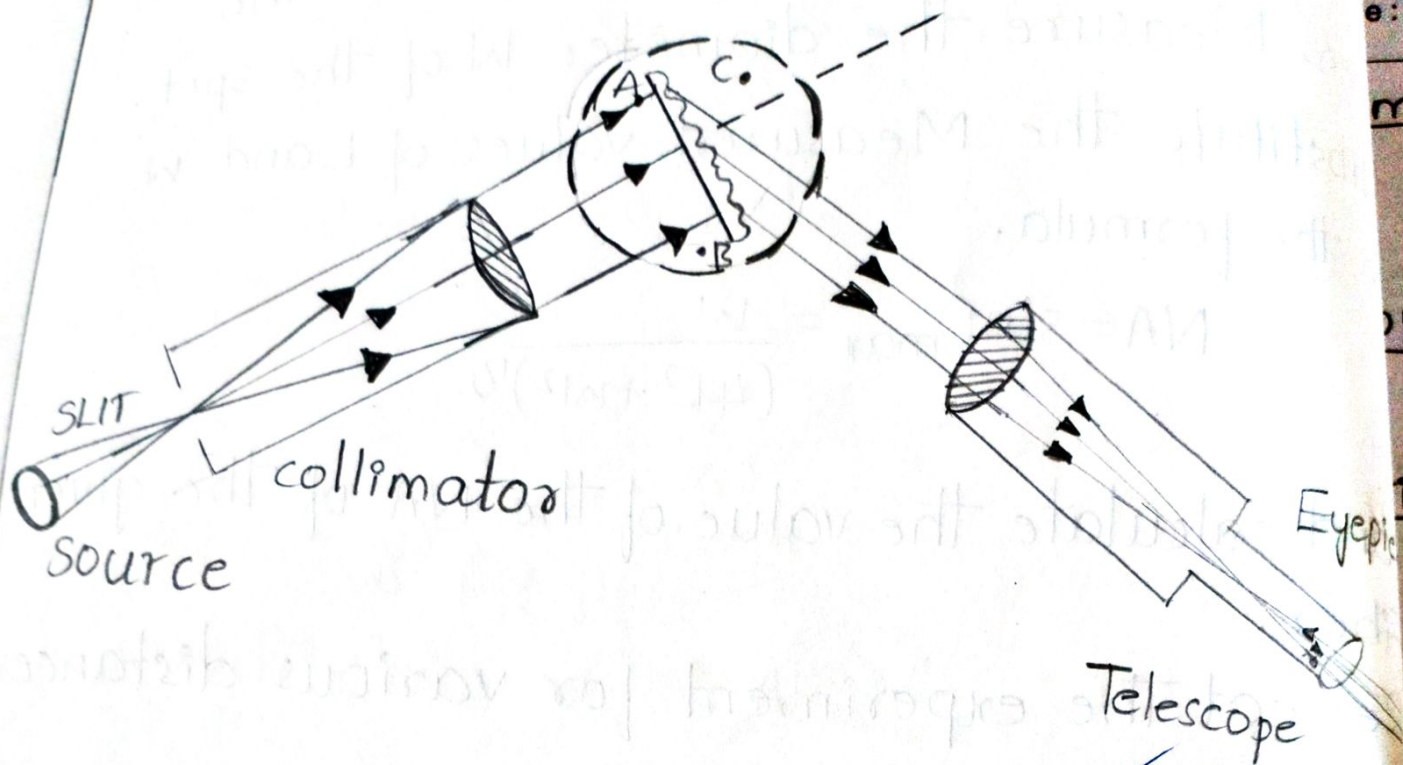
Result-

The Numerical aperture of a given optical fiber is found to be 0.529



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Diagram -



Aim - To determine the wavelength of monochromatic light using Diffraction Grating by normal Incidence method.

Apparatus - plane Diffraction Grating, spectrometer, Sodium vapour lamp and reading lens.

principle -

Wavelength of the light $\lambda = \frac{\sin \theta}{Nn}$

Where θ : Angle of diffraction

N : Number of lines per cm. on the grating

n : Order of the spectrum

Description -

A plane diffraction grating consists of a sided glass plate with equidistant parallel lines drawn very closely on it by means of diamond tip. The number of lines/inches on the grating will vary from grating to grating and will be mentioned on it. Other types of gratings are replica of the original grating on a plane celluloid film. The celluloid film is fixed on an optical plane glass

observation table -

Order of Spectrum (m)	Left hand side		Right hand side		$\theta_1 = (\text{ave})$	$\theta_2 = (\text{band})$	$\theta = \frac{\theta_1 + \theta_2}{2}$	$\lambda = \frac{c \sin \theta}{N \sin \phi}$
	V_1 (a)	V_2 (b)	V_2 (c)	V_2 (d)				
1	MSE = 37	159	382	200.5	+382.48 - 300 = +43	41.33	21.08	5.297 x 10 ⁻⁵
	VC = 12	30	28	20				
	T.R =	T.R =	T.R =	T.R =				
	$\frac{(MSE + VC)}{60}$ $= \frac{37 + 12}{60}$ $= 39.2 = 159.5$	$\frac{159 + 30}{60}$ $= \frac{189}{60}$ $= 315$	$\frac{382 + 28}{60}$ $= \frac{410}{60}$ $= 382.48$	$\frac{200 + 20}{60}$ $= \frac{220}{60}$ $= 200.5$				
2	MSE = 312.5	132	404.5	234	404.83 - 312.83 = 92	92.09	46.02	6.011 x 10 ⁻⁵
	VC = 20	7	20	12				
	T.R =	T.R =	T.R =	T.R =				
	$\frac{312.5 + 20}{60}$ $= \frac{332.5}{60}$ $= 312.83$	$\frac{132 + 7}{60}$ $= \frac{139}{60}$ $= 132$	$\frac{404.5 + 20}{60}$ $= \frac{424.5}{60}$ $= 404.83$	$\frac{234 + 12}{60}$ $= \frac{246}{60}$ $= 234$				

Care should be taken while handling the grating to avoid any scratches on the grating.

Theory -

When a parallel beam of monochromatic light from the collimator of a spectrometer is made to pass normally through a plane diffraction grating mounted on the prism table, diffraction pattern will be formed which can be observed through the telescope. The diffraction pattern will be formed which can be observed through the the telescope. The diffraction pattern consists of a central sharp lines with other symmetric lines pertaining to first, second, third, ... Other on either side of the central line. If N is the number of lines on the grating per cm, n , the order of spectrum (1, 2, 3, ...), and θ , the angle of diffraction, then the wavelength of the given light is given as

$$\lambda = \frac{\sin \theta}{Nn} A^\circ$$

$$\theta = \frac{\theta_1 + \theta_2}{4} = \frac{43 + 41.33}{4} = 21.08$$

$$\theta = \frac{\theta_1 + \theta_2}{4} = \frac{92 + 92.09}{4} = 46.02$$

$$\lambda = \frac{\sin \theta}{Nn} = \frac{\sin(21.08)}{5905 \times 1} = \frac{0.35}{5905} = 5.92 \times 10^{-5} \text{ cm}$$

$$[\because 1 \text{ inches} = 2.54 \text{ cm}] \quad N = \frac{15000}{2.54} = 5905$$

$$\lambda = \frac{\sin \theta}{Nn} = \frac{\sin(46.02)}{5905 \times 2} = \frac{0.71}{5905 \times 2} = 6.011 \times 10^{-5}$$

$$\lambda = \frac{\lambda + \lambda}{2} = \frac{5.927 \times 10^{-5} + 6.011 \times 10^{-5}}{2}$$

$$\lambda = \frac{11.938 \times 10^{-5}}{2}$$

$$\lambda = 5.969 \times 10^{-5} \text{ cm}$$

$$\lambda = 5969 \times 10^{-8} \text{ cm}$$

$$\lambda = 5969 \text{ \AA}$$

procedure -

- preliminary adjustment of the spectrometer like
- Focusing the telescope to a distance object to receive parallel beam of light rays
 - Adjusting the collimator (illuminated by the given monochromatic light) to produce parallel beam of light rays and
 - Leveling of prism (grating) table using spirit level is done.

The plane diffraction grating is mounted vertically on the grating (prism) table normal to the incident light. The telescope is made in line with the collimator by coinciding the vertical cross wire of the telescope with the vertical slit from the collimator. The readings on the spectrometer are noted as direct readings. Then the telescope is turned from its position through 90° and fixed. The grating platform is released and rotated until the image of the slit reflected from the grating is observed. The vertical crosswire of the telescope is made to

Coincide with the fixed edge of the image then grating platform is fixed. The vernier table is now rotated in the appropriate direction through 45° so that the light rays from the collimator falls normally on the grating.

Now the telescope from the initial position of the direction reading is rotated as shown in the figure 1 to one side (Left side position) until a slit of reduced intensity is observed which the first order slit is. The centre of telescope crosswire is made to coincide with the vertical slit and the spectrometer readings on either side viz., Vernier 1 and vernier 2 is noted. Then the telescope is further moved away from the center to observe the second order slit. Again the center of the cross wire is made to coincide with the slit and the vernier readings (vernier 1 and vernier 2) are noted.

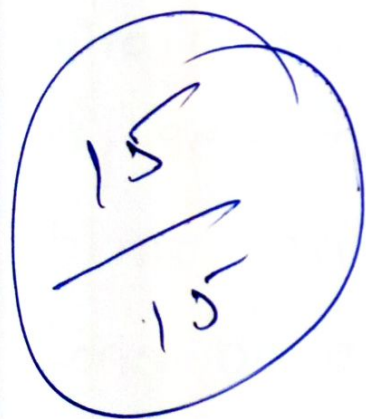
This procedure is repeated by moving the telescope to the other side of the direct reading

precautions -

- 1) Care should be taken while handling the power supply
- 2) Experiment should be conducted in absence of any other light
- 3) Readings should be taken without parallax error.
- 4) Conversion of degrees to minutes and vice versa should be done properly.

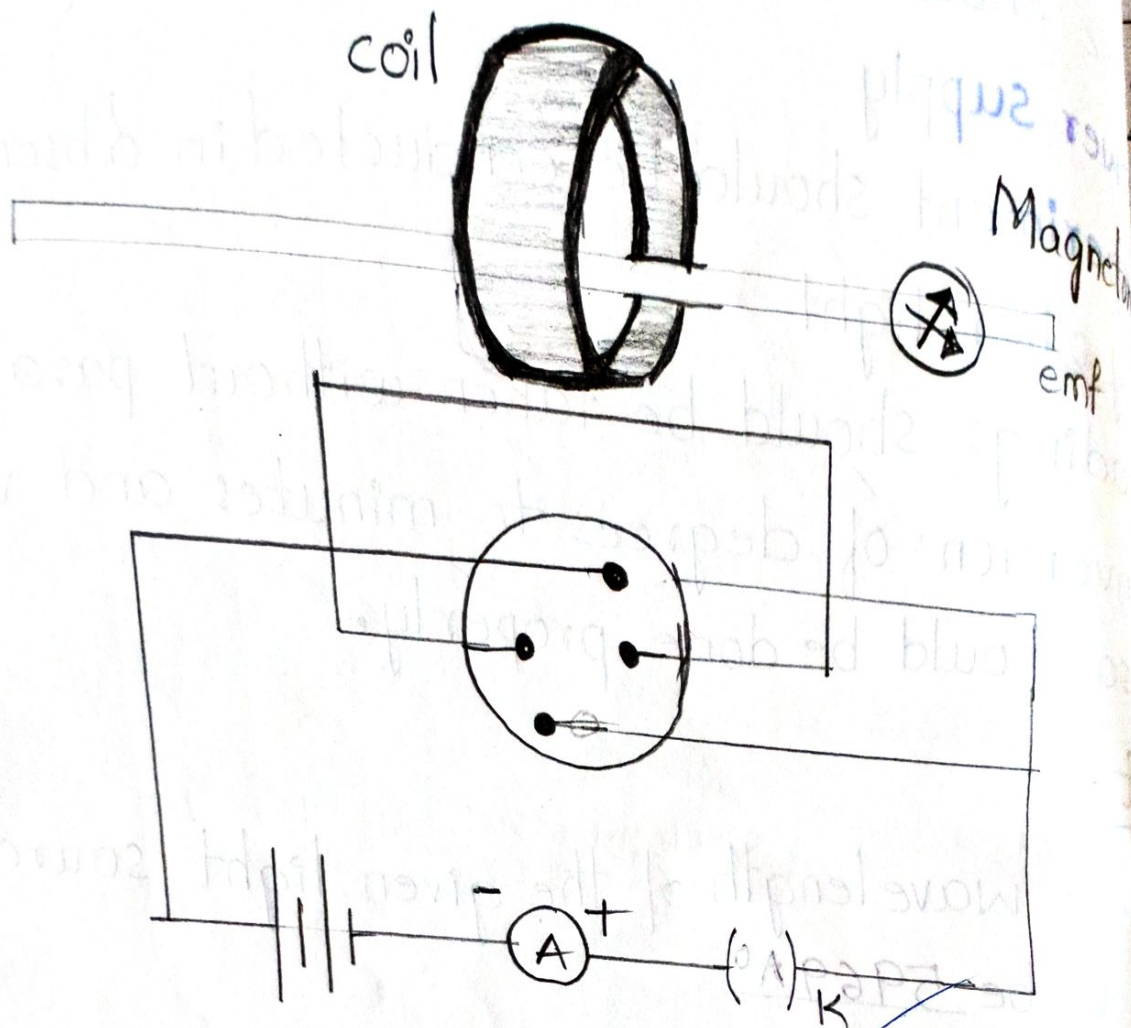
Result -

The wavelength of the given light source is found to be 5969 Å



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Diagram



Aim - To determine the magnetic induction at several points on the axis of a current carrying circular coil using Stewart and Gees type of tangent galvanometer.

Apparatus - Stewart and Gees type of tangent galvanometer, Rheostat, ammeter, Battery eliminator, commutator, Connecting wires.

Description -

The Apparatus consists of a circular frames made up of non-magnetic substance: An insulated copper wire is wound on the frame. The ends of wire are connected to the other two terminals. By selecting a pair of terminals the number of turns can be changed. The frame is fixed to a long base at the middle in a vertical plane along the breadth side. The base has leveling screws. A rectangular non-magnetic metal frame is supported on a movable platform. The platform can be moved on the frame along the

Observation

Distance (cm)	Deflection on east side				Deflection on west side				$\theta_E + \theta_W$ $= \frac{\theta_E + \theta_W}{2}$	$\tan \theta$
	θ_1	θ_2	θ_3	θ_4	θ_1	θ_2	θ_3	θ_4		
0	52	52	53	53	52	52	53	53	52.5	1.303
4	46	46	49	49	47	47	45	45	46.75	1.063
8	31	31	35	35	30	30	34	34	32.5	0.637
12	18	18	21	21	17	17	22	22	19.5	0.354

distance	Betano	θ_E	θ_W
0	4.951×10^{-5}	52.5	50.5
4	4.039×10^{-5}	47.5	46
8	2.4206×10^{-5}	33	32
12	1.345×10^{-5}	19.5	19.5

Axis of the coil. The compass is so arranged that the center of the magnetic needle always lie on the axis of the coil.

Theory-

The Magnetic field (B) at a point on the axis of a circular coil carrying current "i" is given by equation.

$$B = \frac{\mu_0 n i a^2}{2(x^2 + a^2)^{3/2}} \text{ Tesla}$$

n = Number of turns

i = Current flowing through the coil

a = radius of the coil (cm)

x = distance from the coil along the axis (cm)

μ_0 = permeability of free space.

The apparatus is arranged so that the plane of the coil is in the magnetic meridian. The frame with compass is kept at the center of the coil and the base is rotated so that the plane of the coil is parallel to the magnetic needle in the compass.

The compass is rotated so that the aluminum pointer reads 0-0. Now rectangular frame is along East-West direction. When current "I" flows through the coil, the magnetic field produced is in the direction perpendicular to the plane of the coil. The magnetic needle in the compass is under the influence of two magnetic fields "B" due to the coil carrying the current and the other Earth's magnetic field " B_e " which are mutually perpendicular to each other. The needle deflects through an angle satisfying the tangent Law

$$\tan \theta = \frac{B}{B_e} \quad \text{or} \quad B = B_e \tan \theta$$

Where B_e is the Earth's Magnetic field, " θ " is the average of mean deflection angle.

The theoretical value

$$B = \frac{\mu_0 n i a^2}{2(x^2 + a^2)^{3/2}} \text{ Tesla}$$

procedure -

With the help of deflection Magnetometer and a chalk, along time of about 1 meter its drawn on the working table to represent the magnetic Meridian. Another Line perpendicular is also drawn. The Stewart and geel's galvanometer is set with its coil in magnetic meridian is shown in the figure.

The Magnetometer is at the centre of the coil is rotated, along time of about 1 meter as shown on the working table to represent the magnetic Meridian. Another line perpendicular to the Line is also drawn. The Stewart and geel's galvanometer is set with the coil in the Magnetic Meridian as shown in the figure. The Magnetometer is moved towards east side in steps and after reverse of current are noted. The Mean deflection be noted as θ_e . The Magnetometer is further towards east in steps 50 or 4 cm,

and the deflection each time before and after reversal of current is noted until the deflections fall to 25° .

The experiment is repeated by shifting the Magnetometer towards east in steps 5 or 4 cm and the deflection each time before and after reversal of current is noted. The mean deflection be noted as θ_e .

The Magnetometer is further moved towards East in steps of 5 or 4 cm and the deflection each time before after reversal the current is noted until the deflections to 25° .

The Experiment is repeated by shifting the Magnetometer towards west from the center of the coil and the deflections are noted before and after the reversal are noted. The mean deflection is tabulated as θ_w . The mean value of θ_e and θ_w for each distance (x) is formed and B value is calculated. A graph is drawn

With in $\tan \theta$ on y-axis and the distance on x-axis is drawn.

precautions -

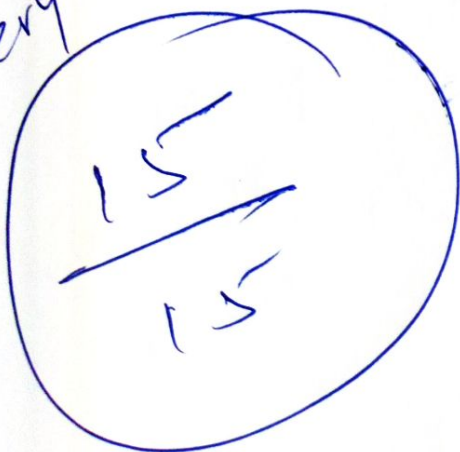
- ① The apparatus should be properly aligned with respect to earth magnetic field.
- ② Any stray Magnetic field should be kept away from the apparatus during the Experiment.
- ③ The power supply should be placed sufficiently isolated from the set-up during experiment.
- ④ Electrical connection should be properly inspected before switching on the experiment.
- ⑤ Deflection reading should be taken without parallax error.

Result-

The magnetic induction values at different points on the axis of the coil are as below.

distance	$B = B_e \tan \theta$	$B = \frac{\mu_0 n i a^2}{2(x^2 + a^2)^{3/2}}$ Tesla
0	$4.951 \times 10^{-5} \text{ T}$	$5.160 \times 10^{-5} \text{ T}$
4	4.039×10^{-5}	$4.147 \times 10^{-5} \text{ T}$
8	2.4206×10^{-5}	$2.485 \times 10^{-5} \text{ T}$
12	1.345×10^{-5}	$1.378 \times 10^{-5} \text{ T}$

Very Good



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29/3/19