II Jai Sri Gurudev II

Sri Adichunchanagiri Shikshana Trust (R)
SRI JAGADGURU CHANDRASHEKARANATHASWAMIJI INSTITUTE OF TECHNOLOGY, CHICKBALLAPUR-562 101

ENGINEERING PHYSICS LABORATORY MANUAL

NAME : Dept of physics

BRANCH : ....

SECTION : ....

BATCH : ....

DEPARTMENT OF THE PHYSICS

S.J.C.INSTITUTE OF TECHNOLOGY, CHICKBALLAPUR
P.B.No.20,B.B.No.20, B.B.Road chickballapur-562101

Affiliated to VTU, Belgaum, Approved by AICTE, New Dehli,
Accredited by NBA,NAAC and ISO-9001:2015 certified

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General Instructions

- Students have to attend all the labs regularly in time. If there is any genuine reason for absent then, with the permission of Lab in charge & HOD they have to complete the corresponding experiment within next lab.
- Everybody should come prepared for the lab by reading the procedure of the respective experiment thoroughly and reading the viva questions and answers for the corresponding experiment.
- For every lab, bring sufficient number of laboratory worksheets, graph sheets, calculator etc.
- In case of electrical experiment, before switching ON the circuit show the circuit connections to the lab in-charge.
- While leaving the experimental table, don't forget to switch off the devices.
- Before finishing the experiment, don't forget to show and get signature on at least one reading from the lab in-charge.
- Instead of doing wrong calculations ask the faculty, if there is any doubt.
- Don't use pencils for entering readings in the tabular column. Use only pen to write the readings and don't overwrite the readings.
- Plan the experimental work so that it is finished within the stipulated time.
- On the same day of performing an experiment, the concerned teacher-in-charge must sign the calculations and for that experiment, the internal assessment marks should be obtained. Failing this, one will get zero marks for that experiment.
- Lab record must be completed, before coming to the next Lab session. Record writing also carries marks.
- The lab internal assessment marks will be given by considering the following things, Average marks obtained for each experiment, lab internal marks (conducted at the end of the semester) and based on the attendance percentage.
- The minimum marks to be obtained in the lab internal assessment is 20.
- If any student fails to get minimum marks, that student is marked as NSSR (Not Satisfied Sessional Requirement) and will be detained in the lab.

- The detained student has to take the lab exam once again in the next semester and he has to attend the lab regularly and get internal marks.

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EXPERIMENT NO. DATE:

CHARGING AND DISCHARGING OF A CAPACITOR

AIM : To determine the dielectric constant of unknown dimensions of a capacitor by charging and discharging it through a resistor.

APPARATUS: Stop clock (0.1 sec resolution), Digital DC voltmeter, set of resistors, set of capacitors ,DC power supply etc.

FORMULA :

1. The capacitance of the parallel plate capacitor is given by

$$C = \frac{Tp}{0.693R} \text{ in Farad}$$

Where, Tp is half time in seconds.
R is the resistance in Ω

2. The dielectric constant of the material is given by

$$\varepsilon_r = \frac{Cd \times 10^{-6}}{A\varepsilon_0}$$

Where,

ε_0 is the permittivity of free space = $8.854\times10^{-12}\ Fm^{-1}$.

A is the area of the plate

d is the distance(separation) between the plates or thickness of the dielectric material.

PROCEDURE

1. The circuit connections are made as shown in Figure-1. R selected as 100KΩ and Capacitor C1is selected and connected to the circuit using patch cords.
2. The digital stop clock is reset by pressing reset button. The display indicates 00.0.
3. The digital DC voltmeter and 5V-power supplies are connected to the circuit as shown in Figure-1.
4. Switch S1 (Charge-discharge) is thrown to the charge position.
5. Switch S2 (Halt Start) is thrown to the start position watching the digital stop clock and the voltmeter.
6. The clock is stopped by controlling Halt-Start switch after 5 seconds and the voltmeter reading is noted. The capacitor is charged for 5 seconds and voltage across the capacitor after 5 second is noted

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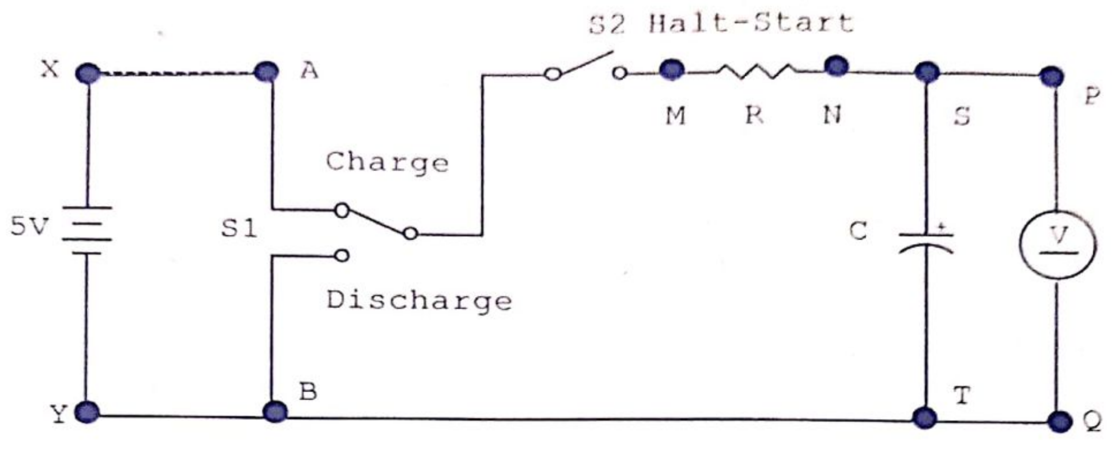
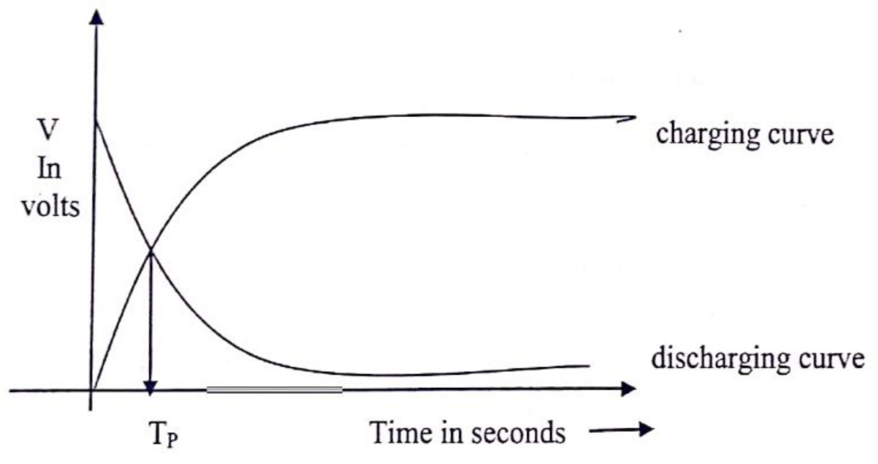
FIGURE-1, Charging and discharging of a Capacitor Electrical connections



SPECIMAN GRAPH NATURE:



OBSERVATIONS:

Physical dimensions of capacitor

Capacitor	C1	C2	C3
Length(mm)	47	114	183
Breadth (mm)	5	5	6
Separation (mm)	0.075	0.075	0.075

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TABULAR COLUMN:

$C = C_1$, $R_1 =$ K Ω

Time (sec)	voltage in volts	
	Charging voltage(V)	Discharge voltage(V)
0		
5		
10		
15		
20		
25		
30		
35		
40		
45		
50		
55		
60		
70		

CALCULATION:

1. The capacitance of the parallel plate capacitor is given by

$$C = \frac{Tp}{0.693R} \text{ in Farad}$$

2. The dielectric constant of the material is given by

$$\varepsilon_r = \frac{Cd \times 10^{-6}}{A\varepsilon_0}$$

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7. When the capacitor is charged to maximum voltage (4.5V and above), the charging is stopped and the charge discharge switch is thrown to discharge position and clock is reset.
8. The voltage across the discharging capacitor is noted after 5 seconds interval by stopping clock after five seconds. This is done until the capacitor is discharged fully.
9. Similarly Experiment is repeated for C_2 and C_3 capacitors with resistance values R_2 and R_3

RESULT: Dielectric constant of the materials is found to be ε_r =----------

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VIVA-VOCE

1. What is capacitance? What is the unit of capacitor?
Ability to store charge in a capacitor is called capacitance. The unit of capacitor is farad.
2. What is dielectric? What is its function?
Dielectric is an insulator, which is used to increase the capacitance of the capacitor.
3. Specify the color codes of resistors?
0-black,1- brown,2-red,3-orange,4- yellow,5- green,6- blue,7- violet,8- gray,9- white-10
4. Give the equations for the effective capacitance of 2 capacitors in series and parallel?
C_S=C1C2/C1+C2, C_P=C1+C2
5. Define electric flux?
Total number of lines of force emitting from a charge is called electric flux.
6. Define dielectric constant?
The dielectric constant is a factor by which capacitance of a capacitor is increased when vacuum is substituted by a dielectric medium which fills the entire region where electric field would be set on subjecting the capacitor to a static electric potential.
7. What is the half time constant?
It is the time required to chare or discharge 50% of the maximum charges on the plates of a capacitor.
8. Why are the dielectrics used in capacitors?
To increase the capacitance of a capacitor. They also increase the operating voltage of the capacitor.
9. Define capacitors.
It is electrostatic device used to store electrostatic charges.
10. Mention the factors the capacitance of capacitors depends?
i) Size and shape of the capacitors ii) Dielectric constant between the plates
iii) Surface area of the capacitors iv) Distance between the plates.
11. Define one farad?
The capacitance of the capacitors is said to be one farad if one coulomb of charge required to raise the potential of one volt.
12. Give an expression for capacitance of spherical capacitors.
$C= 4\pi r \varepsilon_r \varepsilon_0$ where ε_0 permittivity Of free space
ε_r is relative permittivity (dielectric constant) and r is the radius of the spherical capacitor.
13. Define dielectric constant.
It is the ratio of capacitance of a capacitor when placed in given medium to that in air.
14 What is the effect of temperature on dielectric constant of given capacitor?
As temperature is increases dielectric constant decreases.
15. What is the dielectric constant for perfect conductor? ∞ (Infinity).
16. Define half time.
The time at which voltage across the capacitor remains same, during charging and discharging is called half time.
17. Mention the types of capacitors.
i) spherical ii) cylindrical & iii) parallel plate capacitors.

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18. Mention the applications of capacitors.

i) Used to store electric charges

ii) Used to store Electrical energy

iii) Used in AC circuit to control current .

iv) Used to deflect an electron beam

v) Used as a potential divider

vi) Used in radio circuits for tuning

vii) Used to separate radioactive radiations & generation detection of electromagnetic radiations.

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EXPERIMENT NO: DATE:

TRANSISTOR CHARACTERISTICS

AIM : To study the input and output characteristics of the given NPN transistor in the common emitter configuration and to determine its input resistance, DC current gain and current amplification factor.

APPARATUS : Transistor characteristics kit consisting of power supply, digital voltmeter, digital milli ammeter and digital micro ammeter.

FORMULA :

1. $$\beta = \frac{\Delta I_C}{\Delta I_B} = \frac{I_{C2} - I_{C1}}{I_{B2} - I_{B1}}$$

Where ΔI_B =change in base current

ΔI_C = corresponding change in collector current

2. $$R_i = \frac{\Delta V_{BE}}{\Delta I_B}.$$

ΔV_{BE}=change in voltage across base and emitter.

ΔI_B =change in base current

3. Current amplification factor $\alpha = \frac{\beta}{1+\beta}$

PROCEDURE:

The circuit connections are made as shown in the figure.

i) To study the input characteristics:

The digital voltmeter is connected across the C-E junction. The voltage V_{CE} is adjusted to 1 V. Now the voltmeter is disconnected and connected across the base emitter junction. V_{BE} is varied in the steps of 0.1 V and the corresponding current I_B is recorded. A graph is plotted with I_B along Y-axis and V_{BE} along X-axis. From the graph the input resistance can be calculated using the formula

$$R_i = \frac{\Delta V_{BE}}{\Delta I_B}.$$

The knee voltage (cut-in voltage) i.e., the voltage beyond which current I_B increases rapidly with increase in V_{BE} is evaluated by extrapolating the steep portion of the curve.

ii) To study the output characteristics:

1. The digital voltmeter is connected across collector-emitter junction. The base current I_B is adjusted to a suitable value. V_{CE} is varied in small steps(0.1V)

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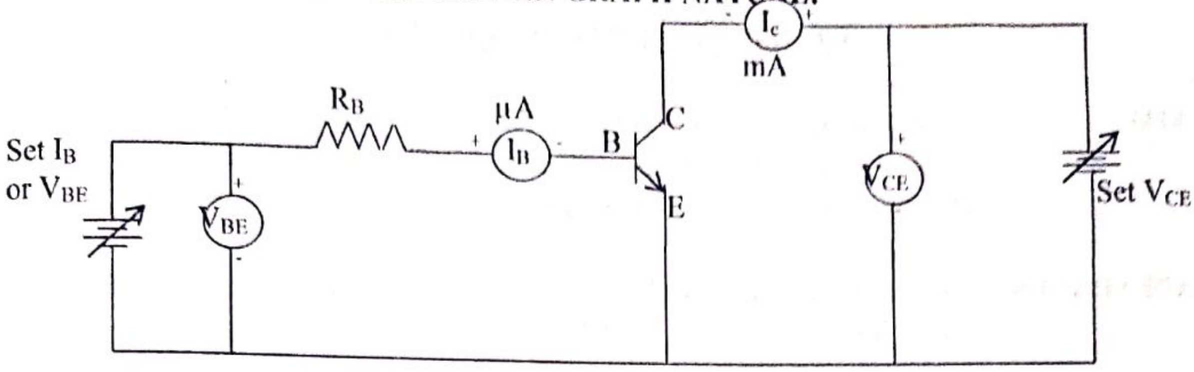
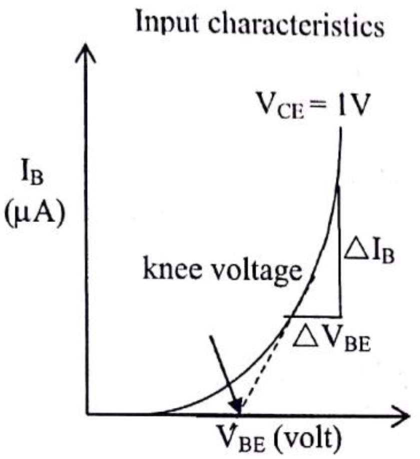
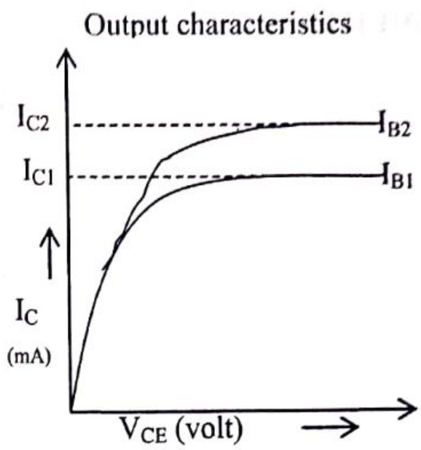
CIRCUIT DIAGRAM &SPECIMEN GRAPH NATURE:







TABULAR COLUMN:

1. Input characteristics:

V_{CE} = ……… V

V_{BE} (volt)	I_B (μA)
0	
0.1	
0.2	
0.3	
0.4	
0.5	
0.55	
0.6	
0.65	
0.7	
0.75	
0.8	
0.85	
0.9	

Knee voltage, V_{knee} = ………. V

ΔV_{BE} =--------V

ΔI_B =----------μA

Input resistance, $R_i = \dfrac{\Delta V_{BE}}{\Delta I_B}$

=

= ……. Ω.

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and in each case the collector current I_C is noted. The procedure is repeated for different I_B. A graph Output characteristics:

I_{B1} = 20 μA		I_{B2} = 40 μA	
V_{CE} (volt)	I_C (mA)	V_{CE} (volt)	I_C (mA)
0.1		0.1	
0.2		0.2	
0.3		0.3	
0.4		0.4	
0.5		0.5	
0.6		0.6	
0.7		0.7	
0.8		0.8	
0.9		0.9	
1.0		1.0	

CACULATIONS:

$$\beta = \frac{\Delta I_C}{\Delta I_B} = \frac{I_{C2} - I_{C1}}{I_{B2} - I_{B1}} =$$

$$\alpha = \frac{\beta}{1+\beta} =$$

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is plotted with V_{CE} along X-axis and I_C along Y-axis. The current gain 'β' and output resistance is found out from the graph using the formulas.

$$\beta = \frac{\Delta I_C}{\Delta I_B} \qquad R_o = \frac{\Delta V_{CE}}{\Delta Ic}.$$

RESULT:

1. Input resistance, R_i = ………..Ω
2. Current gain, β = …………
3. Current amplification factor α = ----------------

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VIVA-VOCE:

1. What are the different configurations used?
   The different configurations are A. common –base configurations B. common –emitter configurations C. common –collector configurations
2. What is current gain?
   It is the ratio of output current to the input current. It is also called as current amplification factor.
3. What is the relation between I_e, I_b and I_c ?
   The emitter current I_e is always equal to the sum of the base current I_b and the collector current I_c
   i.e. $I_e = I_b + I_c$
4. How base emitter and collector of a transistor are identified?
   The base-emitter connection is forward biased and the collector-base is reversed
5. What are the applications of a transistor?
   It is used as an amplifier, oscillator and integrated circuits.
6. What is transistor?
   Transistor is a three terminal two junctions semiconducting device.
7. Mention the types of transistor.
   They are two types' n-p-n & p-n-p transistors.
8. Which modes of configuration are generally used & why?
   CE mode because it has high current gain, high voltage gain, high power gain and impedance gain is very small.
9. Mention the applications of transistors.
   They are used in amplifiers, oscillators, analog circuits & as a switch in digital circuits.
10. What are the differences between p-n-p and n-p-n transistor?
    The first case the n type material sand witched between two p type materials. While in the second case p- type semiconductor is placed in between two n- type conductor. In p-n-p transistor majority charge carriers are holes and minority charge carriers are electrons. Where as in n-p-n transistor majority charge carriers are electrons and minority charge carriers are holes.
11. Why it is called a transistor?
    A transistor is derived from the words transfer and resistor. Because transistor is a resistor that amplifies the signals as they are transferred through it from its inputs to output terminals.
12. Under normal use of transistors, how they are biased?
    The emitter is forward biased and the collector is reverse biased.
13. On what factor does the characteristics of a transistor depends?
    It depends upon the mode of connection. Basically, there are three modes of configuration CB, CE & CC mode.
14. What are the advantages of common emitter configuration?
    High current gain, high voltage and power gain and the ratio of output impedance to input impedance is very small.

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DATE:

EXPERIMENT No:

NEWTON'S RINGS

AIM:

To determine the radius of curvature of the given Plano-convex lens by forming Newton's rings.

APPARATUS:

Plano-convex lens, optically plane glass plate, traveling microscope, sodium vapor lamp, etc.

FORMULA USED:

The radius of curvature of the given Plano-convex lens

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

Where D_m and D_n are the diameters of the m^{th} and n^{th} dark rings,

λ Is the wavelength of sodium light $=5893X10^{-10}$ m

m and n are the ordinal numbers of any two different rings.

EXPERIMENTAL SET UP:

Light from a monochromatic source is reflected by a glass plate G inclined at an angle of 45° to the horizontal. This reflected light falls on the lens placed over a fine glass plate. The rays reflected from the top and bottom layers of the thin air film overlap producing interference. The traveling microscope above the plate can be focused to see the alternate bright and dark concentric rings. These are Newton's rings.

PROCEDURE:

The least count of the Travelling microscope is determined. The traveling microscope is focused to observe the rings clearly with the dark spot the center. The cross wires are adjusted so that one of them is tangential to the ring and the other is along the diameter of rings. Starting from the center the cross wire is moved towards one side counting the dark rings. The cross wire is made tangential to 12^{th} dark ring and the traveling microscope reading is taken. Then the cross wire is made tangential to 10^{th}, 8^{th}, 6^{th}, 4^{th} and 2^{nd} dark rings and readings are taken for each case. After crossing the center of the ring system the readings corresponding to 2^{nd}, 4^{th}, 6^{th}, 8^{th}, 10^{th} and 12^{th} dark rings on the other side are taken. The diameters of the rings are calculated. The radius of curvature 'R' of the lens surface in contact with the glass plate can be calculated

RESULT:

The radius of curvature of the given plano convex lens is found to be = __________ m.

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TABULAR COLUMN:

m Order of ring	Reading of micrometer						Ring diameter $D_m = (R_2 - R_1)$ (cm)	D_m^2 (cm)	n order of ring	Reading of micrometer						Ring diameter $D_n = (R_4 - R_3)$ (cm)	D_n^2 (cm)	$D_m^2 - D_n^2$ $(cm)^2$
	Left hand side			Right hand side						Left hand side			Right hand side					
	PSR (cm)	HSR	TR (cm)	PSR (cm)	HSR	TR (cm)				PSR (cm)	HSR	TR (cm)	PSR (cm)	HSR	TR (cm)			
12	2.6	97		2.2	91				6	2.6	32		2.3	50				
10	2.6	79		2.3	10				4	2.6	04		2.3	72				
8	2.6	60		2.3	23				2	2.5	68		2.4	03				

Mean $D_m^2 - D_n^2$ = ………… Cm^2

= …………… m^2

Wavelength of sodium light, $\lambda = 5893 \times 10^{-10}$m.

m – n = ……….

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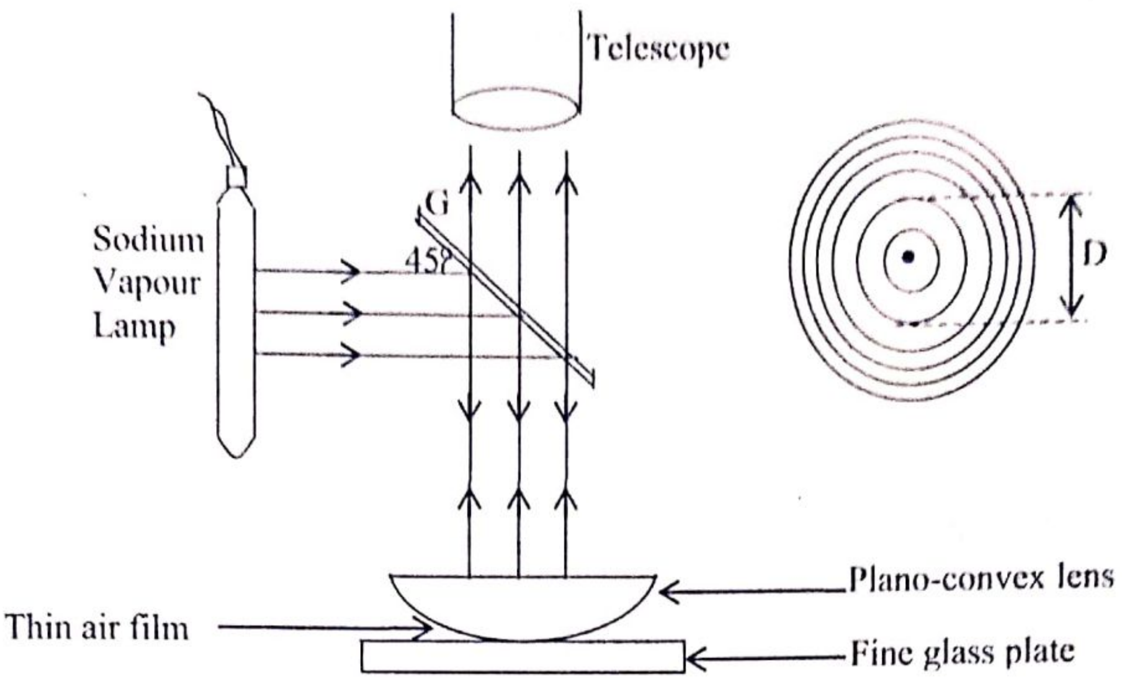
DIAGRAM:



LEAST COUNT OF TRAVELING MICROSCOPE:

$$\text{Pitch} = \frac{\text{Distance uncovered on pitch scale}}{\textit{No of ratation given to srew head}} = \text{-----------------------cm}$$

Total no. of divisions on head scale = ---------------

$$\text{L.C of the T.M} = \frac{\text{Pitch}}{\text{Total no. of divisions on head sacle}}$$

=

= ……….. cm

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CALCULATIONS:

Radius of curvature of the given Plano convex lens, $R = \dfrac{D_m^{\ 2} - D_n^{\ 2}}{4(m-n)\lambda}$

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VIVA-VOCE:

1. What are Newton's rings? Why they are circular?
   When monochromatic light is made to fall on lens system consisting of a Plano convex lens with large curvature and a plane glass plate the large no. of alternate bright and dark concentric rings are observed in the reflected and the transmitted light are called Newton's rings. The fringes are circular because the air film is symmetrical about the point of contact of the lens and glass plate.
2. What is the principle used in the experiment?
   The principle used in this experiment is interference of light.
3. Why a lens with large radius of curvature is used?
   f=2R. f-focal length, R-radius of curvature.
4. How concentric alternate dark and bright rings are formed?
   Bright rings are formed due to constructive interference, if $2t = (2n-1)\lambda/2$ and dark rings are formed due to destructive interference, if $2t = n\lambda$. Where t= thickness of film, n=0, 1, 2..........etc λ=wave length of incident light.
5. What change will be observed when a white light is used?
   When white light is used the diameter of the rings of the different colors will be different and colored rings are observed. Only the first five rings are clear and after the due to overlapping of the rings of different colors the rings are not viewed.
6. What is radius of curvature?
   The Radius of the sphere to which the lens becomes a part is called Radius of curvature.
7. What do mean by monochromatic light?
   A light having a single wave length is called monochromatic light.
8. What are coherent sources?
   The sources of light that emits light of same wave length, frequency, amplitude with constant phase or a fixed phase are known as coherent sources.
9. Is the center of the Newton's rings dark or bright? Why?
   Dark, because at the point of contact the interfering rays will have a path difference equal to $\lambda/2$. this satisfies the condition for destructive interference.
10. What are Newton's rings?
    Newton's rings are alternate bright and bright rings observed due to interference of light.
11. How are these rings formed?
    Due to interference of light reflected from the lower spherical surface of the lens and the upper surface of the plane glass plate.
12. Are the rings equispaced?
    No, With the increase of the diameter the rings get closer and closer.
13. On what factors does the diameter of the ring depend?
    It depends upon i) Wavelength of light used
    ii) Refractive index of the film enclosed and
    iii) Radius of curvature of the lens surface in contact with glass plate
14. Define interference.
    The modification and the redistribution of light energy due to superposition of two or more waves is known as interference.
15. Why do you hold the glass plate at 45° to the vertical?
    This will make the angles of incident and reflection is zero.
16. Why the central fringe is always dark?
    At the point of contact the thickness of air film is zero, i.e, the path difference between the two

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interfering beams is zero, therefore the central fringe is always dark.

17. What will happen if white light source is used instead of sodium lamp? Colored fringes with a dark center will be observed. In this case the violet color will come across first near to the center.

18. Why the violet color will come across first near to the center?
Because the diameter of the ring is directly proportional to the square root of the wave length of light used. In white light, violet has the shorter wavelength and red has longer wavelength.

19. What will happen if few drops of a transparent liquid are introduced between the lens and the glass plate?
The diameter the rings is reduced by a factor of $\sqrt{\mu}$. Where, μ. Is the refractive index of liquid used.

20. What are the uses of Newton's Rings?
1. To determine the wavelength of monochromatic light, the R.I of liquid, the radius of spherical surface and measure expansion coefficient of crystals.

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Experiment. No.:

Date :........

SERISE AND PARALLEL RESONANCE

AIM : To study the frequency response of the series and parallel resonance Circuits and **To** determine the included value of the given inductor, bandwidth and quality factor of the circuits.

APPARATUS:

Audio frequency oscillator, AC multi meter, inductance of unknown value, resistor and capacitor of known value.

FORMULA:

1. The inductance $$L = \frac{1}{4\pi^2 f_r^2 C} \quad \text{henry.}$$

   Where f_r is the resonant frequency

   C is the capacitance of a capacitor

2. The quality factor $$Qf = \frac{fr}{BW}$$

3. The bandwidth $$BW = f_2 - f_1 \quad \text{k}\,Hz$$

PROCEDURE:

1. **SERIES RESONANCE:**

The resistor, capacitor, inductor are connected in series with signal generator as shown in the fig.1. Set the amplitude of the signalgenerator for maximum and multimeter for 200 volts AC range. The frequency is increased in steps of 1 KHz (1000Hz) and corresponding value of voltage is recorded in multimeter. Until the voltage is reaches maximum and further decreases tominimum, the current flowing through the circuit is calculated using the formula $I = \frac{V}{R}$. Where R is the resistance of the resistor.

The resonance graph is plotted by taking frequency f (in KHz) along X-axis and current I (in mA) along Y-axis. The frequency f_r corresponding to I_{max} is marked on the graph. A straight line is drawn parallel to X-axis at the point $I_{max}/\sqrt{2}$, which cuts resonance curve at the frequencies f_1 and f_2. The bandwidth is given by

$$BW = f_2 - f_1 \text{ K}\,Hz$$

2. **PARALLEL RESONANCE :**

The capacitor is connected in parallel with the inductor. The combination is connected in series with the resistor and signal generator as shown in the fig.2. The experiment is repeated as in the case of series, here the voltage decreases, becomes minimum and again increases as frequency is increased the corresponding current is calculated. Using $\mathbf{I} = \frac{V}{R}$

The resonance graph is plotted by taking frequency f (in KHz) along X-axis and current I (in mA) along Y-axis. The frequency f_r corresponding to I_{min} is marked on the graph. A straight line is drawn parallel to X-axis at the point Imin√2, which cuts resonance curve at the frequencies f_1 and f_2. The bandwidth is given by

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CIRCUIT DIAGRAM:

SERIES RESONANCE:

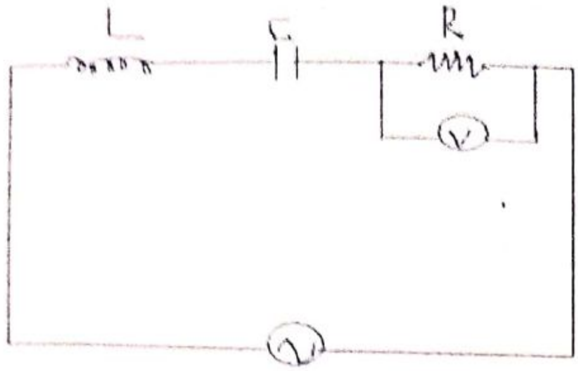

Fig.1

PARALLEL RESONANCE:

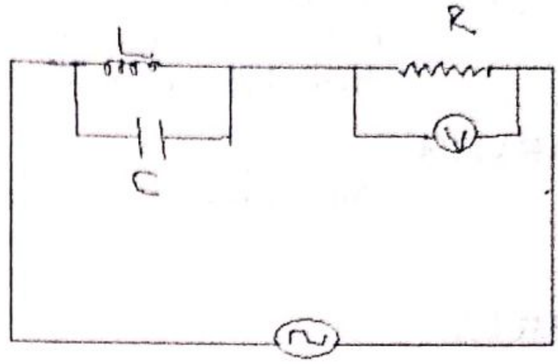

Fig.2

SPECIMEN GRAPH:

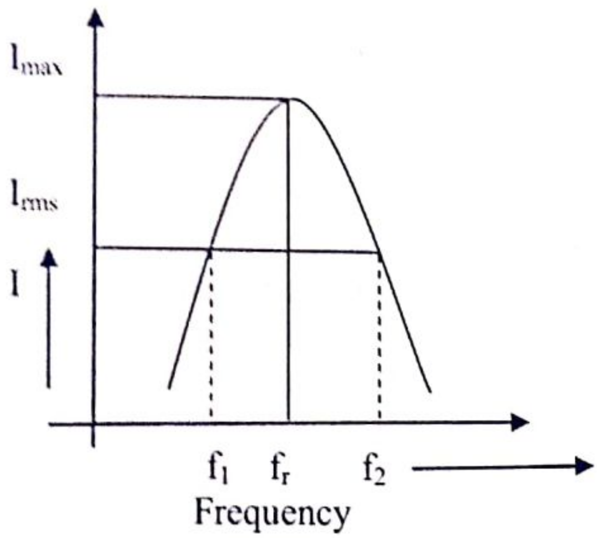

Fig.3 Plot of Current v/s frequency For Series LCR Circuit

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

SPECIMEN GRAPH:

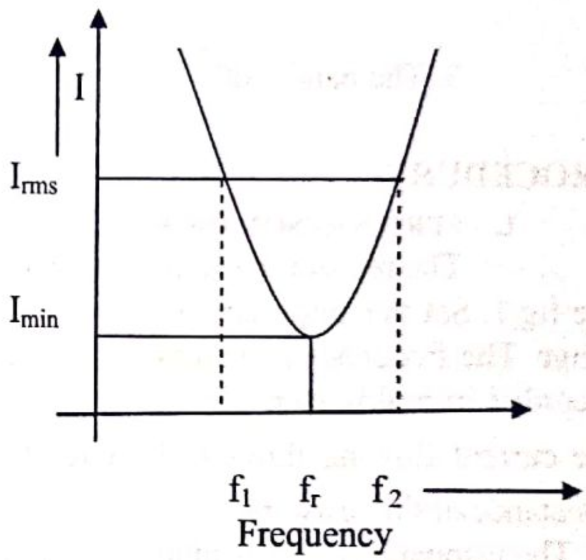

Fig.4 Plot of Current v/s frequency for Parallel LCR Circuit

$$I_{rms} = I_{min}\sqrt{2}$$

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OBSERVATIONS AND TABULAR COLUMN:

SERIES RESONANCE

Resistance R = … Ω. Capacitance C = …….μF.

Frequency *KHz*	Voltage(V)	Current(A) $I = \frac{V}{R}$
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

PARALLEL RESONANCE

Resistance R = … Ω. Capacitance C = …….μF.

Frequency *KHz*	Voltage(V)	Current(A) $I = \frac{V}{R}$
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

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$$BW = f_2 - f_1 \text{ k } Hz$$

RESULT

1. The value of the inductance of the given inductor is found to be **L** = …….**H**
2. The quality factor is found to be
   - i) for series resonance — Q = ……….
   - ii) for parallel resonance — Q = …… ..
3. The band width
   - i) for series resonance — BW = …… KHz
   - ii) for parallel resonance — BW = …….. .KHz

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CALCULATIONS:

Series resonance:

The value of inductance $L = \frac{1}{4\pi^2 f_r^2 C}$ henry.

The quality factor of the circuit is $Qf = \frac{fr}{BW}$

The bandwidth $BW = f_2 - f_1$ K Hz

Parallel resonance:

The quality factor of the circuit is $Qf = \frac{fr}{BW}$

The bandwidth BW $= f_2 - f_1$ KHz

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VIVA-VOCE:

1. Define resonance?

When the natural frequency of the system matches with applied frequency, the system is said to be under resonance.

2. What is the potential difference across L&C at resonance?

Since both L&C are at the same potential at resonance, potential difference is equal to zero.

3. Define power factor?

Power factor is defined as ratio of the resistance to the impedance. Power factor= resistance/ impedance.

4. How to change the resonance frequency in LCR circuit?

Changing R cannot change resonance frequency but either changing L or C, one can change it. Because that are related by an equation $f_0=1/2\pi\sqrt{LC}$.

5. What is a inductor?

An inductor is a passive component used to store energy in the form of a magnetic field.

6. What is capacitor?

A capacitor is a passive used to store energy in the form of a electrostatic field.

7. What is quality factor?

It is defined as the ratio of resonant frequency to the bandwidth of the circuit. It measures the sharpness of resonance.

8. Define mutual inductance?

It is the phenomenon of inducting emf in one coil by varying the current in the other.

9. What are the applications of LCR resonant circuits?

These are widely used in radio and television receivers.

10. How the resonance happens in LCR circuit?

The capacitive reactance $X_c = 1/2\prod fC$

The inductive reactance $X_L=2\prod fL$

11. At resonance the capacitive reactance is equal to inductive reactance and the circuit is said to be resonating. What is the condition for the resonance in LCR circuit?

At resonance, the capacitive reactance is equal to the inductive reactance,

i.e, $X_C=X_L$ $1/2\pi fL=2pfL$ or $LC=1/4\pi^2 f^2$.

12. Why the series resonance is called an acceptor circuit and parallel is called rejecter circuit?

In LCR series, the circuit accepts one frequency component out of the rang of ac input signals and attains maximum current at that frequency known as resonance frequency. And hence the LCR series circuit is called an acceptor circuit. Similarly, the parallel resonance circuits rejects the signal of the same frequency as its own resonance frequency . LCR parallel circuit is rejecter circuit.

13. How do we identify the resonance in the LC circuit?

When LC series with the power supply, the current attains maximum at resonance frequency, where as LC is in parallel, the records minimum at the resonance frequency.

14. What is self inductance of an inductor?

The induced emf in an inductor =-L dI/dt, where L is the co-efficient of self inductance and is often referred as self inductance, dI/dt is the rate of change of current. The coefficient of self inductance is numerically equal to inductance in it when the rate of change of current dI/dt=1amp/sec.

15. What is the function of inductor ?

An inductor is a coil which opposes the change of current.

16. Define the term Henry?

The inductance of the coil is said to 1 Henry is 1 volt of emf is induced in the coil when current through it changes at one amp/sec.

17. What is power factor?

It is defined as the ratio of resistance to the inductance.

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18. What is resonance frequency ?

The frequency at which the inductive reactance is equal to capacitance reactance.

19 . Define inductive reactance X_L and capacitive reactance X_C.

Inductive reactance of a coil is its effective opposition offered by the inductor to the flow of current. It is given by $X_C=1/wC=1/2\pi fC$.

20. What is the differences between impedance and resistance?

Impedance is the opposition to flow of ac and the resistance in the opposition to the flow of dc.

21. Why series LCR is high pass filter and parallel LCR is low pass filter?

The band width in series LCR circuit is very high & it allows large range of frequencies & in parallel, the band width is very low & it allows only smal range of frequencies.

22. What is mean value of sinusoidal AC over a complete cycle? Ans: **Zero**

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DATE:

EXPERIMENT NO.

DIFFRACTION GRATING WITH LASERS

AIM : To determine the wave length of LASERS by using diffraction grating.

APPARATUS: LASER source, Grating, Grating holder, meter scale, Screen etc.

FORMULA: 1. The n^{th} order diffraction angle is given by

$$\theta_n = \tan^{-1}\frac{x_n}{f}$$

2. The wavelength of laser light is given by $\lambda = \dfrac{d \sin\theta\, n}{n}$

Where x_n is the distance of n^{th} order diffraction pattern from the centre 0^{th} order diffraction

f is the distance between the screen and the grating

d is grating constant

θ is the angle of diffraction

n = 1, 2, 3… m is called order of diffraction

PRINCIPLE:

A laser consists of single wavelength falling on a grating will produce diffraction pattern. The principal maximum intensity of the diffracted light is given by $d\sin\theta = m\lambda$ In the above equation all the terms are constant except θ. The angle θ can be measured by experiment by measuring accurately the distance between source and image and distance between the consecutive maximums. Different order of diffraction is the result of different incident angle θ. Hence to specify order θ has been rewritten as θ_n, which indicate the diffraction angle for n^{th} order. Indicates process of diffraction, using laser light and grating. The n^{th} order diffraction angle is given by $\theta_n = \tan^{-1}\frac{x_n}{f}$

Where x_n is the distance of n^{th} order diffraction pattern from the centre 0^{th} order diffraction, f is the distance between the screen and the grating. Substituting $\theta_n$in Eaquation-1, Wave length can be calculated by using eqn.2

$$\lambda = \frac{d \sin\theta\, n}{n}$$

PROCEDURE:

1. The laser is placed on a sturdy table and switched on. At about twometers away on the path of the laser a white laminated wooden screen is placed.. The exact distance between the grating stand and image screen are noted f = 1.0m = 100cm.

2. The grating is now placed on the grating stand close to the laser source and the diffraction pattern is observed as shown in the Figure. Equally spaced diffracted laser light spots are observed. The total numbers of spots are counted. The central direct ray is very bright in the picture as the order increased the brightness deceased.

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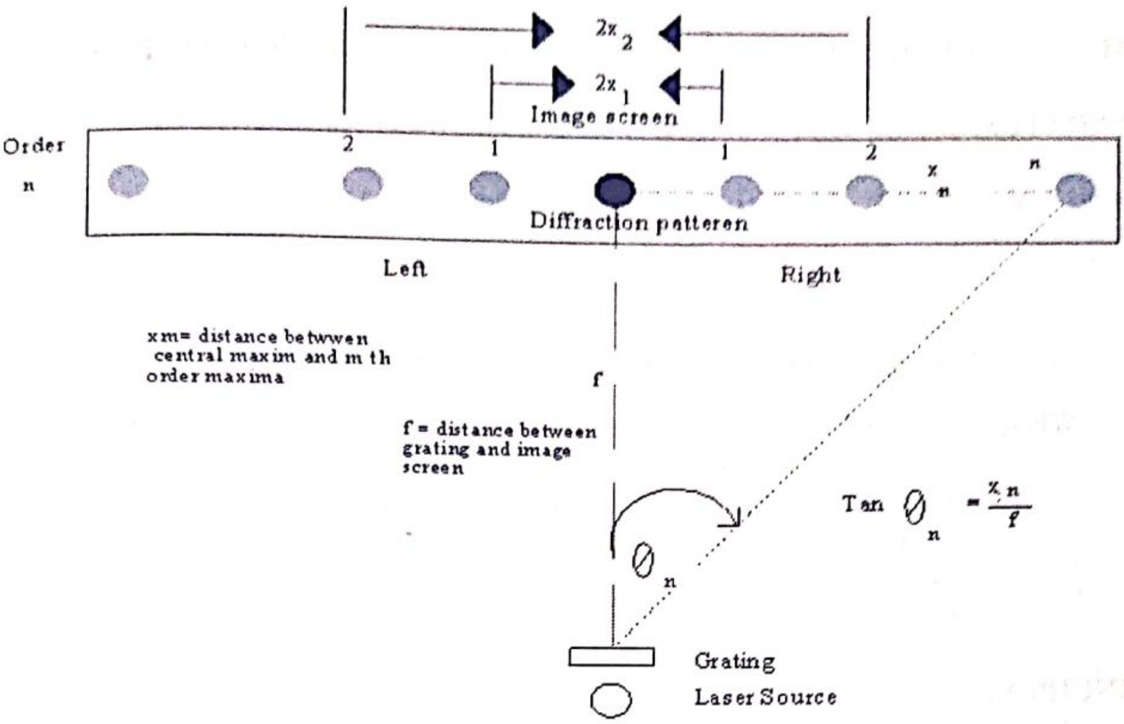
FIGURE:



OBSERVATION:

Grating constant $d = \frac{1}{N} = \frac{1}{\text{no.of lines per Inch}}$

$$d = \frac{1}{N} = \frac{2.54\text{ cm}}{\text{no.of lines on grating}} = \text{--------} = \text{-----------}m$$

TABULAR COLUMN:

500 LPI grating, f=100cm				
Diffraction Order = n	**Distance**		**Diffraction angle (θ_n)°**	**λ (nm)**
	$2x_n$(cm)	**x_n(cm)**		
1				
2				
3				
4				
5				

Average λ = ----------nm

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3. The centre of the spots of the diffraction pattern are marked on the screen using a pencil and after marking all the diffraction pattern, the image screen is removed and the distances between consecutive order of diffraction is measured using a scale and tabulated The distance between the two first ,second, third....etc. orders diffraction spots are measured.

4. Using equation-2 diffraction angles are calculated .Similar calculations are made for different orders of the diffraction and the diffraction angle is calculated. Similar calculations are done for different orders of the diffraction and the grating constant obtained is tabulated in Table-1. And the average value of wavelength of laser source is calculated.

RESULTS:

The wavelength of LASER light is found to be ---------------------nm

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VIVA-VOCE:

1. What is a plane diffraction grating?
   An optically plane glass plate on which very large no. of equally spaced opaque straight ruling is called *diffraction grating.*
2. What is a grating constant?
   It is the distance between two consecutive opaque rulings.
3. Explain the physical significance of grating constant?
   It is used to study the phenomenon of diffraction of light. When a ray of light is incident on the plate, it deviates from the mean path w r t its wavelength.
4. Explain the phenomenon of grating constant?
   It is one of the properties of light. When the light ray incident on opaque obstacle, it encroaches at the geometric shadow region. This property of bending of light is known as diffraction.
5. Where is the zero order spectrum?
   The central maximum is the zero order spectrum.
6. What is the LASER?
   Light Amplification by Stimulated Emission of Radiation. It is an optical device which amplifies the light. Laser requires an optical medium for amplification by achieving population inversion between a pair of energy levels.
7. What do you mean by population inversion and meta stable state?
   An artificial situation in which the number atoms in the excited state are greater than the number of ground state is called population inversion
8. How laser is more advantage than the ordinary source of light?
   Laser is monochromatic, high intense, high narrow beam of light.
9. What is mean by induced absorption?
   It is absorption of an incident photon by an atom as a result of which atom makes transition from ground state to an excited state such that the difference in energy of which two states is equal to energy of a photon.
10. What is mean by spontaneous emission? It is an emission of photo, when an atom transits excited state to lower energy states without aid of any external agency.
11. What is mean by stimulated emission?
    The interaction of relevant energy with an excited atom triggers the excited atoms to drop to the lower energy state giving up a photon. The phenomenon of forced emission photon is called stimulated emission.
12. How do you distinguish between diffraction and refraction?
    The property of bending of light is known as diffraction. Refraction is direction of light when it is passing through change in optical medium.
13. What is diffraction?
    The deviation of light ray from its rectilinpath, when it passes across objects whose dimensions are comparable to the wavelength of incident light is called diffraction.
14. How many types of diffraction are there?
    There are two types of diffraction.
    a. Fresnel diffraction.
    b. Fraunhofer diffraction
15. Distinguish between Fresnel diffraction and Fraunhofer diffraction?
    In Fraunhofer diffraction the source and the screen are effectively at infinite distance from the diffraction slit or aperature. in Fresnel diffraction the source and the screen are both at finite distance.
16. What is the type of diffraction in the diffraction grating expt?
    Fraunhofer diffraction is involved, because source and the screen are effectively at infinite distance.
17. Mention some of the applications of LASER?
    Welding, cutting, &drilling

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FERMI ENERGY OF GIVEN CONDUCTOR

AIM: To determine the FERMI ENERGY and FERMI TEMPERATURE of the given conductor.

APPARATUS: Copper wire wounded on insulated material, laboratory thermometer, test tube beaker, Milli ammeter, Milli voltmeter and regulated power supply.

FORMULA: The Fermi energy of a given copper coil is calculated using the formula

1. $$E_F = 1.37 \times 10^{-15} \sqrt{\frac{DAS}{L}} \quad eV$$

Where, D id the density of the copper material
A is the area of cross-section of copper wire
L is the length of the copper wire in meter
S is the slope of the graph

2. Fermi Temperature,

$$T_F = \frac{E_F}{k} \quad K$$

Where $k = 1.38 \times 10^{-23}\ J\ K^{-1}$ is Boltzmann constant.

PRINCIPLE:

"The energy corresponding to the highest occupied level by the electrons in an energy band at absolute zero temperature is called the Fermi energy (E_F) and the energy level is referred to as the Fermi level. "Fermi level" is the term used to describe the top of the collection of electronic energy levels at absolute zero temperature.

"The Fermi temperature (T_F) is the temperature at which the thermal energy of the free electron in a solid becomes equal to the Fermi energy.

PROCEDURE: The circuit connections are made as shown in the figure 1. The given copper coil, which is connected across the milli voltmeter and thermometer are inserted into the test tube.

The test tube containing copper coil and thermo meter is immersed into the beaker containing boiling water. Starting from the 75^0C.The millivoltmetre reading and milli ammeter reading are recorded for every 5^0C fall of temperature. The readings are tabulated. Then the resistance of the coil at different temperatures T, is calculated using the formula $R = \frac{V}{I}$, Then a plot of resistance R versus Temperature T is made. Plot a graph of temperature T along X-axis and resistance R along Y-axis. The slope S is calculated from the graph as shown in the figure 2. Using the given length L and the radius of the copper wire r. The Fermi energy of a given copper coil is calculated using the formula.

Density of the copper wire $D = 8930\ Kg\ m^{-3}$
Radius of the copper wire $r = 0.26 \times 10^{-3} m$
The Area of cross section of copper wire $A = \pi r^2 = 2.1239 \times 10^{-7}\ m^2$
The Length of the copper wire L = 3.6 m,

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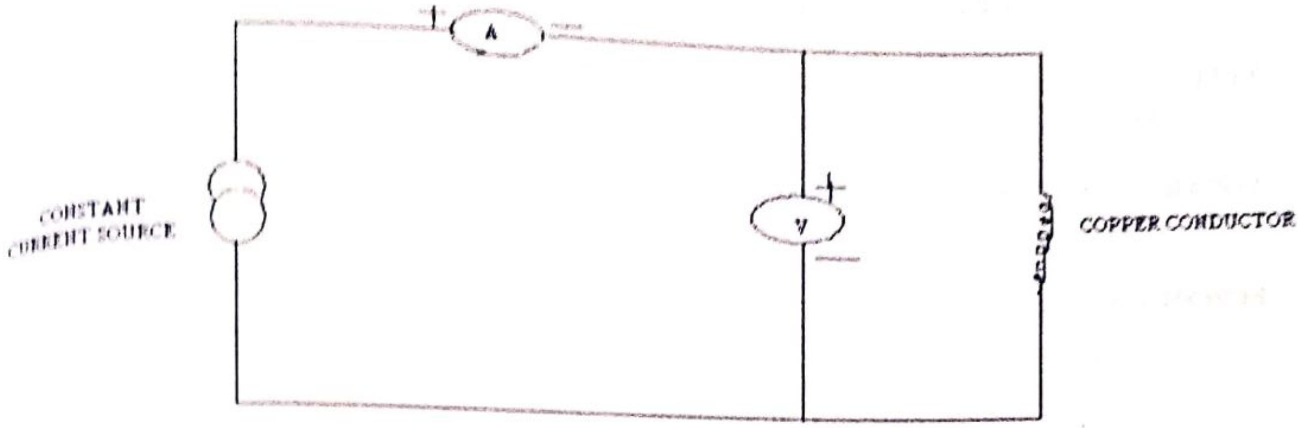
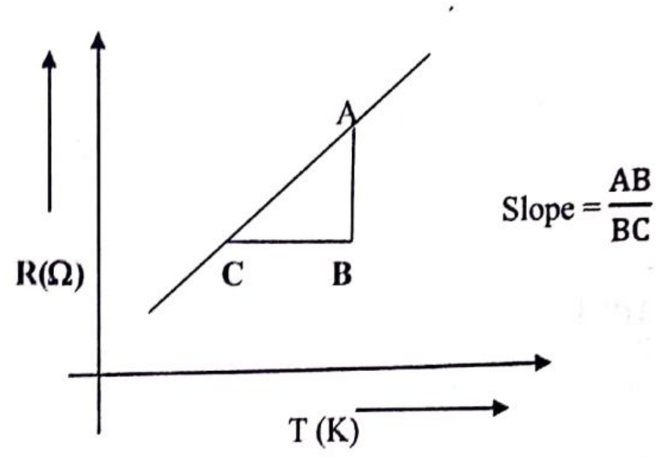
OBSERVATION:

CIRCUIT DIAGRAM:



SPECIMEN GRAPH:



TABULAR CALUMN:

Temperature		Voltage (mV)	Current (mA)	Resistance $R = \frac{V}{I}$ (Ω)
t (°C)	T (K)			
80				
75				
70				
65				
60				
55				
Room Temp.				

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S is the slope of the graph________

The Fermi energy of a given copper coil is calculated using the formula

$$E_F = 1.37 \times 10^{-15} \sqrt{\frac{DAS}{L}} \quad J$$

$$E_F = \text{.................} \quad eV$$

Fermi Temperature,

$$T_F = \frac{EF}{k} \quad K$$

Where $k = 1.38 \times 10^{-23}\ J\ K^{-1}$ is Boltzmann constant.

RESULT:1. The Fermi energy of a given copper coil is found to be E_F=-------- eV

2. Fermi Temperature of copper T_F= -------- K

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VIVA-VOCE

1. What is meant by Fermi energy?

It is the energy of the highest occupied level at zero absolute.

2. What is relation between E_f & T_f? $E_f = k_B T_f$

3. What is meant by Fermi temperature?

It is the temperature at which the average thermal energy of the free electrons in a solid becomes equal to the Fermi energy at 0° K. it is this temperature at which gas be considered degenerate. It depends on mass of fermions and energy.

4. What is Fermi velocity?

It is the velocity of those electrons, which occupy the Fermi level.

5. Are the energy levels lying above E_f are empty at 0 K?

Yes, they are empty, but E_F are filled.

6. What is the effect of atomic number Z on E_f & T_f?

As Z value decrease E_f & T_f increase.

7. Define mobility of electrons?

In addition to the thermal motion, electrons drift due to the applied field. The magnitude of the drift velocity per unit field defined as the mobility of electrons.

8. Define electrical conductivity?

Electrical conductivity is defined as the current density per unit electric field. In terms of electron mobility μ, electrical conductivity σ= ne μ.

9. Define mean free path?

The average distance traveled by an electron between two successive collisions in side a metal in the presence of applied field is known as mean free path.

10. What is meant by Fermi energy?

It is the maximum energy that an electron in a metal can posses at absolute zero of temp.

11. Define energy level and its importance.

It is the highest reference energy level of an electron (particle) at absolute zero of temp. It is the reference energy level which separates the filled energy level and vacant energy level.

12. What is meant by Fermi temperature?

The temp at which the average thermal energy of the free electron in a solid becomes equal to Fermi energy at absolute zero of temp.

13. What is meant by Fermi velocity?

The velocity of an electron which occupy the Fermi level is called Fermi velocity

14. What is meant by conductors?

The material which conduct electric current when a potential is applied across them.

15. What is meant by insulators?

The material which does not conduct electric current under normal condition.

16. What are fermions?

Particles with odd half integral spins (1/2, 3/2, 5/2 etc.) are fermions. Fermions obey the Pauli's exclusion principle.

17. State Ohm's Law.

The current flowing through the conductor is directly proportional potential across its ends.

18. Define valance band?

The outer most orbital of an electron are called valance electron. These electrons occupied by a band called valance band.

19. Define conduction band?

It is lies next to the valence band. It is empty band or partially filled electron band at absolute temperature.

20. What is meant by free electron?

It is an electron which moves freely or randomly in all direction in the absence of external field .

OR

The outer most orbital of an electron are called valance electron or free electron.

21. How the resistivity does varies with temperature in case of conductors?

Resistivity of conducting material is constant at lower temperature. For higher temperature resistivity is proportional to T.

22. Mention the types of semiconductor.

There are two types i) Intrinsic semiconductor & ii) Extrinsic semiconductor

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ExptNo. **Date:**

I-V CHARACTERISTICS PHOTO DIODE

AIM :To study the I-V characteristics of a photo diode.

APPARATUS: Photodiode experimental setup consisting of: 0-3V regulated power supply, 0-2mA digital dc current meter, 0-20V digital dc volt meter, white light LED module, and photo diode LED type.

PRINCIPLE:

Silicon diodes do not conduct in the reverse bias whereas the Photo Diodes are optimized to conduct in the reverse bias by controlling the level of doping and also due to its inherent structure. When there is no light falling on the Photo Diode it does not conduct in the reverse bias, hence light is must for electrical conduction in Photo Diode.

An increase in illumination results in the number of electron hole pairs generated in the semiconductors and the minority charge carries which are generated close to the junction are swept across the junction in this way constitute flow of PHOTOELECTRIC CURRENT through the diode. When illuminated , the diode current under reverse baised condition becomes leakage current and photoelectric current. The I-V characteristics are shown in the fig.2

PROCEDURE:

1. The circuit connection are made shown in the fig.1
2. Verie the voltage intervals of 1volt (0-10) and corresponding values of diode current is noted down in mil ammeter. (Adjust the distance between light source and photodiode such that ammeter current does not exceed 2 to 2.5 m A).
3. Plot a graph of voltage applied versus diode current.
4. Change the light intensity with the help of control knob.
5. Again take readings of applied voltage and corresponding diode current & plot on the same graph. The graph will be similar to the one shown in fig-

RESULT: The I-V characteristics of a photo diode are studied and the Readings are tabulated in the tabular column.

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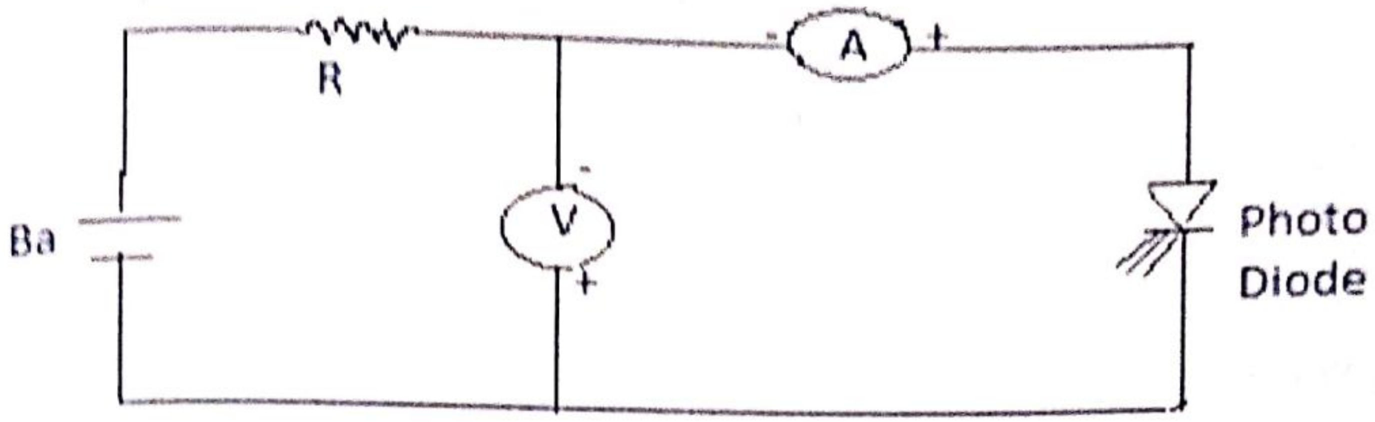
CIRCUIT DIAGRAM :



SPECIMEN GRAPH NATURE:

TABULAR COLUMN:

(Negative voltage and current indicate the reverse bias).

SL.NO.	Voltage(Volts)	Current I(µA)		
		d=5cm	d=10cm	d=15cm
1				
2				
3				
4				
5				
6				
7				
8				

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VIVA-VOCE

1. What is a photodiode?

   Photodiode is a two terminal junction diode in which the reverse saturation current changes when it's reverse biased junction is illuminated by suitable wavelength of light.

2. On which principle the photodiode works?

   When a p-n junction is reverse biased, a small amount of reverse saturation current is due to thermally generated electron-hole pairs. The number of these minority charge carriers, depends on the intensity of light incident on the junction.

3. How photodiode is different from LED?

   In Photodiode the illuminated light produce a reverse saturation current but in LED's a suitable biasing current produce a photons of suitable frequency.

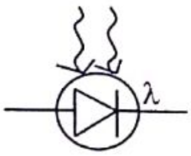
4. What factors we must consider while selecting photodiode?

   While selecting a photodiode for the required purpose it is necessary to know Wavelength of light for which it is sensitive. Operating voltage. Switching time and mounting.

5. What are the applications of Photodiode?

   Photodiodes are used in detection, demodulation, switching, logic circuits, character recognition, optical communication equipments, encoders etc.

6. Write the symbol of photodiode?



7. What is optoelectronics?

   It is the technology that makes use of the principles of optics and electronics.

8. Name any two optoelectronic devices.

   A light emitting diode and photo diode.

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DATE:

EXPERIMENT.NO.

TORSIONAL PENDULUM

AIM : To determine (1) the moment of inertia of the given disc and (2) the rigidity Modulus of the material of a wire by using torsional pendulum.

APPARATUS : Torsional pendulum, Stop-clock, Screw gauge, Meter scale, chuck net, etc.

FORMULA : 1. Moment of inertia of the disc is given by

$$I = MR^2 \quad kg.m^2 \quad \text{-------------------------(1)}$$

2. Rigidity modulus of the material of the wire

$$n = \frac{8\pi I}{r^4}\left(\frac{l}{T^2}\right) \quad N/m^2 \quad \text{-------------------------(2)}$$

Where,

M is mass of the circular disc in Kg   M = -------------x 10^{-3} kg

R is radius of circular disc in meter   R =----------------x10^{-2} m

T is the Time period seconds

l is the Length of the suspension wire in meter

r is the Radius of the wire in meter   r = 0.23x 10^{-3} m

PROCEDURE :

The experimental arrangements are made as shown in Figure. Measure the length of the suspension wirebetween the two chucks nuts .Set it in torsional oscillation without any lateral movement. Note the time for 5 oscillations and calculate time period (T).Repeat the experiment for different values of length of the suspension wire, calculate mean values $\left(\frac{l}{T^2}\right)$.

Measure the diameter (2r) of the wire at various places, with a screw gauge. Find the mean of the diameter and calculate the radius (r).

Measure the circumference of circular disc using thread and calculate the radius of circular disc.

Finally the Moment of inertia of the disc and rigidity modulus of the wire is calculated using the formulas.

$$I = MR^2, \qquad n = \frac{8\pi I}{r^4}\left(\frac{l}{T^2}\right)$$

RESULT:

1. The moment of inertia of the disc (I) =-----------------Kg-m^2.

2. Rigidity modulus of the material of given wire (n) = -----------------N/m^2

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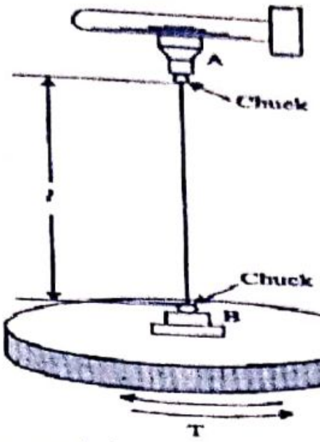
FIGURE:



Torsion pendulum experimental set up

TO FIND THE TIME PERIOD OF THE DISC:

Length of the suspension wire in 10^{-2} m	Time for the 05 oscillations			Time Period (T= t/5) Sec	T^2 Sec^2	$\frac{l}{T^2}$ m/s^2
	Trail 1 Sec	Trail 2 Sec	Mean time(t) Sec			

Mean $(\frac{l}{T^2})$ = --------------m/s^2

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CALCULATIONS :

1. Moment of inertia of the disc is given by

$$I = MR^2 \qquad kg.m^2$$

2. Rigidity modulus of the material of the wire

$$n = \frac{8\pi I}{r^4}\left(\frac{l}{T^2}\right) \qquad N/m^2$$

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VIVA-VOCE

1) What is meant by Torsional Pendulum?
When a rigid body attached to the lower end of of the wire whose top end is fixed to the rigid support and make to oscillate about its axis is called torsional pendulum

2)Define Moment of inertia of a body.
When a rigid body rotates about an axis ,it has the tendency to oppose the change in its state of rest or of uniform rotation about its axis this tendency is called M.I of a body.

3). what are the factors on which moment of inertia of a body depends.
of inertia depends on a) mass of a body b) axis of rotation c) distribution of mass about the axis of rotation

4.Difine rigidity modulus?
The ratio of the shear stress to the shear strain within the elastic limit is known as rigidity modulus
5. Define Shear stress or Tangential stress
It is defined as the restoring force per unit area parallel to the surface of the body.
6. Define shear strain and longitudinal strain?
It is defined as the ratio of change in shape of the body to the original shape.
7. On what factor (l/T^2) of torsional pendulum depends?
It depends on a) length of the wire of the torsional pendulum b) diameter of the wire c) nature of the material of the wire.

8. if we change the length and radius of the wire what happens to the value of 'n'
It is constant for a given material hence by changing the dimensions it will not change
9. what is the type of oscillation we see here?
This is simple harmonic oscillation type

10. does the fluids posses rigidity modulus?
As fluids do not posses shape of their own they do not have rigidity modulus
11. diffentiate between simple pendulum and torsional pendulum?
In a simple pendulum the simple harmonic motion is due to restoring force which is the component of the weight of the bob.In a torsinal pendulum simple harmonic motion is due to the restoring couple arising out of torsion and shearing strain
12. what is S.H.M ?
A body is said to have S.H.M , if its acceleration is always directed towards affixed point on its path and is proportional to its displacement from the fixed point

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Experiment No.

YOUNG'S MODULUS BY SINGLE CANTILEVER

AIM: - To determine the young's modulus of the material of the given beam by the method of single cantilever.

APPARATUS: - Single cantilever setup,slotted weights, travelling microscope , reading lens and lamp.

FORMULA:

$$q = \frac{4Mgl^3}{bd^3y} \ \text{N/m}^2$$

Where, M-mass producing the Elevation (in kg).

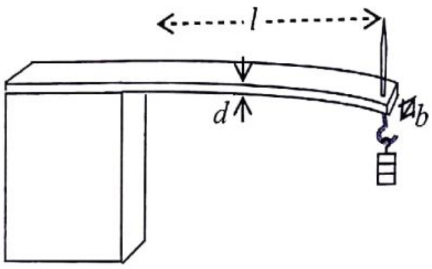
g-acceleration due to gravity (= 9.8 ms^{-2}).

l-distance between the needle and fixed end (in m).

b&d -breadth and thickness of the wooden scale (in m).

y-mean elevation produced (in m).

DIAGRAM:



PROCEDURE:-

- The tip of the needle (inverted image) on the single cantilever is made to coincide with the intersection of the cross wire of the travelling microscope (with no load in the hook).
- Note down the readings of the travelling microscope in the tabular column as the no load reading.
- Now add some weight to the hook (say 50gm). Again coincide the tip of the needle to the intersection of the cross wire and corresponding readings are noted in the tabular column.
- This is repeated up to 250gm in steps of 50 gm every time and corresponding readings are noted in the tabular column.
- The experiment is repeated by decreasing the load in theweight hanger in steps of50g and the corresponding readings are taken and are tabulated.
- The elevation or deflectionof the cantilever beam 'y', for load 'M' in kg is found out from the tabular column.
- By using the breadth (b) and thickness (d) of the bar, the young's modulus of the material of the beam is calculated.

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$$LC = \frac{Value\,of\,1\,M\,S\,D}{Total\,no.of\,V\,S\,D} = ...$$

TR= MSR+ (CVD x LC)

Tabular column to find elevation

Load in hanger (g)	Load increasing			Load decreasing			Mean R_1 (cm)	Load in hanger (g)	Load increasing			Load decreasing			Mean R_2 (cm)	Elevation $y = R_1 \sim R_2$ (cm)
	MSR (cm)	CVD	Total (cm)	MSR (cm)	CVD	Total reading (cm)			MSR (cm)	CVD	Total reading (cm)	MSR (cm)	CVD	Total reading (cm)		
0								150								
50								200								
100								250								

Mean elevation, y = -------------- m

CALCULATION:

$$q = \frac{4M\,g\,l^3}{b\,d^3\,y}$$

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RESULT:-Young's modulus of the material of the beam is found to be q= ---------------N/m^2

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VIVA-VOCE

1. What is meant by least count?

   It is the least value that can be measured using the instrument.

2. What is neutral axis in bending?

   It is the axis of a layer in the specimen which doesn't undergo any deformation inthe presence of applied force.

3. Define stress? What are different types of stress?

   If an external force (F) is applied uniformly over a surface of area (A) then the force per unit area (F/A) is defined as stress. S.I unit of stress is N/m^2.

4. Define strain?

   The fractional change in the dimensions of a body by the external force acting on it is known as strain. Strain has no units and dimensions.

5. State Hooke's law of elasticity?

   Hooke's law is stated as the stress is directly proportional to strain within the elastic limits.

6. What are different types of strain? Linear strain, volume strain, shears strain.

7. Explain different elastic moduli?

   Young's modulus, bulk modulus, rigidity modulus.

8. What is elasticity? What is elastic limit?

   Elasticity is that property of a material due to which it regain its original state or condition On removal of the external forces to which it is subjected. The point beyond which the body ceases to be elastic is known as elastic limit.

9. What is Poisson's ratio?

   Within the elastic limit of a body, the ratio of lateral strain to the longitudinal strain is called Poisson's ratio.

10. Will there be any change in the Young's modulus of the material if its length or thickness is changed?

    No

11. What is a cantilever?

    A set up in which a beam is fixed at one end and loaded at the other end is called cantilever.

12. Mention the units of stress and strain? The unit of stress is Nm^{-2} and strain has no unit.

13. Define elasticity.

    The property of the body by virtue of which it regains its original shape or size, when the external force is removed is known as elasticity.

14. What are elastic and plastic bodies?

    The bodies which regain their Shape or sizes after removing the deforming force are called perfectly elastic. If the does not the bodies which regains their Shape or sizes after removing the deforming force are called perfectly elastic.

15. What is the practical use of the knowledge of elastic modulus?

    This is helps to calculate the stress and strain of body of given known size.

16. What is the effect of temperature on elastic moduli ?

    In general, the elastic limit decreases with rise in temperature.

17. What is the effect of impurities on elasticity?

    The addition of impurities may increases or decreases the elasticity of the material.

18. Define Young's modulus of material.

    It is the ratio of longitudinal stress to longitudinal strain.

19. Define rigidity modulus. It is the ratio of tangential stress to the shearing strain.

20. Define Bulk modulus. A: It is the ratio of volume stress to the volume strain, with in the elastic limit.

21. How will the value of Y changes with a change in length, breadth of the bar?

    Y remains constant. With a change in length, breadth of the bar

22. Can you define the young's modulus and bulk modulus of a material for all states of Matter?

    No. young's modulus is applicable for only solids. Bulk modulus of a material for all states of Matter

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Experiment No.

TANGENT GALVANOMETER

AIM: To determine the magnetic field intensity along the axis of a circular coil carrying current and earth's horizontal magnetic field by deflection method.

APPARATUS: Deflection magnetometer, sprit level, commutator, ammeter, variable power supply and connecting wires.

FORMULA:

$$B = \frac{\mu_0 nI}{2} \frac{a^2}{\left(a^2 + x^2\right)^{3/2}}$$

Where B – the magnetic field intensity at the centre of a circular coil,

n – number of turns in the TG coil,
a – radius of the coil
x – distance between the centre of the coil and pointer in the compass box in meter
μ_0 - permeability of free space = $4\pi x 10^{-7}$ Hm^{-1}.
I – the current through the coil

$$B_H = \frac{B}{\tan\theta}$$

Where B_H – horizontal component of earth's magnetic field

and

θ – mean deflection in TG.

PROCEDURE:

1. The connections are made as shown in the circuit diagram.
2. Arrange the deflection of the magnetometer in the magnetic meridian of the earth
3. Now align the plane of the coil with respect to 90°-90° line of the magnetometer.
4. Keep the magnetometer exactly at the centre of the coil (for this case x = 0).
5. Pass a current I (say 0.2A) to flow through the coil and the corresponding magnetometer deflections θ_1 and θ_2 are noted.
6. The direction of the current is reversed by using the commutator C and the corresponding magnetometer deflections θ_3 and θ_4 are noted.
7. Average deflection θ is calculated.
8. Calculate the magnetic field at the centre of the coil by using the given formula $B = \frac{\mu_0 nI}{2} \frac{a^2}{\left(a^2 + x^2\right)^{3/2}}$ and also B_H .

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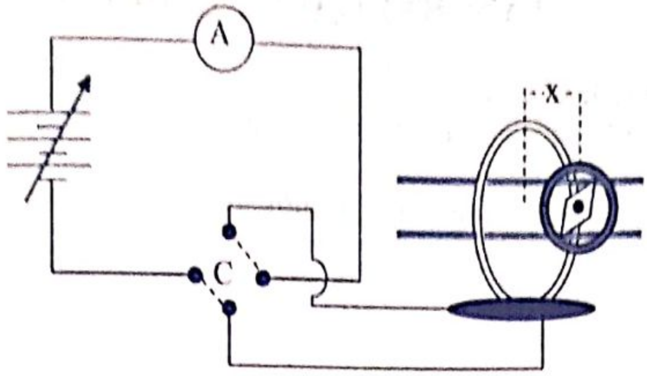
CIRCUIT DIAGRAM:



TABULOR COLUMN:

n = 50 turns

Sl. No.	Current I in A	X in m	Deflections in degrees				Average θ in degree	B inT	$B_H = \frac{B}{\tan\theta}$ In T
			θ_1	θ_2	θ_3	θ_4			
1	0.2	0							
2		0.05							
3		0.1							
4		0.15							
5	0.3	0							
6		0.05							
7		0.1							
8		0.15							

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9. Repeat the experiment for different values of x (say 5cm, 10cm, ...) by sliding the magnetometer along the axis.
10. Find the average of both B and B_H.

RESULT:

The magnetic field intensity along the axis of the given circular coil is calculated and is as shown in the tabular column.
At the center (x = 0) it is found to be B = ...T and
the Earth's horizontal magnetic field intensity is found to be B_H =................T

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Experiment No.

ACCEPTANCE ANGLE AND NUMERICAL APERTURE.

AIM: To determine the Acceptance angle and Numerical aperture of the given optical fiber.

APPARATUS: Laser source, Optical fiber, Screen, Scale.

FORMULA: The Acceptance angle,

$$\theta_0 = \tan^{-1}\left(\frac{D}{2L}\right)$$

Where D – the diameter of the bright circle formed on screen,

L – the distance between the optical fiber end and screen.

And the Numerical Aperture,

$$NA = \sin\theta_0$$

PROCEDURE:

- Switch on the laser sourceand adjust the distance between output end of the optical fiber and the screen 'L' (say 5 cm).
- Place a graph sheet on the screen and observe the circle formed on the graph sheet.
- Mark the points 'a','b','c' & 'd' on the inner bright circle as shown in the diagram. Note down the horizontal diameter D_1 and vertical diameter D_2 of the inner bright circle in the tabular column.
- Repeat the above steps for different values of L (for 4cm, 3cm, …).
- Find the Acceptance angle from the tabular column and hence the Numerical aperture.

RESULT: The Angle of acceptance and Numerical aperture of the given optical fiber are found to be

θ_0 = ………….

NA = …………

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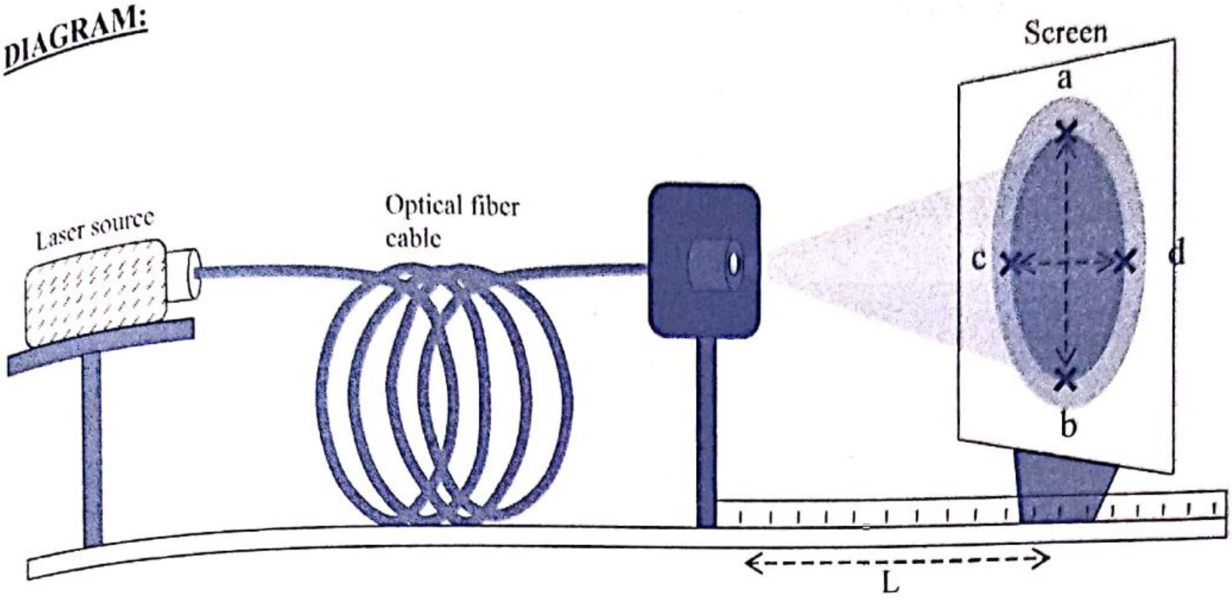
DIAGRAM:



Tabular column:

Trail No.	L (in cm)	Horizontal diameter D_1 (in cm)	Vertical diameter D_2 (in cm)	Mean Diameter D (in cm)	Acceptance angle $\theta_0 = \tan^{-1}\left(\frac{D}{2L}\right)$	Numerical aperture NA $NA = \sin\theta_0$
1						
2						
3						
4						

$(\theta_0)_{mean}$ = __________ $(NA)_{mean}$ = __________

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Experiment No.

SPRING CONSTANT

AIM:- To determine the spring constants in Series and Parallel combination.

APPARATUS: Springs, Scale, Rigid stand, Slotted weights, etc.

FORMULA:- 1) Spring constant,

$$k = \frac{F}{x} \quad in \ Nm^{-1}$$

Where, F – Force applied (= mg) in N.

x – Displacement produced in the spring in m.

2) Spring constant for Series combination of springs,

$$k_{Series} = \frac{k_1 k_2}{k_1 + k_2} \quad in \ Nm^{-1}$$

3) Spring constant for Parallel combination of springs,

$$k_{Parallel} = k_1 + k_2 \quad in \ Nm^{-1}$$

PROCEDURE:-

- Hang the spring1 to the given rigid stand with dead load and note down the position 'a' of the pointer on the scale with initial load.
- Add some more load into the weight hanger (say 50gm) and note down the position 'b' of the pointer on the scale with final load.
- Repeat the same for some more loads in steps of 50gm and tabulate the readings in the tabular column.
- Find out the average spring constant 'k_1'.
- Repeat the above steps for the spring 2 and find out 'k_2'.

To verify Series combination law of springs:

- Hang the springs in series combination as shown in the diagram. With the initial load, note down the position 'a' of the pointer on the scale.
- Add some more load into the weight hanger (say 50gm) and note down the position 'b' of the pointer on the scale with final load.
- Repeat the same for some more loads in steps of 50gm and tabulate the readings in the tabular column.
- Find out the average spring constant 'K_{series}'.

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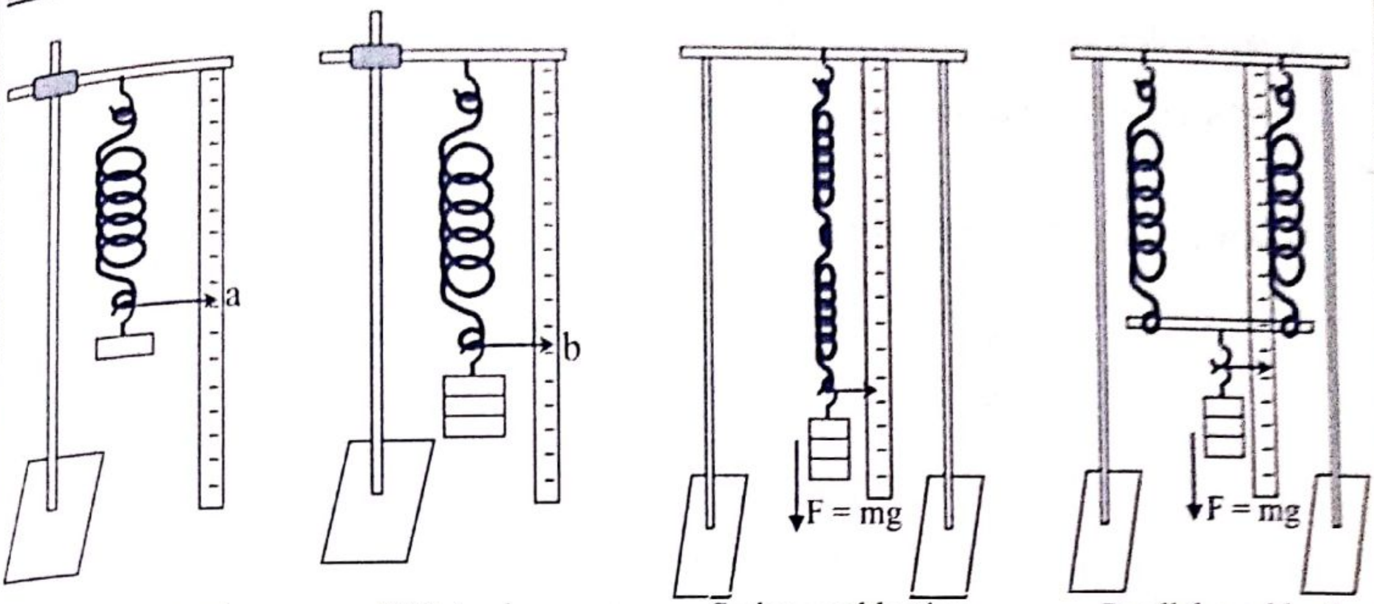
DIAGRAM:-



With initial load   With load   Series combination   Parallel combination

TABULAR COLUMN:-

To find k_1

Pointer reading with initial load, a = ………… m

Trial No.	Load in kg	Pointer reading 'b' in m	Spring stretch (x = b - a) in m	Force, F (F = mg) in N	Spring constant $k_1 = F/x$ in N/m
1	W + 50				
2	W + 100				
3	W + 150				

Average k_1 = …………….. N/m

To find k_2

Pointer reading with initial load, a = ………… m

Trial No.	Load in kg	Pointer reading 'b' in m	Spring stretch (x = b - a) in m	Force, F (F = mg) in N	Spring constant $k_1 = F/x$ in N/m
1	W + 50				
2	W + 100				
3	W + 150				

Average k_2 = …………….. N/m

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To verify series combination of springs

Pointer reading with initial load, a = ………… m

Trial No.	**Load in kg**	**Pointer reading 'b' in m**	**Spring stretch (x = b - a) in m**	**Force, F (F = mg) in N**	**Spring constant $k_1 = F/x$ in N/m**
1	W + 50				
2	W + 100				
3	W + 150				

Average K_{series} = …………….. N/m

Theoretical calculation, $k_{Series} = \frac{k_1 k_2}{k_1 + k_2}$ in Nm^{-1}

To verify parallel combination of springs

Pointer reading with initial load, a = ………… m

Trial No.	**Load in kg**	**Pointer reading 'b' in m**	**Spring stretch (x = b - a) in m**	**Force, F (F = mg) in N**	**Spring constant $k_1 = F/x$ in N/m**
1	W + 50				
2	W + 100				
3	W + 150				

Average $K_{parallel}$ = …………….. N/m

Theoretical calculation, $k_{Parallel} = k_1 + k_2$ in Nm^{-1}

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To verify Parallel combination law of springs:

- Hang the springs in parallel combination as shown in the diagram. With the initial load, note down the position 'a' of the pointer on the scale.
- Add some more load into the weight hanger (say 50gm) and note down the position 'b' of the pointer on the scale with final load.
- Repeat the same for some more loads in steps of 50gm and tabulate the readings in the tabular column.
- Find out the average spring constant '$K_{parallel}$'.

Calculate the theoretical values of K_{series} and $K_{parallel}$ and compare the values with experimental values.

RESULT:-

The spring constants for the springs are found to be, k_1 = ... N/m

k_2 = ... N/m

The spring constants for the combination of springs are found to be,

Combination	Theoretical	Experimental
Series	K_{series} =	K_{series} =
Parallel	$K_{parallel}$ =	$K_{parallel}$ =

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