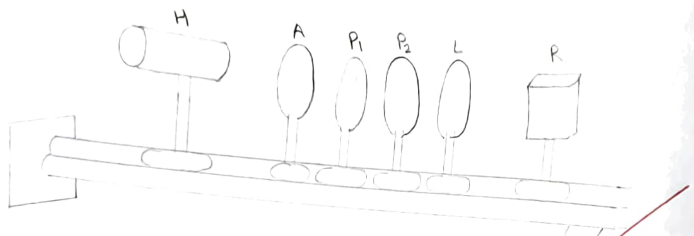

Fig1: Pictorial Representation of measurement set up for measurement of photo conductivity of the given crystal. (Left-Right): Lamp housing(H), adjustable slit (A) polarizer (P_1), analyzer (P_2), lense (L) and photo resistor material (R)

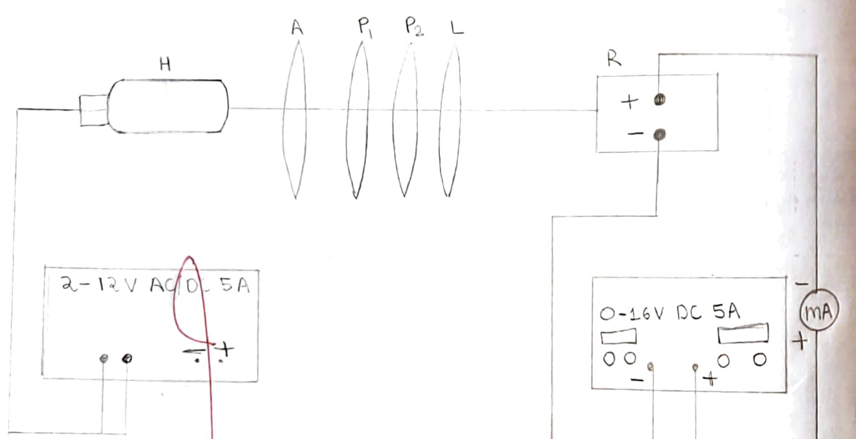

Fig2: Schematic representation of circuit connections for measurement set up for measurement of photoconduct. of given circuit.

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Experiment: PhotoConductivity

Objective- To measure the I-V characteristics of CdS as a function of irradiance and applied voltage.

Apparatus- light source (yellow light bulb), lamp housing, adjustable slit, polarizer, analyzer, voltage source i) 2-12V ii) 0-16V, focussing lense, optical bench.

Introduction- when light radiation fall on a semiconducting or insulating crystal an increase in electrical conductivity of material results. This is recognized as phenomena of photoconductivity. The prime features of photoconductivity are-

1) Photoconductivity of a given material depends upon the wavelength of light
ii) Presence of impurity substantially affects photoconductivity of the material since impurities may reduce its photo sensivity.
iii) Illumination has direct impact on charge carrier concentration of material

Theory- When a material is exposed to the illumination of an appropriate wavelength, that is equivalent or more than its bandgap (E_g) then there is higher probability for transition of its charge carriers from valence to conduction band. The free electron-hole pairs produced in this manner serve as carriers of electrical conductivity. This excitation of charge carrier results into

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Observation Table 1:

S.NO	Irradiance(α)	$\cos^2\alpha$	Photocurrent with respect to the varying voltage (VDC) (mA)		
			1V	2V	4V
1	90°	0	054	107	213
2	60°	0.125	180	372	749
3	30°	0.75	372	742	1465
4	0°	1	433	896	1763

Observation Table 2

S.NO	DC voltage applied to the CdS crystal (V)	Photocurrent with respect to varying irradiance (I_{ph} mA)			
		90°	60°	30°	0°
1	1	056	197	422	512
2	2	[illegible]	388	[illegible]	1006
3	4	[illegible]	734	1540	1545
4	8	[illegible]	[illegible]		

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photoconductivity when there is potential diff. applied to material. Photoconduction however is not an intrinsic phenomena of a material. It depends upon the parameters like irradiance, temp & trap distribution across its band gap. Trap are nothing but the discrete energy levels of certain imperfections distributed across forbidden band gap of the material. Role of imperfect^n distributed across forbidden bandgap of the material. Role of imperfect^n or traps is vital in the sense that traps of the form of recombination centre reduce photoconductivity whereas the activation centers tend to increase or ~~decrease~~ contribute to it. Hence evaluation of photoconductivity (I-V) characteristics of (CdS) is targeted as

1) Study of photoconductivity (I-V) characteristics of CdS with respect to the variation in irradiance
2) Study of photoconductivity (I-V) characteristics of CdS with respect to variation in potential diff applied to CdS.

Procedure

a) Measurement of photocurrent as func^n of irradiance (α) at const. voltage

1) Mount the lamp housing (H), adjustable slit (A), Polarizer (P) lense (L) and photoresistor material (R) on the optical bench as in foll. fig 1.

2) Connect the leads of the lamp housing to the power supply (0-12V A.C/D.C, 5amp) and apply 10V ac to lamp.

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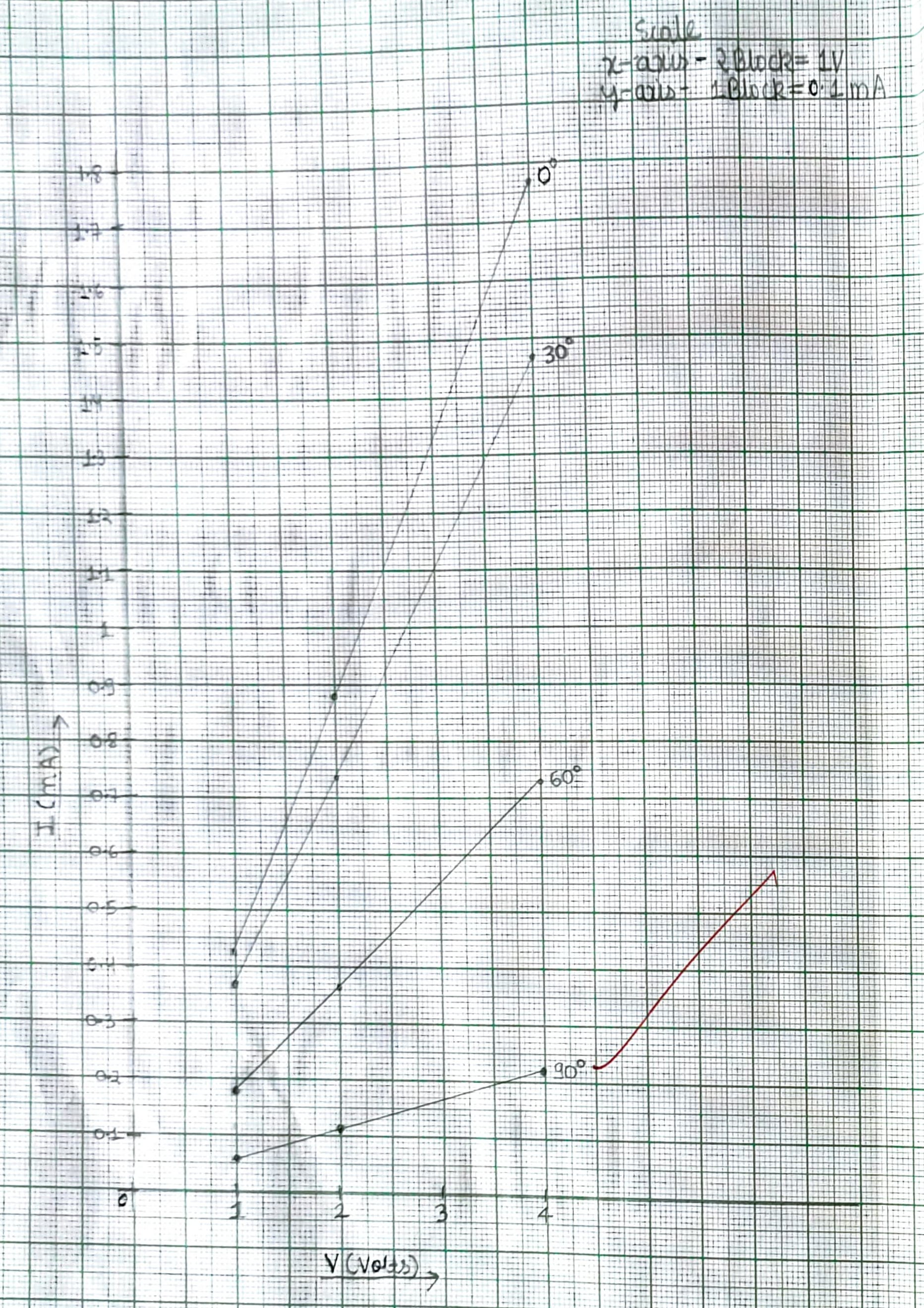

Current-Voltage characteristics of CdS photoresistor

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3) Adjust the heights of lamp housing (H), adjustable slit (A) polarizer (P_1), analyzer (P_2), lens (L) and photo-resistor material (R) so that all these are fixed on same optical axis

4) Make the connections to photo-resistor and the given photo-current measuring unit (multimeter) as shown in fig2

5) Set both of polarizer and analyzer at 0 mark initially.

6) Adjust the lamp, lense, and photoresistor to make a homogenous beam of light fall straight on the surface of photoresistor.

7) Apply a D.C voltage of 12V to photo-resistor

8) Adjust the width of the slit to make a 9mA current flow through the photo-resistor keep this width fixed throughout the experiment.

9) At the constant voltage of 12V DC applied to the photoresistor vary the angle of polarizer and analyzer and record the corresponding variation in the photocurrent Iph.

b) Measurement of Photocurrent as function of D.C voltage applied to the crystal at constant irradiance

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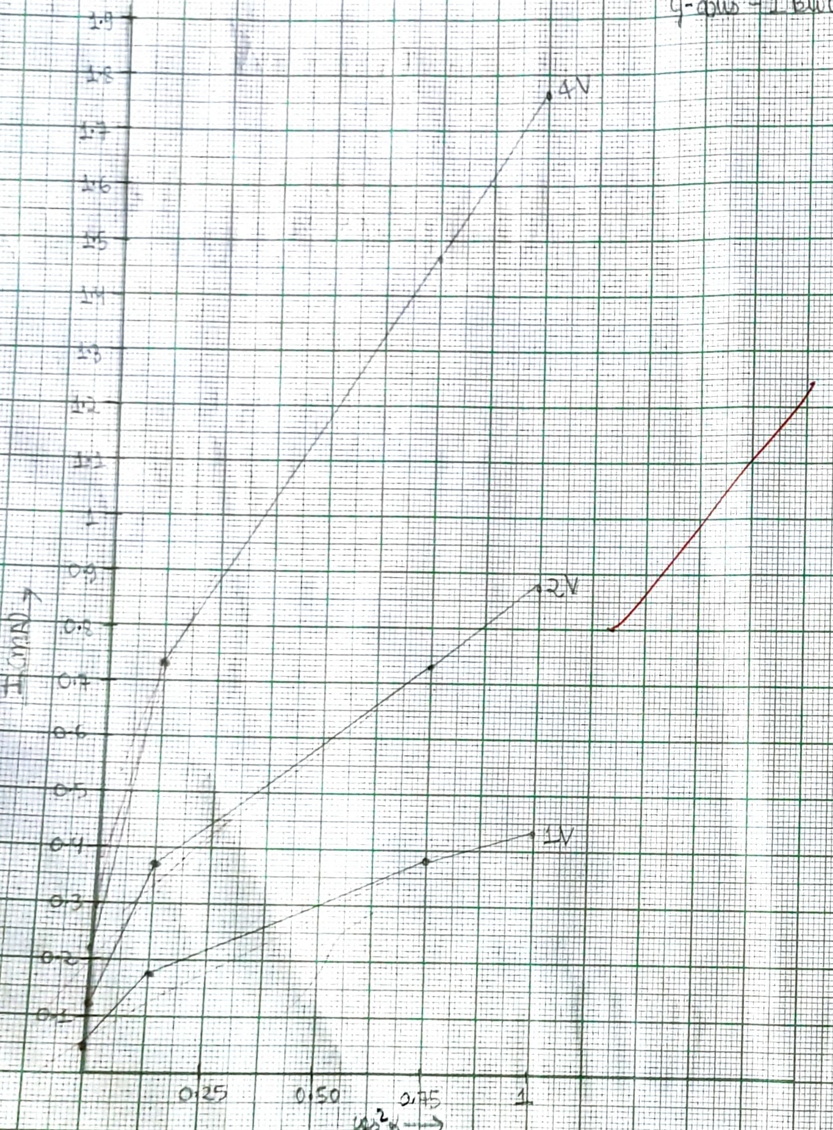
Scale
x-axis - 2 Block = 0.25
y-axis = 1 Block = 0.1 m



Current - Irradiance characteristics of CdS photoresistor.

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Result : The photoconducting CdS crystal behave like an ohmic resistance that depends on irradiance.

Jyoti
20th Aug. 2019

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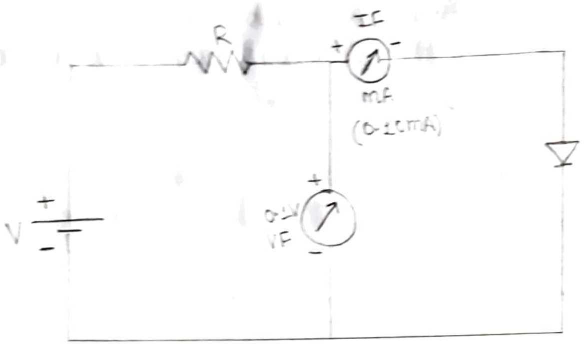

Forward Bias
Fig(A)

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Experiment: Study of Diode

Aim: To study the forward and reverse characteristics of Si and Ge Junction diode

Theory: Semiconductor P-N Junction is practically unidirectional device having more conduction in one direction and negligible conduction in opposite direction.
when P-N Junction is formed, potential barrier is developed across the junction that opposes the further transition of electrons and holes across the junction. Now if the external potential difference is applied across the junction so that the P end is connected to the +ve of external supply. It will oppose the junction potential barrier and when external P.D just balances the P.D now it becomes easy for electrons and holes to move toward the junction and cross the junction. Thus with further increase in external P.D more and more electrons and holes will cross the junction and contribute towards external current in the circuit. Hence diode conducts and it is referred to as Forward bias.
If the polarity of external supply is reversed so that P end is connected to the -ve of external supply, it will assist the junction potential difference and width of depletion layer will further increase making it still for electrons and holes to cross the junction. Hence diode will not conduct and it is referred as Reverse bias.

However due to minority carries very small current of

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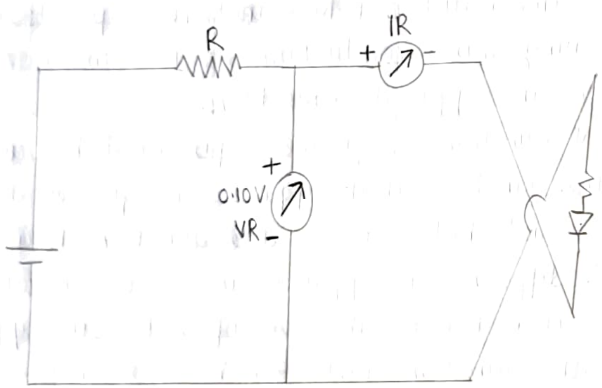

Reverse Bias
Fig (b)

the order of few μA is observed when diode is Reverse Bias But as compared to forward current which is of the order of few mA practically we can neglect the ~~re~~ reverse current and p-n junction diode may be treated as unidirectional device.

Semiconductor used for the manufacturing of p-n junction diode may be Si & Ge. The basic difference between Si & Ge is the energy band gap is 1.21 eV for Si and 0.72 eV for Ge at room temp. Both Si and Ge diodes are commercially available.

A number of differences between these two types are relevant in design. A note worthy feature of I-V characteristics is that there exist cut in or threshold voltage V_t the current rises very rapidly. It is found that V_t is approximately 0.2 V for Ge and 0.6 V for Si. Note that the cut in voltage for Si diode is offset about 0.4 V with respect to the cut in voltage for Ge. The reason for this difference is found in part, in the fact that the reverse saturation current in Ge diode is normally larger by a factor of about 100 then the reverse saturated current in a Si diode of comparable ratings.

Procedure -

(A) Forward Characteristics

1) Make connections as shown in fig. (A)
2) Keep meter switches as under
   Voltmeter = 1V & Ammeter = 10mA

Observation Table

Table 1: Forward Characteristics

S.NO	VF (Volts)	Iv (mA)
1	0.10	0
2	0.50	0.4
3	0.65	1.2
4	0.75	4.2
5	0.90	9

Table 2: Reverse Characteristics

S.No	V_R (Volts)	I_R (μA)
1	1?	2
2	2.5	10
3	3	14
4	4	18
5	5	22
6	6	28
7	7	32
8	8	40
9	9	42

Readings ... 0.1 to 2.5?

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3) Gradually increase VF in steps of 0.1V from 0 and not IF (Forward Current). Tabulate the reading.

(B) Reverse Characteristics
1) Make connections as shown in fig.(B)
2) Keep meter switches as under
Voltmeter = 10V & Ammeter = 100μA
3) Gradually increase VR in steps of 1V and measure diode current.
4) Plot the graph b/w VR & IR

Observations

a) Least Count of Ammeter = 0.1 mA

b) Least Count of Voltmeter = 0.1V

Result and Conclusion

From I-V characteristics of diode it is observed that diode conducts when it is forward bias. Current increases rapidly with forward voltage. However there is cut in voltage below which there is no conduction. In reverse bias reverse saturation current of diode is very small of the order of few microamperes.
The diode can be used as a unidirectional device which finds important application as rectifier. It is observed

Precautions?

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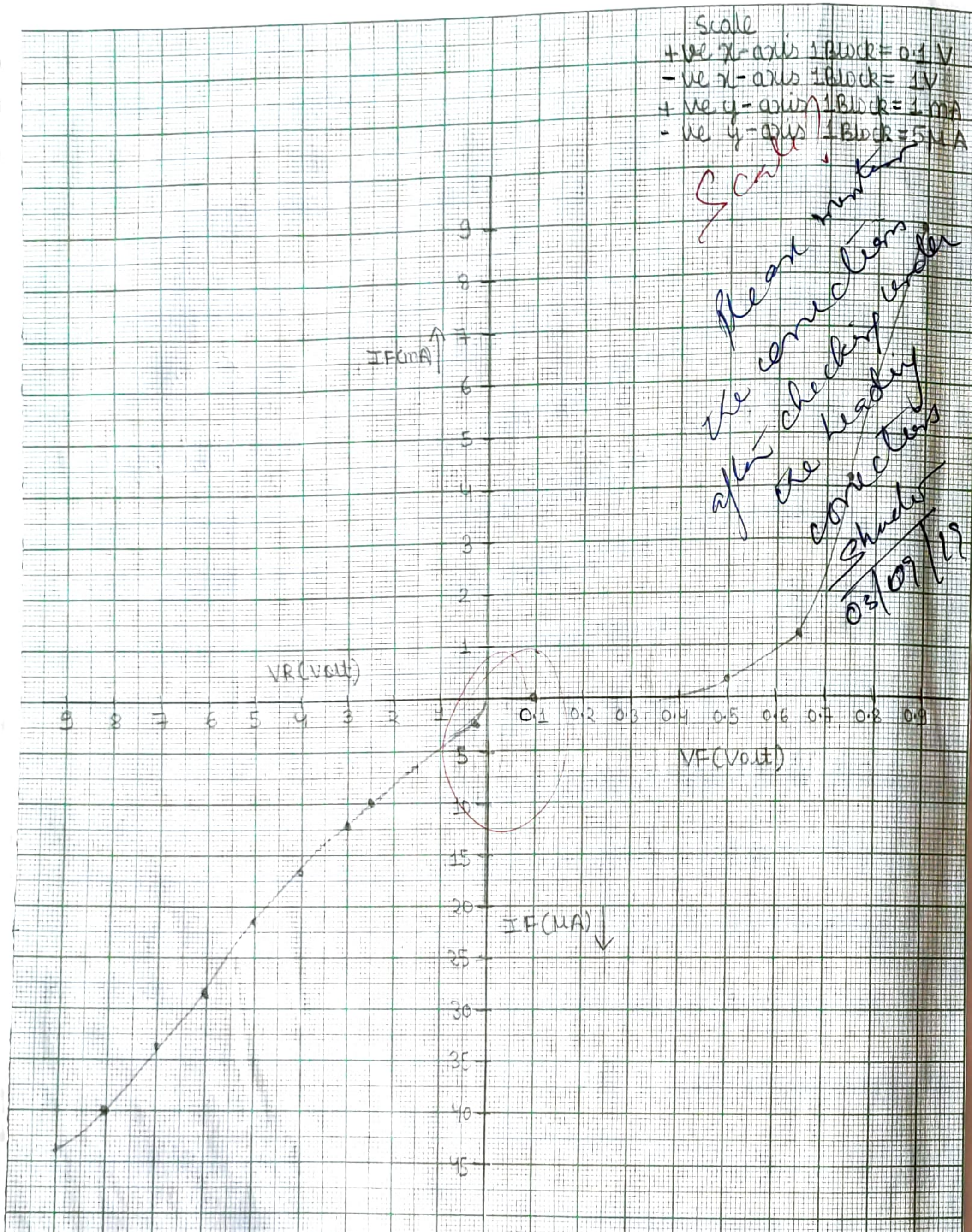


V-I Characteristics of a Diode

that the comparisons of V-I characteristics of Si & Ge that the cut-in voltage for Ge diode is smaller than cut in Si diode and forward current for Ge diode is larger for same forward Voltage.
Reverse saturation current in Ge diode is also higher than the reverse saturation current in Si diode for comparable range.

Sources of Error

a) Check whether all +ve & -ve terminals are connected accurately.

b) Voltmeter should be connected in parallel

c) Ammeter should be connected in series.

d) In forward Bias p end of ~~the~~ diode should be connected to +ve of battery & n end to -ve terminal and in reverse bias it is vice-versa.

Page No. 2

Experiment: Frequency Of A.C Mains

Aim – To determine the frequency of A.C Mains using an electrical vibrator.

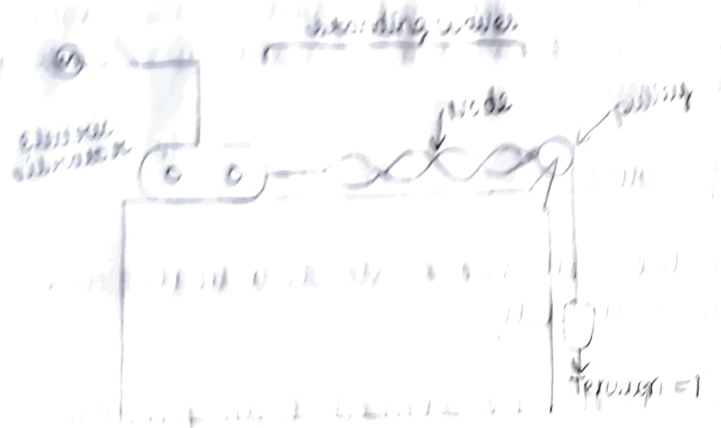
Apparatus – Electrical vibrator, lamp, meter scale, Pulley, Weighing Box, Thread.

Theory – when a chord of mass per unit length 'm' is connected to the vibrator rod and stretched with Tension (T), the chord vibrates in segments. If the length of the chord is then adjusted untill well defined nodes are formed, the frequency of the stretched string is same as the vibrating rod which in turn is equal to frequency of A.C Mains. Then if 'l' is length of 1 loop of vibrating string, the frequency of vibration is given by

$$f = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

where f = frequency of Rod (ac mains)
l = distance b/w two nodes
T = Tension applied
m = mass per unit length of thread.

Procedure – a) The current is switched on and it is seen that the rod of electric vibrator begins to vibrate. The length of chord is adjusted



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Observation Table

S.NO	Mass of pan weight suspended (gm)	Tension T= mg (dynes)	No. of Loop	Length of thread (cm)	length of 1 loop (l) (cm)	$f=\frac{1}{2l}\sqrt{\frac{T}{m}}$
1	15.67	15356.6	12	190	15.83	f_1=43.94
2	35.67	34956.8	9	190	23.70	f_2=44.72
3	40.67	39856.6	8	190	27.10	f_3=47.13
4	50.67	49656.6	7	190	31.60	f_4=46.09
5	65.67	64356.6	6	190	38.00	f_5=44.97

Mean Value of $f = \frac{f_1+f_2+f_3+f_4+f_5}{5}$

$= \frac{43.94+44.72+47.13+46.09+44.97}{5}$

$=$ 46.38 Hertz.

till it is found that its free end attains maximum amplitude.

b) String is made to pass over the pulley and suitable weight is put on the pan. The length of the string is adjusted till it is found that node are well defined.

c) Nodes are observed at the extreme end points of thread. Measure the length of the string and numbers of loops between them.

d) Calculate the length of one loop 'l'

e) Calculate the tension and compute f, frequency of A.C Mains.

f) Repeat the experiment with different Tensions.

Observations

a) Mass of the pan = 15gm

b) Mass of thread per unit length = 0.007932 gm/cm

c) Acc. due to gravity $g = 980\ cm/sec^2$.

Result

The frequency of A.C Mains is found to be 46.38 Hz.

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Sources of Error and Precautions.

1) There should be no friction in the pulley because it causes the tension to be less than that is actually applied

2) The nodes and antinodes should be sharply defined which justifies the optimum weight put on the pan

3) The length of the steel rod should be initially adjusted so that it vibrates with max. amplitude

4) The chord should be inextensible so that its mass per unit length remains constant.

Shweta
03/09/19

Date

Expt. No. 4 Page No.

MELDE'S Experiment

Aim- To determine the frequency of electrically maintained tuning fork

Apparatus Required: Electrically maintained tuning fork, Battery, Eliminator, Meter Scale, Pulley, weight Box, Thread.

Theory: When a chord of mass per unit length 'm' is connected to the vibrator fork and stretched with Tension T, the chord vibrates in segments. If the length of the chord is then adjusted until well defined nodes are formed the frequency of the ~~strecthed~~ string is same as the vibrating fork. Then ~~if~~ 'l' is length of one loop of vibrating string, the frequency of vibration in transverse arrangement of fork to thread is given by

$$f = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

and the frequency of vibration in longitudinal arrangement is given by $f = \frac{1}{l}\sqrt{\frac{T}{m}}$

Formula:

The frequency in transverse arrangement

$$f = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

when f = frequency of Rod (ac main)

l = Distance b/w two nodes

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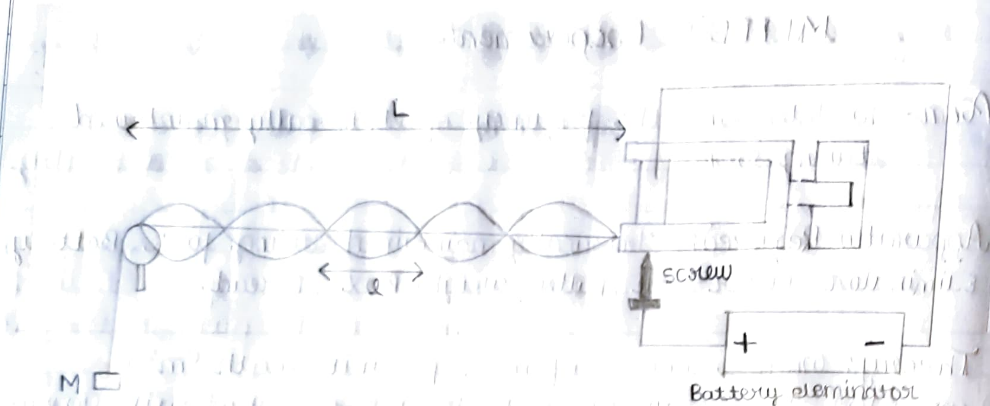

Fig(1): Transverse arrangement

Fig(2) Longitudinal arrangement

T = Tension Applied

m = Mass per unit length of thread

the frequency in longitudinal arrangement

$$f = \frac{1}{2l}\sqrt{\frac{T}{m}}$$ with same meaning of symbols

Procedure:

(a) Transverse arrangement

1) Fix a thread to one of the prongs of the fork with the help of a screw supplied for that purpose. Stretch the thread in a line with the prong of the fork and pass it over a ball bearing pulley clamped to a stand.

2) The current is switched on and adjust the platinum contact screw to make the fork vibrate. It is seen that the prong of fork begins to vibrate.

3) The length of chord is adjusted till it is found that its free end attains maximum amplitude

4) Nodes are observed at the extreme end points of thread. Measure the length of the string & numbers of loop b/w them

5) Calculate the length of one loop 'l'

6) Calculate tension and compute f, frequency of fork

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Table 1: For longitudinal arrangement

S.No	Mass of pan + weight (gm)	Tension	No of loops	length of thread (cm)	length of one loop (cm)	$f = \frac{1}{l}\sqrt{\frac{T}{m}}$
1	13·98	13700·4	10	208	20·8	$f_1 = 63.18$
2	23·98	23500·4	8	208	26	$f_2 = 66.20$
3	28·98	28400·4	7	208	29·71	$f_3 = 63.68$
4	33·98	33300·4	7	208	29·71	$f_4 = 68.96$
5	43·98	43100·4	6	208	34·66	$f_5 = 67.24$
6	63·98	62700·4	5	208	41·60	$f_6 = 67.58$

Mean Value of $f = \frac{f_1+f_2+f_3+f_4+f_5}{6}$

$= \frac{63.18+66.20+63.68+68.96+67.24+67.58}{6}$

$= 66.14$ Hertz

Table 2: For Transverse arrangement.

S.No	Mass of pan + weight (gm)	Tension	No of loops	length of thread (cm)	length of 1 loop (cm)	$f = \frac{1}{2l}\sqrt{\frac{T}{m}}$
1	13·98	13700·4	17	183	10·76	$f_1 = 61.07$
2	23·98	23500·4	13	183	14·07	$f_2 = 61.16$
3	28·98	28400·4	12	183	15·25	$f_3 = 62.03$
4	33·98	33300·4	11	183	16·63	$f_4 = 61.60$
5	43·98	43100·4	10	183	18·30	$f_5 = 63.68$
6	63·98	62700·4	8	183	22·87	$f_6 = 61.46$

Mean value of $f = \frac{61.07+61.16+62.03+61.60+63.68+61.46}{6}$

$= 61.83$ Hertz

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8) Repeat the experiment with constant tensions but diff. segments

(b) Longitudinal arrangement

1) Fix a thread to one of the prongs of the fork. With the help of a screw supplied for that purpose, stretch the thread at right angles to the length of the prong of the fork and pass it over a ball bearing pulley clamped to a stand [Fig 2]

2) Perform the experiment same as for Transverse arrangement.

3) For a particular segment, calculate the length of one loop 'l', tension and compute f, frequency of fork.

4) Repeat the experiment with constant tensions but diff. segments

Observations

a) Mass of the pan = 13·98 gm

b) Mass of the thread per unit length (m) = 0·007932 gm/cm

c) Acceleration due to gravity $g = 980$ cm/sec^2

Result:

The frequency of fork is found to be 63·98 Hertz

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Sources Of Error And Precautions:

a) There should be no friction in the pulley because it causes the tension to be less than that is actually applied.

b) The nodes and antinodes should be sharply defined which justifies the optimum weight put on the pan.

c) The length of steel rod should be initially adjusted so that it vibrates with maximum amplitude.

d) The chord should be inextensible so that its mass per unit length remains constant.

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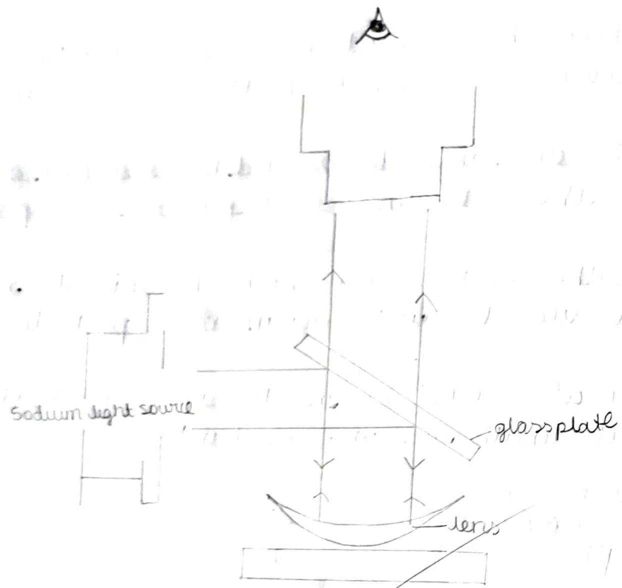

Fig 1: Diagram of newton Ring experiment

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NEWTON'S RINGS

Aim – To determine the radius of curvature of a lens by Newtons Ring method.

Apparatus – Newtons Ring apparatus, which consist of plano-convex lens of large radius of curvature and a plane glass plate, travelling microscope and light reflecting unit. Reading lens and Sodium vapour lamp

Formula – The radius of curvature of a lens is calculated from formula

$$R = \frac{D^2_{(n+p)} - D^2_n}{4p\lambda}$$

where D_n is diameter of n^{th} bright fringe
D_{n+p} is diameter of $(n+p)^{th}$ bright fringe
R is radius of the curvature of the lens

Theory – The experimental arrangement for obtaining Newtons rings shown in Fig 1. Newtons rings apparatus consists of a plano convex lens with its convex surface resting on a plane glass plate. This arrangement forms an air film between the glass plate and the plano convex lens. The thickness of the film is zero at the center (point of contact) increases as one moves rapidly outwards (Fig 2).. By taking the radius of curvature of the lens very large the thickness of air film becomes very small. A parallel beam of monochromatic

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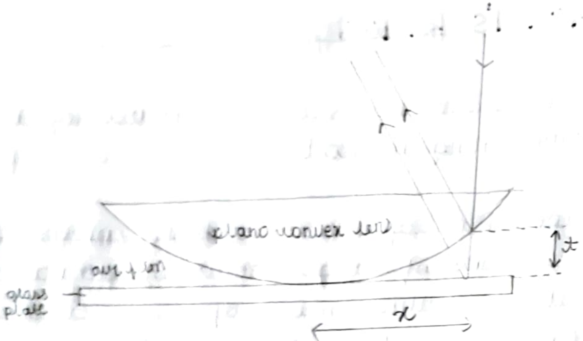

Fig 2: arrangement for producing Newton's ring

(a) (b)

Fig 3: Diameter of Bright Fringe

light is allowed to fall on a glass plate which is inclined at 45° to horizontal. The glass plate reflects the light vertically downwards. Thus the light is normally incident on the air film enclosed between the plano convex lens and the glass plate. This light is reflected from upper and lower surface of air film. These rays interfare to produce localised circular fringes in air film. Depending upon path diff bright and dark circular fringes formed.
These fringes can be seen with the help of microscope. The fringe system consist of alternate bright and dark concentric rings with dark fringes at the centre.

Diameter of Bright Rings

let x be radius of n^{th} Bright ring and R is radius of curvature of the lens. Hence $D_n = 2x$

$$D_n^2 = (n-1/2)4\lambda R$$

and $D_{n+p}^2 = (n+p-1/2)4\lambda R$

Thus equation for Radius of curvature is

$$R = \frac{D_{(n+p)}^2 - D_n^2}{4p\lambda}$$

Procedure

a) Clean plano-convex lens and glass plate
b) Don't touch the lens and the glass plate with finger.
c) Place the lens over glass plate

Observations:

Least count of main scale = 0.05 cm
Least count of Vernier scale = 0.001 cm

Table

Ring Number	microscope reading from Right hand side of the centre	microscope reading from left hand side of the center	Diameter D_n (cm)	D_n^2 (cm)	$D_{n+p}^2 - D_n^2$ (cm)^2
20	~~6.248~~ 5.554	6.248	0.694	0.481	0.060
18	5.576	6.225	0.649	0.421	0.061
16	5.608	6.200	0.600	0.360	0.060
14	5.622	6.170	0.548	0.300	0.047
12	5.645	6.148	0.503	0.253	0.059
10	5.675	6.110	0.440	0.193	0.042
8	5.698	6.088	0.390	0.152	0.036
6	5.720	6.060	0.340	0.115	

Calculations

$$D_{n+p}^2 - D_n^2 = \frac{0.060+0.061+0.060+0.047+0.059+0.042+0.036}{7} = 0.052$$

$$R = \frac{D_{n+p}^2 - D_n^2}{4p\lambda} = \frac{0.052}{4\times2\times5893} = 110.725\,cm$$

d) Below the microscope objective, place a light reflecting unit inclined at 45° to the horizontal

e) Allow a beam of parallel light from sodium lamp to fall on reflector. See through microscope. Bright and Dark circular ring will be seen

f) Be sure that cross wire can be moved above 20–25 fringes on both side of the dark rings.

g) Set the microscope of the cross wire on central ~~bright~~ dark fringe. Move the cross wire till it crosses over 20^{th} Bright ring on left hand side of the centre. Take readings for 18^{th}, 16^{th} – – – – 6^{th} bright ring. Now move the cross wire to right of centre so that it falls over middle of 6^{th} Bright ring. Take readings ~~so~~ as done earlier.

Result – The radius of curvature (R) of a lens is 110.725 cm

Sources of Error and Precautions

1) Light should fall normally on air film.
2) Convex lens should have large radius of curvature so that thickness of air film lies b/w glass plate & lens
3) The glass plate and planoconvex lens must be well cleaned.
4) While measuring diameter one of the cross wire should lie tangentially on the middle of bright ring.
5) Back lash error of micrometer screw should be avoided

Circuit diagram

Photocell

Aim– To study the characteristics of a photo cell/solar cell.

Apparatus Required – Photocell characteristics kit with D.C power supply and Digital meter, Light source (lamp of 100W), optical bench, scale etc.

Theory – Photocells are of two types
i) Vaccume filled Photocell and ii) Gas filled Photocell

Vaccume filled Photocell : It consist of a semi-cylindrical plate C coated with cesium and a wire of platinum or nickel placed along the axis of cylinder. The whole system is fixed on an ebonite base & is enclosed by an evacuated glass cover as shown in Fig (1)
when radiation falls on the semi cylindrical plate (cathode) C, electrons are emitted and are collected by anode (A)
The two important characteristics of this photocell are–
a) Photo current Vs anode light intensity (I–X) characterist at diff anode voltage. Since the light intensity X falling on the photocell is proportional to $1/d^2$, where d is distance of photocell for the source, a plot of I Vs $1/d^2$ where d is dist. of photocell from source, a plot of I Vs $1/d^2$ will be same as I vs X plot.

Observation Table

Table 1 for I-V characteristics

S.No	Anode Potential	Corresponding microammeter Reading (μA)		
		$d_1 = 20\,cm$	$d_2 = 30\,cm$	$d_3 = 40\,cm$
1	0	0.5	0.3	0.2
2	2	3.7	2.2	1.6
3	4	6.0	3.8	2.8
4	6	8.0	5.2	3.5
5	8	9.8	6.0	4.2

Table 2 : I-X characteristics

S.No	Dist. (d)	$X = 1/d^2$	micro ammeter Reading		
			$V_{a1} = 3V$	$V_{a2} = 8V$	$V_{a3} = 13V$
1	20	2.5×10^{-3}	4.6	9.4	12.3
2	25	1.6×10^{-3}	3.6	7.2	9.6
3	30	1.1×10^{-3}	2.8	5.8	7.4
4	35	8.1×10^{-4}	2.5	4.6	5.9
5	40	6.2×10^{-4}	2.2	4	4.9

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ii) Gas filled Photocell : Its construction is exactly similar to vacuume filled photocell expept that the gas filled photocell is filled with Inert gas. like Vaccume filled photocell, this cell has also 2 imp. characteristics – a) I-V characteristics b) I-X characteristics.

Procedure

a) Keep the photocell in sunlight for 15 to 20 min so that it gets properly activated.

b) Make connection as per Fig-3

c) Keep micro-ammeter selector switch toward 200μA side. Voltmeter range selector switch toward 20 V side.

d) Place the lamp (100W) close to cell so that the light from the lamp falls on cell, note the dist. as d_1

e) For I-X characteristics the dist of lamp from photocell is kept at ~~certain~~ fix value and noted as d. Now +ve potential of anode inc. and corresponding reading in micro ammeter (I) is noted.
The experiment is repeated with two other distances (intensities) d_2 & d_3

f) A graph is plotted by taking anode voltage on X-axis

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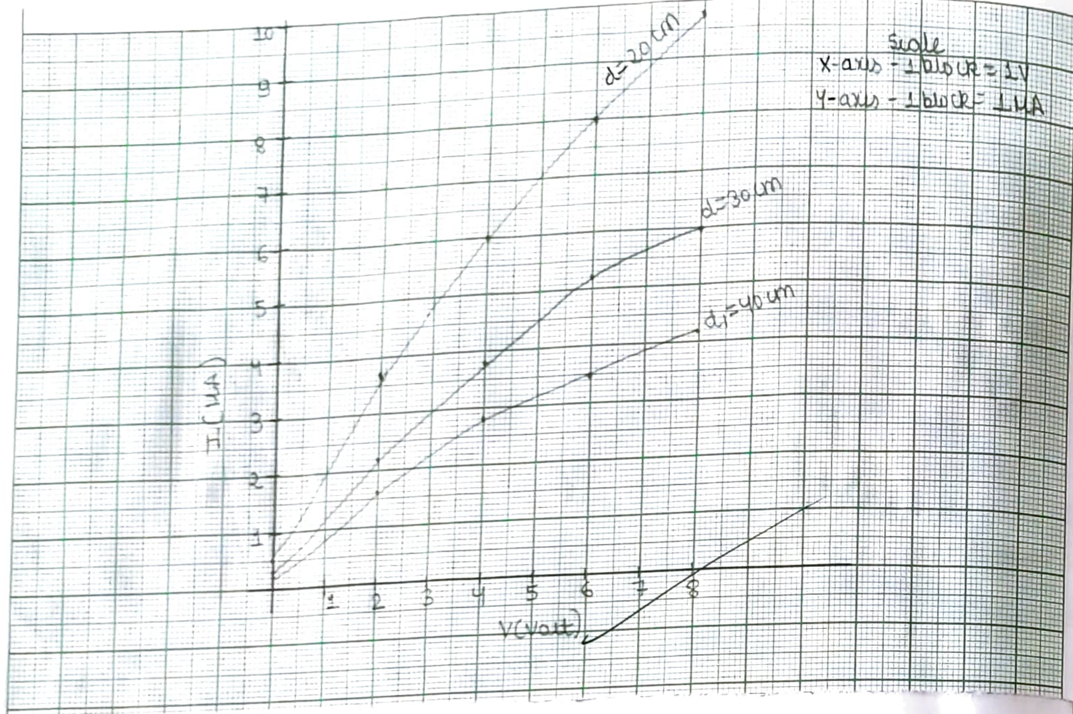

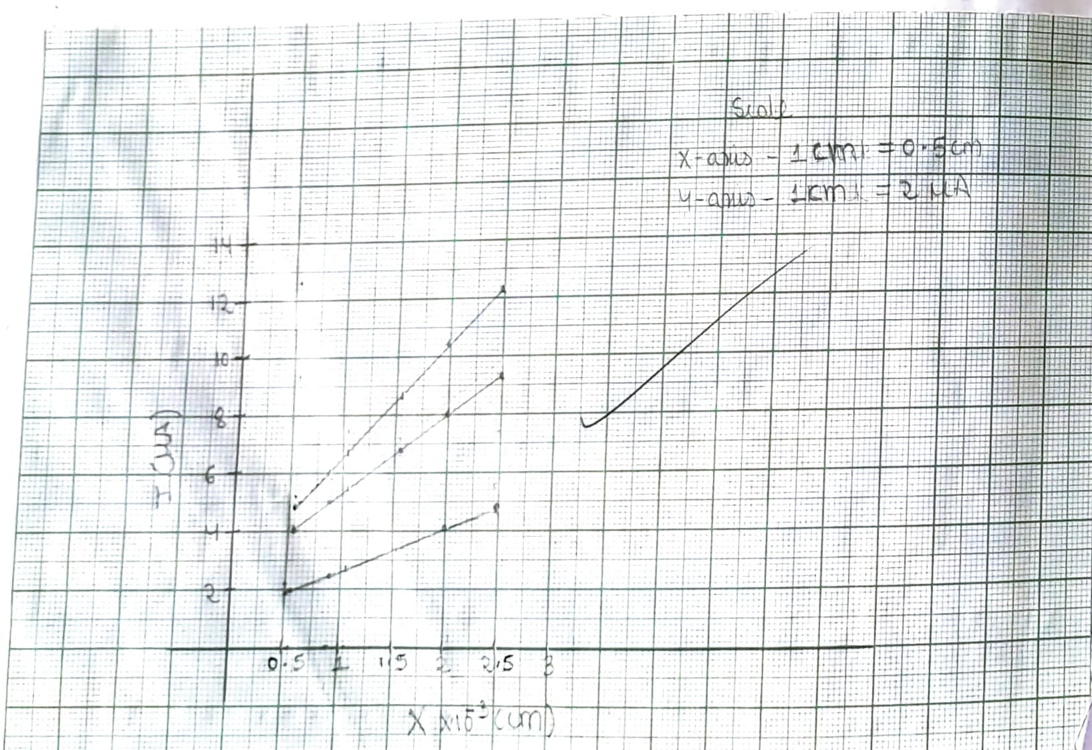

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and corresponding reading in micro ammeter on y-axis. to obtain I-V characteristics.

g) Now for I-X characteristics the anode voltage is kept at a certain fix value and noted as Va. Change the distance of lamp from this photocell in steps of 5cm & corresponding reading in micro ammeter (I) is noted.

h) The graph is plotted by taking Intensity (X) on x-axis and corresponding reading in micro ammeter (I) on y-axis to obtain I-X characteristics.

Result

The I-V characteristic curves of given photocell is given in graph

The I-X characteristic curve of given photocell is given in graph

15/10/19

Precautions

1) Avaide the extra light falling on photocell

2) Set the photocell such that it yields max^m current

3) Close the opening window of photocell when it is not in use

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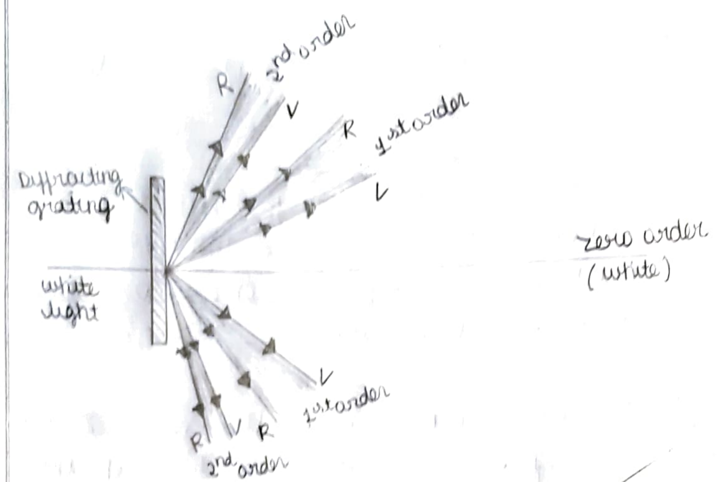

Diffraction Pattern from grating

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Plane Transmission Grating

Aim- Determination of wavelength of different colours of mercury light using a plane transmission grating.

Apparatus:- Spectrometer with the grating stand, diffract^n grating of known grating element, mercury lamp and reading lens.

Theory- A transmission diffraction grating is a glass slide with large number of parallel closely spaced slits (transparent spaces) drawn on it. Early ones were carbon covered glass slides etched by a needle point - now they tend to be printed onto a slide. When a parallel beam of monochromatic light is directed normally (at right angles to it) at a diffraction grating, light is transmitted by the grating in certain directions only because the light passing through each slit is diffracted and these diffracted light waves from adjacent slits reinforce each other in certain direc^n only, including the incident light direction, and cancel out in all other directions.

If the source of light is mercury lamp (having all visible colours) this grating separates the colors of incident light because different wavelengths are diffracted at different angles, according to grating relationship

$$\sin\theta = \frac{n\lambda}{(e+d)}$$

$(e+d)$ = grating element , θ = angle of diffrac^n

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n - order of diffraction
λ - wavelength of light

Procedure

1) Set the telescope and collimator in one line so that the direct image of slit falls on the intersection of wires. Note the reading. Now mount the grating and turn the telescope by 90°. Turn the gratting in such a way that the reflected image of slit is received in the telescope. It means that the incident rays on the grating are incident at 45° to the plane of grating. Now rotate grating by 45° ~~and~~ or 135° so that it becomes normal to collimator and the grating surface facing the telescope. The rulings of the grating are parallel to main axis of the instrument when the axis of telescope is parallel to that of the collimator, an image of the slit will be seen lying with the centre lying on the intersection of the cross-wire of the telescope.

2) Turn the collimator towards left until the diffraction image (colour spectrum) of first order is visible on the intersection of cross-wirer take the reading of two Verniers V_1 (window1) & V_2 (window2) for violet colour

3) Next turn the telescope to get the first order image to the right on the intersection and read the two Verniers V_1 (window1) & V_2 (window2) for violet colour

Teacher's Signature ______

Colour	Vernier	Spectrum of left of direct image			Spectrum of Right of direct image			Difference in reading 2θ	Mean Value of θ
		MSR Degree	VSR Minute	Total Left	MSR Degree	VSR Minute	Total Right		
Violet	V_1	225°	5'	225.084°	198°	8'	198.134°	26.950°	26.30°
	V_2	45°	5'	45.084°	19°	0'	19.00°	26.080°	
green	V_1	229°	0'	229.00°	195°	5'	195.087°	33.917°	33.95°
	V_2	49°	9'	49.150°	15°	9'	15.15°	34.000°	
Yellow	V_1	230°	4'	230.067	194°	4'	194.067°	36.00°	35.53°
	V_2	50°	4'	50.067	15°	0'	15.00°	35.067°	

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4) The differences in the reading of the same vernier of the two setting gives twice the angle of diffraction. Calculate mean value. Use this and the known grating element for the calulation of wavelength of light

5) Same experiment can be repeated ~~by~~ for green and yellow light

Observation

Lines per inch gratting = 15000

Grating element $(e+d) = 2.54/15000$ cm

Least count : main scale = 0.5° (degree)

Vernier scale = 30" (Seconds)

Calculations

1) for violet $\lambda = \frac{(e+d)}{nt} \sin\theta = 1.69 \times 10^{-4} \times 0.229 = 3870\,Å$

2) for green $\lambda = \frac{(e+d)}{n} \sin\theta = 1.69 \times 10^{-4} \times 0.2919 = 4934\,Å$

3) for yellow $\lambda = \frac{(e+d)}{n} \sin\theta = 1.69 \times 10^{-4} \times .305 = 5156\,Å$

Result

1) Wavelength of violet light = 3870 Å
2) Wavelength of green light = 4934 Å
3) Wavelength of yellow light = 5156 Å

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Sources of Error and Precautions:

1) Avoid the extra light falling on telescope
2) Prior to any measurement with spectrometer, the telescope collimator and Prism table should be set properly.
3) The width of slit should be made as nerrow as possible Reading of both vernier should be taken
4) The position of minimum deviation should be obtained for each colour.

15/10/19

NODAL SLIDE

Aim- To verify the formula for the combination of lenses using nodal slide assembly.

Apparatus - Nodal slide Assembly and the convex lenses.

Theory- If f_1 & f_2 are the focal lengths of the component lenses of a system and lenses be situated at a distance x apart, then the focal length of the combination is given as $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{x}{f_1 f_2}$

where f_1 and f_2 are focal lengths of first and second lens and x is seperation b/w them in combination.

Procedure- a) Adjust the lens holder on carriage of lens L_1, cross slit, light source and plane mirror that the line joining their centers are parallel to the bench.

b) Adjust the alignment of plane mirror so that the image of the cross slit form close to itself

c) Adjust the position of the lens so that axial movement of lens holder through a small angle (by 5°) donot produce any shift in the image. At this point read the position of cross slit, R_1 and axis of nodal slide R_2 Then difference will give f_1 (one face)

Teacher's Signature

Set	Lights on	Position of cross slit (cm)	Position of Nodal (cm)	$f_1 = R_1 - R_2$
Lens L_1	one face	11.5	31.7	20.2
	other face	11.5	32.2	20.7
Lens L_2	one face	11.5	31.5	20
	other face	11.5	31.7	20.2
Lens L_3	one face	11.5	22.6	11.1
	other face	11.5	22.7	11.2

$F_1 = \frac{20.2+20.7}{2} = 20.45$, $F_2 = \frac{20+20.2}{2} = 20.10$

$F = \frac{11.1+11.2}{2} = 11.15$

$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{x}{f_1 f_2} = \frac{1}{20.45} + \frac{1}{20.10} - \frac{4}{20.45 \times 20.10}$

$F = 11.261$ cm

exp. $F = 11.15$ cm

Error = 0.985%

d) Rotate the carriage by 180° axially (other face). Take the reading again for cross slit, R_1 and the axis of nodal slide R_2 to get f_1. Their average will give f_1.

e) Repeat the same procedure (step 1 to 3) with second lens L_2 and obtain f_2.

f) And then repeat again with both the lenses on the carriage simultaneously. At this point read the distance between 2 lenses as x cm.

g) Take similar reading after shifting the position of 2 lenses by rotating carriage 180°.

Result

Value of focal length f_1 = 20.45 cm
Value of focal length f_2 = 20.10 cm
Value of Experimental Focal length of comb. = 11.15 cm
Value of F (calculated) = 11.261
% error between calculated and experimental = 0.985%

Sources Of Errors and Precautions:

1) The cross slit must be properly and intensely illuminated by light coming from lamp, so that image obtained is bright and distinct.

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2) Since the image is formed on principle ~~axis~~ focus of the which lays on the principle axis, the lenses must be so mounted on the lens holder that principle axis of the system passes through the point of intersection of cross slits. If this condition is not adhered to the image of cross slit won't form.

3) The mirror employed should be a perfect plane so that all the incident light are reflected back without suffering any change.

29/10/18

S.No	Posit^n of fixed source P_1(cm)	Posit^n of Photometer a(cm)	Position of 2nd source P_2		$T_1=b_1-a$	$r_2=b_2-a$	t%
			with plate b_2(cm)	without plate b_1(cm)			
1	0	40	59.6	84.8	44.8	19.6	19.14
2	0	45	69.7	93.2	48.2	24.7	26.26
3	0	55	82	105	50	27	29.16
4	0	40	56.6	72.5	32.5	16.6	26.08
5	0	45	65	83.7	38.7	20	26.20

$$\text{Mean \%} = \frac{19.14+26.26+29.16+26.08+26.20}{5}$$

$$= 25.468\%$$

L-B Photometer

Aim- To determine the percentage of transmission for a Semi-transparent film using Lummer-Brodhum Photometer.

Apparatus- L.B Photometer assembly with two light sources, transparent glass plate with stand.

Theory- Its optical arrangement is illustrated in fig 1. It consists of a system of right angled isosceles prisms so arranged that the field of view of telescope is divided into two, one portion being illuminated by light coming from one of the sources and the other by light from the second source. This is achieved in following manner. Light from the two sources is admitted through the aperture AA and falls on slab DD of magnesium carbonate. Light is diffusly reflected from the surfaces of the slab and except for the rays that cut the faces of the total reflection prism P and Q normally, the rest are absorbed by the interior of the blackened sides of the box containing this arrangement. These rays are totally reflected at the hypotenuse surface of the prism P and Q and then enter the prism combination SR. It consists of two right angled prism with their hypotenuse surfaces in optical contact. The hypotaneous of S is rounded off except for the central portion

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which lies in contact with R. The reason for this is that light can pass through the region of contact as if the prism were one solid medium. other ~~ca~~ rays suffer total reflection and donot pass through the combination. Of the rays totally reflected by P on to the surface of S only the central system incident on the surface of contact of the two prisms is allowed to pass through and enter the telescope other rays are totally internally reflected. In a similar manner rays coming from Q and meeting the surface of contact of two prisms pass through the combination and are not able to enter the telescope.

The light which falls on the ~~telescope~~ portion of R outside the surface of contact, are totally reflected and enter the telescope, so the central portion of the field of view is illuminated with light coming from source on the left side whereas that surrounding the central portion is illuminated by light from the other sources. If the illumination of the two portion is ~~at~~ same, the field of view will appear to be uniformly illuminated (Fig 2a, b). It means the intensity of illumination on either side of the slab DD is same. If then the sources have illuminating powers P_1 and P_2 and their distances from the photometer-head are r & r_1 resp.

$$I = \frac{P_1}{r^2} = \frac{P_2}{r_1^2}$$

Teacher's Signature ______

Since both the portions of light received by the telescope traverse the same thickness of glass any absorption by it will affect the intensity of the two equally and will not interfere with the adjustment
If a semi-transparent film is kept between one source P_1 and photometer head, keeping their position constant the second source is moved to distance r_2 to keep the balance of intensities.

$$\frac{P_1}{r^2} = \frac{P_2}{r_2^2} = 1$$

where $P_3 = t . P_1$

& t = transmittance coefficient

$$\frac{t . P_1}{r^2} = \frac{P_2}{r_2^2} = \frac{t P_2}{r_1^2}$$

$$t = \frac{r_1^2}{r_2^2}$$

$$t\% = 100 \times \frac{r_1^2}{r_2^2}$$

Procedure

a) Keep the photometer head and the source P_1 at a fixed distance r (say 40 cm)

b) On viewing through photometer eyepiece, two spots of unequal intensities are observed.

c) Adjust the sources P_2 to make the intensity of spots

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equal, this is called a photometric balance (Fig). Note its position at b_1 cm to calculate r_1

d) Then insert given glass plate between screen of photometer and P_1. Then again note the dist. r_2 for photometric balance by moving P_2.

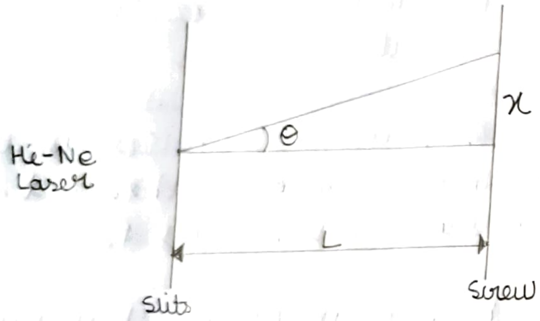
e) ~~Experiment~~ Repeat the experiment by changing r and also by rotating photometer by 180°.

f) t is calculated from r_1 & r_2.

Result

The percentage and transmittance for the given film is found to be 25.468%.

23/...



Laser Diffraction Experiment

5-Slit Diffraction

Objective- To determine the Grating element of given 5 slits grating using He-Ne laser

Apparatus Used- optical bench with suitable accessories 5-slit unit, He-Ne laser source etc

Theory- In physics a laser is a device that emits light through a specific mechanism for which the term laser is an acronym of Light Amplification by Stimulated Emission of Radiation.

A He-Ne lasar is a type of small gas laser this lasers have many industrial and scientific uses and are often used in laboratary demonstrations of optics. The gain medium of the laser, as suggested by its name is a mixture of He and neon gas in a 5:1 to 20:1 ratio, contained at low pressure.

It is based on the diffraction of light. The very heart of the explanation of all diffraction phenomena is interference. when two waves combine their displacements add, causing either a ~~laser~~ lesser or greater total displacement depending on the phase difference b/w two waves.

Bright bands observed on the screen happen when the light has interfered constructively - where a crest

Observation Table

Distance of screen from slit D(cm)	Fringes	Position of fringes on screen			Fringe width x(mm)	Mean Value of x(mm)
		Main Scale(mm)	Circular Scale (mm)	Total (mm)		
30cm	1	11.00	23	A = 11.46	A−B = 1.82	1.76
	2	9.00	37	B = 9.74	B−C = 1.70	
	3	8.00	05	C = 8.10		
40cm	1	11.00	11	A = 11.22	A−B = 2.58	2.55
	2	08.00	32	B = 8.64	B−C = 2.52	
	3	06.00	06	C = 6.12		

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of a wave meets a crest from another wave. The dark region show destructive interference − a crest meets a trough.
for constructive interference to give bright band occurs when

$$\frac{n\lambda}{d} = \frac{x}{L} \Rightarrow n\lambda = \frac{xd}{L}$$

where λ − is wavelength of light
d − is separation of slit
n − is order of maxima observed (for max. $n=1$)
x is the fringe distance and
L is the distance from the slit to the screen

Procedure:

1) Make sure that the incident LASER beam and the screen are both along one single horizontal line
2) Set the screen behind the slit so close as to get the sharpest diffracted image. We get four bright Red vertical lines in the image for given set of slits
3) Fix the screen at a pt to 3cm away
4) Set image of slit using screw gauge
5) Measure reading for all rest of lines
6) Measure seperation b/w all the two consecutive lines and find out an average seperation termed as X cm.
7) Using this value of avg separation "x" and that of wavelength 'λ' given for He-Ne LASER.
Calculate grating element d cm

Teacher's Signature

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Observations:

Wavelength of He-Ne laser = 6328 Å

Least count of screw gauge circular scale = ? cm

Result:

The Grating element of given 5 slits grating is ?.

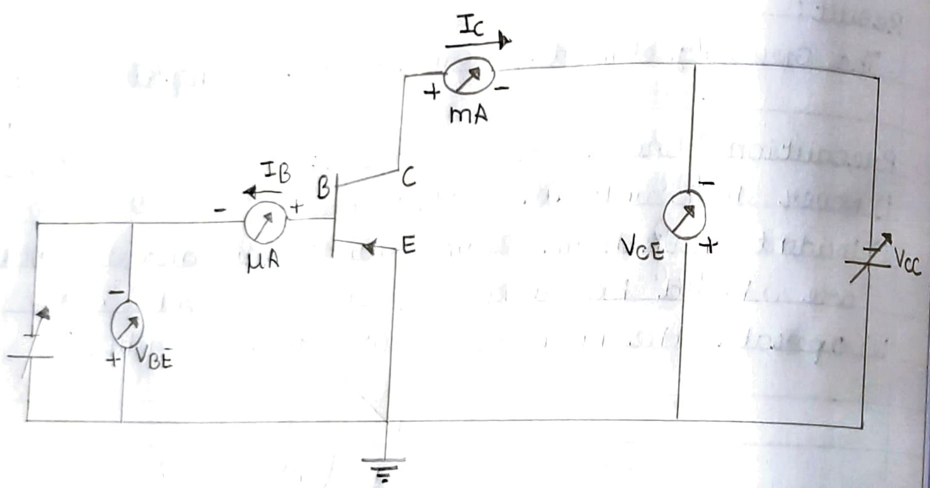
Precautions and Source of Error:

i) Never look into a LASER Beam

ii) Incident LASER beam, Beam expander, slits and the screen ~~are~~ should be along one, single horizontal line.

iii) operate the knob of screw gauge carefully.

Archana
5.11.19



Characteristics Curve Of A Transistor

Aim: To study and plot the transistor input and output characteristics for common emitter configuration

Apparatus: A prepared kit of transistor with connecting wires.

Theory:
Transistor is a three terminal device, consisting of three different doped semi conducting regions, seperated by two junctions. These are named as emitter, base and collector
The doping in the three regions is not the same. The doping is heavy in the emitter region, and is light in base region, while it is only moderate in the collector region. Area of cross section is also not the same throughout, but goes on increasing from emitter towards collector. The base region of the transistor is invariably thin.
There are two types of junction transistor.

Input Characteristics

Procedure:

Keep collector to emitter voltage constant say 1 V

Table 1:

$V_C = 2V$			$V_C = 3V$		
V_{BE} (V)	I_B (μA)	$\frac{V_C}{I_C}$ =	V_{BE} (V)	I_B (μA)	$\frac{V_C}{I_C}$ =
0.1	10	0.01	0.1	10	0.01
0.2	17	0.01	0.2	17	0.01
0.3	27	0.01	0.3	28	0.01
0.4	35	0.01	0.4	35	0.01
0.5	45	0.01	0.5	48	0.01
0.6	55	0.01	0.6	53	0.01
0.7	68	0.01	0.7	69	0.01

Table 2:

I_B = 110 μA			I_B = 150 μA		
V_C (V)	I_C (mA)	V_C/I_C	V_C (V)	I_C (mA)	V_C/I_C =
1	8	0.125	1	16.5	0.06
2	8	0.250	2	16.5	0.12
3	8	0.375	3	16.5	0.18
4	8	0.500	4	16.5	0.24

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2) Increase dc voltage applied to the forward biased base-emitter junction in proper steps and in each case note V_B and I_B reading.

3) Repeat the steps for different V_{CE} voltages.

Observations:

a) Least Count of Ammeters = I_B = 0.5 μA , I_C = ~~0.8~~ 0.1 μA

b) least Count of Voltmeters = V_C = 0.1V , V_B = 0.1V

Output Characteristics:

Procedure:

1) Keep base current I_B constant at say 20 μA

2) Increase collector to emitter voltage V_C in proper steps and for each value of V_C record corresponding collector current I_C.

3) Repeat the steps for different values of I_B.

Observations

a) Least count of Ammeters = (I_C) = 0.1 μA & I_B = 0.5 μA

b) Least count of Voltmeters = (V_C) = 0.1V

(V_B) = 0.1V

Result:

In the common emitter mode for the given PNP/NPN transistor, the characteristics curves are shown in graphs.

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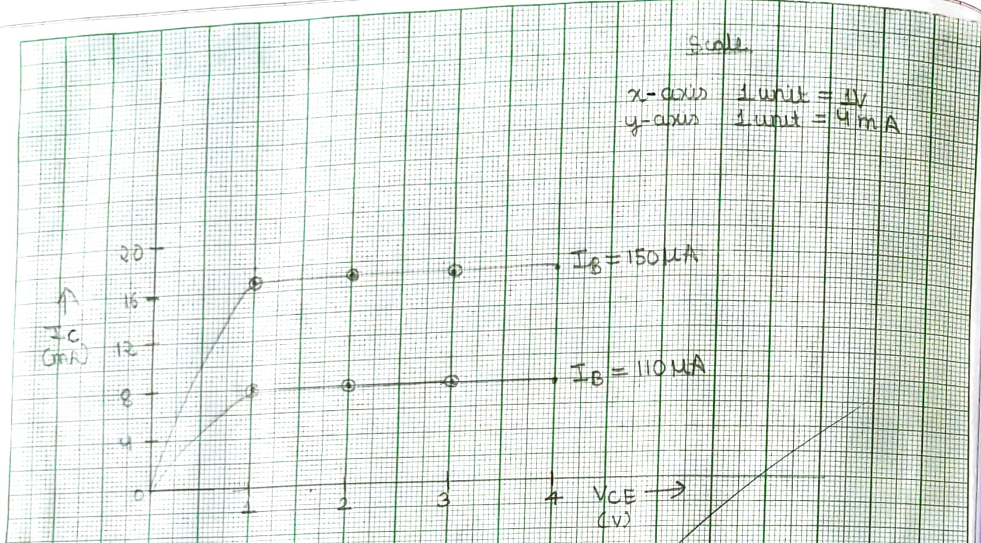
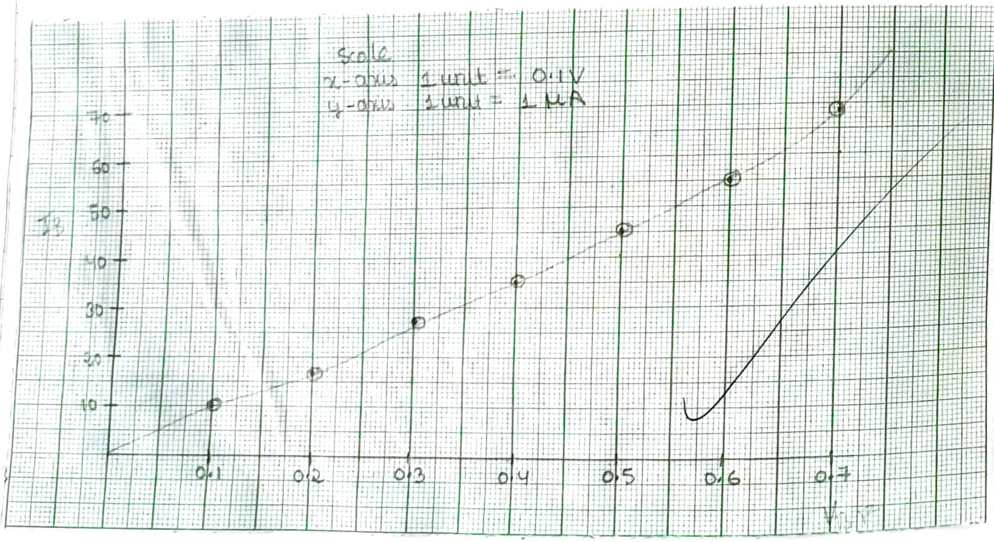


Output characteristics

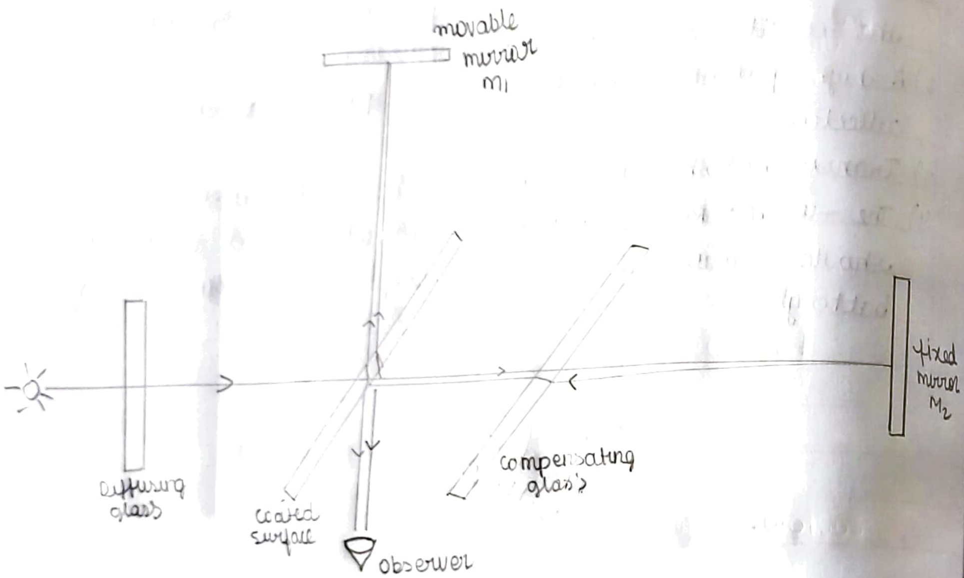


Input characteristics

Precautions:

1) The emitter-base junction is kept in forward bias while the collector-emitter in reverse bias
2) A high potential should not be applied at the base or collector
3) Transistor should not be heated continuously.
4) The +ve marked terminal of ammeter and voltmeter should always be connected to positive terminal of the battery.

5.11.19



optical arrangement and light path in Michelson Interferometer.

Date ______

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Michelson Interferometers

Objective– To determine the wavelength of He-Ne laser with help of Michelson interferometer.

Apparatus required– Michelson interferometer, laser source, screen, etc.

Theory– Michelson Interferometer operates on principle of division of amplitude rather than on division of wave front. The important parts of a Michelson interferometer include a sturdy base, a diffusing glass, a beam splitter, a movable mirror with a micrometer screw for measuring distance of movement, a fixed mirror, and compensating glass. These parts are in Fig 1.

The light source shown to the left can be a white light or spectral light source. It is not generally considered a part of the Michelson Interferometer.

~~The light source shown to the left can be a white light or spectral light source. It is not generally considered a part of a Michelson interferometer.~~

An accurately machined microammeter screw is attached to the movable mirror, permitting the mirror to be moved toward or away from the beam splitter by a precisely determined amount. The micrometer generally has about one inch of movement and usually can measure mirror motion to within 0.002 mm. The two mirrors beam splitters, and

Teacher's Signature ______

Observation Table

No of fringes collapsed	Main Scale (cm)	Circular Scale (cm)	Vernier Scale (cm)	Total (cm)	seperation d_0 for N=50 (cm)
0	0	0.56	0.0000	0.5600	0.0243
25	0	0.57	0.0076	0.5776	0.0068
50	0	0.58	0.0043	0.5843	0.0142
75	0	0.58	0.0044	0.5844	0.0034
100	0	0.59	0.0085	0.5985	0.0249
125	0	0.59	0.0053	0.5953	0.0267
150	0	0.60	0.0019	0.6029	
175	0	0.61	0.0020	0.6120	
200	0	0.62	0.0086	0.6286	

mean value of d_0 = 0.01505 (cm)

Calculations

wavelength $\lambda = 2d_0/N$

$$\lambda = \frac{2 \times 0.01505}{50}$$

$$\lambda = 6020 \text{ Å}$$

compensating glass all are made of carefully annealed glass.

Formula Used:

$$\lambda = 2d_0/N$$

where d_0 is distance measured with micrometer screw and N is number of fringes collapsing.

Procedure:

a) Set up the Michelson Interprometer
b) Mount the laser on the optical table with beam parallel to table surface.
c) The movable mirror will be the one in the direct path of the laser beam
d) Align the mirrors using the laser beam.
e) Adjust the distance of M_1 and M_2 from P to be nearly equal.
f) Adjust the centre of circular fringes in the field of view
g) Note down the least count of micrometer screw provided with mirror M_1
h) Record the initial reading of screw, Now move it slowly and count the no. of fringes collapsing at the center in steps of 25 and each time note down reading
i) Measure the wavelength of the He-Ne laser.

Observations:

Least count of interferometer · Main scale = 1 cm
Least count of circular scale V_1 = 10^{-2} cm
Least count of vernier scale V_2 = 10^{-4} cm

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Result:

The wavelength of given He-Ne laser is 6020Å

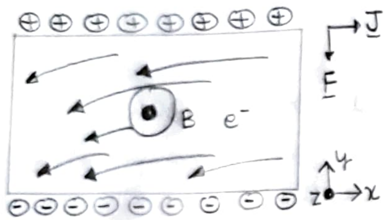
Precautions and Sources Of Error:

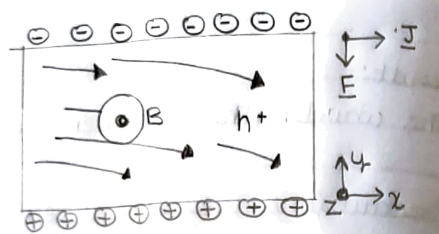
i) The two mirror should be highly silvered on their front surfaces

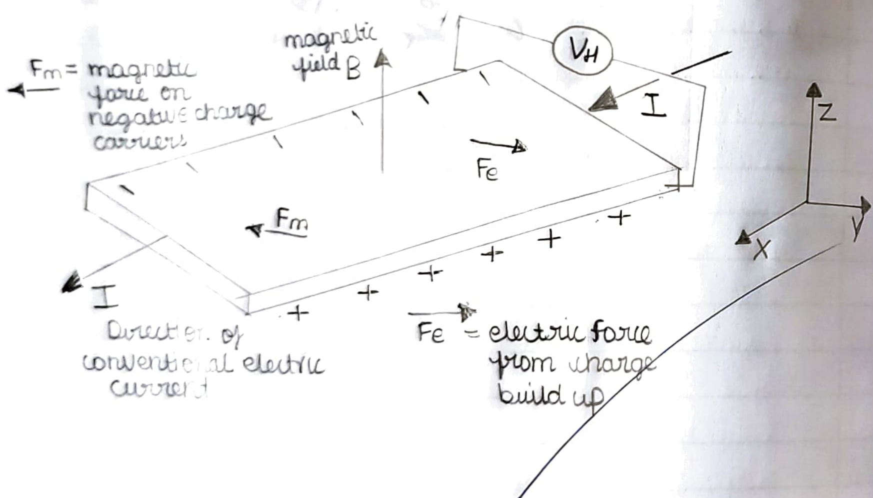
ii) The glass plate should be of same thickness

iii) Adjustment should be made by moving M_1 only

Pooja
5.11.19







HALL EFFECT

Objective— To determine the Hall voltage and Hall Coefficient of Germanium crystal.

Instruments— Hall Probe (Ge Crystal), Hall Effect Set up, Electromagnet, Constant Current Power Supply, Digital Gaussmeter.

Theory— The static magnetic field has no effect on charges unless they are in motion. When the charges flow, a magnetic field directed perpendicular to the direction of flow produces a mutually perpendicular force on the charges. When this happens electrons and holes will be separated by opposite forces. This means that the current of carriers will be deflected from a straight line in y-direction. In other words, there is a component of the velocity in y-direction and the surfaces perpendicular to the y-direction will become charged as soon as the current (or the magnetic field) is switched on.
They will in turn produce an electric field (E_h) which depends on the cross product of the magnetic intensity H and current density J.

$$E_h = RJ \times H$$

where R is called the Hall coefficient
Now let us consider a bar of semiconductor having dimensions x, y and z. Let J is directed along X and H along Z then E_b will be along Y. Then we could write

Table

SET-1 Electromagnet Power supply $H_1 = 1000$ Gauss			SET-2 $H_2 = 1100$ Gauss		SET-3 $H_3 = 1200$ Gauss	
S.NO	I_z (mA)	V_h (mv)	I_z (mA)	V_h (mv)	I_z (mA)	V_h (mv)
1	1	0.2	1	0.2	1	0.2
2	2	0.5	2	0.5	2	0.6
3	4	1.1	4	1.2	4	1.2
4	6	1.7	6	1.8	6	1.9
5	8	2.3	8	2.4	8	2.6
6	10	2.9	10	3.1	10	3.2

$R_1 = \frac{0.1 \times 0.3}{1000} = 3 \times 10^{-5}$ v cm amp^{-1}G^{-1}

$R_2 = \frac{0.1 \times 0.325}{1100} = 2.95 \times 10^{-5}$ vcmamp^{-1}G^{-1}

$R_3 = \frac{0.1 \times 0.35}{1200} = 2.91 \times 10^{-5}$ vcmamp^{-1}G^{-1}

$\langle R \rangle = 2.953 \times 10^{-5}$ Voltcmamp^{-1}G^{-1}

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$R = \frac{V_b/y}{JH}$ or $R = \frac{V_b}{I_x} \times \frac{z}{H}$

where V_h is Hall voltage appearing b/w two surfaces ⊥ to y and $I = Jyz$

Formula Used:

$$R = \frac{V_h}{I_x} \times \frac{z}{H}$$

where V_h is Hall voltage, I_x current, H magnetic intensity and z is thickness of crystal

$$R = \text{slope} \times \frac{z}{H}$$

slope ($\Delta V_h / \Delta I_x$) obtained from V_h versus I_x plot.

Procedure:

a) Connect Hall probe to set up (red to voltage and green to current)
b) Switch ON the setup and adjust current (say mA)
c) Switch over the display to voltage side. See the zero field potential.
d) Place probe in the magnetic field as in fig. and switch on electromagnet power supply and adjust current of power supply at 0.3 Amp for const. field.
Rotate the probe till it becomes ⊥ to mag. field
e) Vary current (I_x) and measure Hall Voltage (V_h) c
f) Repeat experiment for constant 0.4 Amp and 0.5 Amp current to electromagnet power supply.
g) Measure magnetic field by Gaussmeter
h) Plot V_h versus I_x graph.

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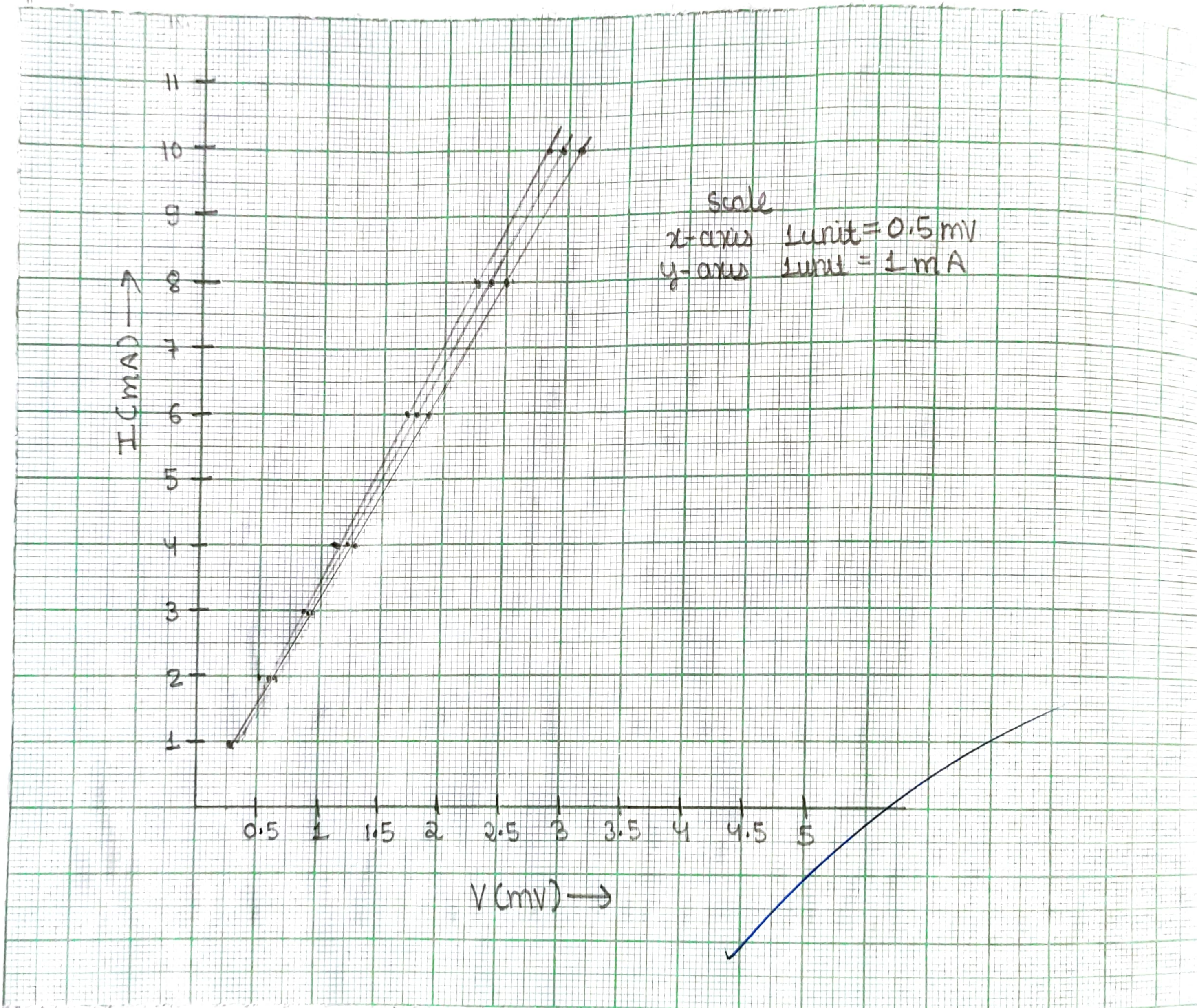
Scale
x-axis 1unit = 0.5 mV
y-axis 1unit = 1 mA
I (mA) →
V (mv) →
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
1
2
3
4
5
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Refractive Index

Aim: To determine the refractive index of material of prism using spectrometer.

Apparatus- Prism, source of mercury light, a spirit level and spectrometer.

Theory- when a ray of light is incident on a prism, it undergoes deviation. when a ray of light incident on a face of prism it passes from rarer medium to denser and thus bents towards the normal and travels within the material of prism. on emerging from other face it passes through denser to rarer medium and thus bents away from the normal. It travels in air. It is evident that it has deviated from its original path by an angle δ. For thin prism of angle A, the deviation produced by it is given by

$$\delta = (n-1)A$$

where n is refractive index of material of prism
The refractive index n of a substance is defined as ratio of light in vacuume to light in medium

$$n = c/v$$

For an isosceles triangle prism, the condition when prism is set in minimum deviation is:

$$n = \frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin A/2}$$

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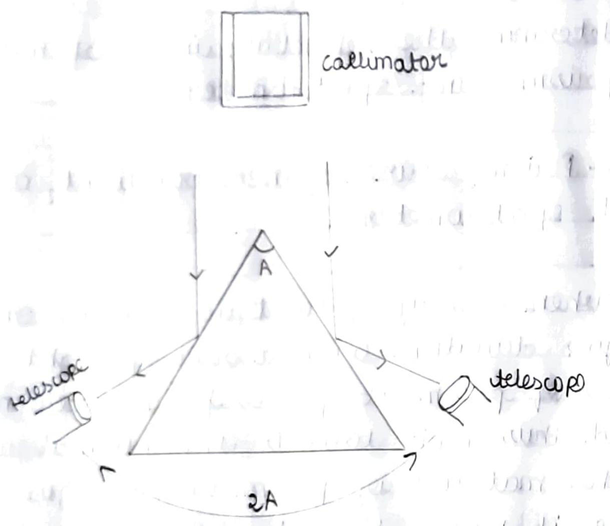

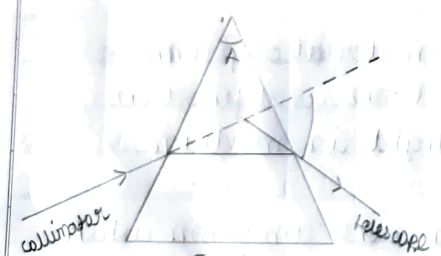

Fig 1

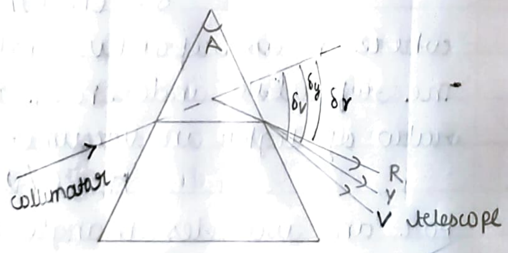

Fig 2

Formula

For an isosceles triangled prism, refractive index of material of the prism n

$$n = \frac{\sin\left(\frac{A+\delta}{2}\right)}{\sin A/2}$$

A – angle of prism

δ – angle of minimum deviation

Procedure –

1) Put a prism on prism table to set its base parallel to collimator beam.

2) Setting for parallel rays move refracting angle of the prism slightly towards the callimeter. The spectrum will get diffused. Focus the callimeter for sharp spectrum. Now move the refracting angle slightly towards the telescope. Spectrum will get diffused again Focus the telescope for sharp spectrum.

3) To measure prism angle – Keep one edge of prism pointed towards callimeter. make the width of slit as narrow as possible. Turn telescope to set the image of the slit from one face. In this position note down the reading of vernier (V_1) from window 1 and reading of vernier (V_2) from window - 2.

Table 1: For angle of prism

S.No	window Vernier	Reflection for left face			Reflection for Right face			Difference 2A	Mean 2A	A
		MSR	VSR	Total	MSR	VSR	Total			
	V_1	228	26	V_{1L} 228.43	109	6	V_{1R} 109.1	$V_{1L}-V_{1R}$ 119.33	120.557	60.2785
	V_2	50	4	V_{2L} 50.066	289	17	V_{2R} 289.3	$V_{2L}-V_{2R}$ 121.784		

Table 2: For finding angle of minimum deviation.

S-No	Colours	Vernier Window	Dispersed angle			Direct angle			Difference $V_{1D}-V_1$ $V_{2D}-V_2$	Mean δ
			MSR	VSR	Total	MSR	VSR	Total		
1	Red	V_1	19	22	19.366	37	2	57.033	$\delta_{1r} = 37.667$	$\delta_r =$
		V_2	199	19	199.316	236.5	7	236.616	$\delta_{2r} = 37.3$	37.483
2	Yellow	V_1	19	9	19.56	37	2	57.033	$\delta_{1y} = 37.983$	$\delta_y =$
		V_2	199	10	199.16	236.5	7	236.616	$\delta_{2y} = 37.43$	37.716
3	Violet	V_1	18	5	18.083	37	2	57.033	$\delta_{1v} = 38.138$	$\delta_v =$
		V_2	197.5	22	197.86	236.5	7	236.616	$\delta_{2v} = 38.750$	38.845

4) Place the prism so that base becomes parallel to the slit and light falls on one face

5) Focus telescope on other face spectrum will be observed from that side. Slowly rotate prism table keeping in view the spectrum by rotating telescope in same direction till spectrum starts moving in opposite direction.

6) Record reading for V_1 and V_2 in Table 2

Observations

Least count

main scale = 0.5 (degree)

vernier scale = 01 (minute)

Calculations

Using the values of $\delta r, \delta y$ & δv in formula calculate the refractive indexes

$$\mu = \frac{\sin\left(\frac{A+\delta}{2}\right)}{\sin(A/2)}$$

$$\text{Red} - \frac{\sin\left(\frac{60.2785+37.483}{2}\right)}{\sin(60.2785/2)} = 1.5034$$

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Yellow = $\dfrac{\sin\left(\dfrac{60.2785+37.716}{2}\right)}{\sin(60.2785/2)} = 1.50616°$

Violet $\dfrac{\sin\left(\dfrac{60.2785+38.845}{2}\right)}{\sin(60.2785/2)} = 1.5179°$

Result

Angle of Prism = 60.2785 degree

Refractive index of prism for different colours

$n(\text{Red}) = 1.5054°$

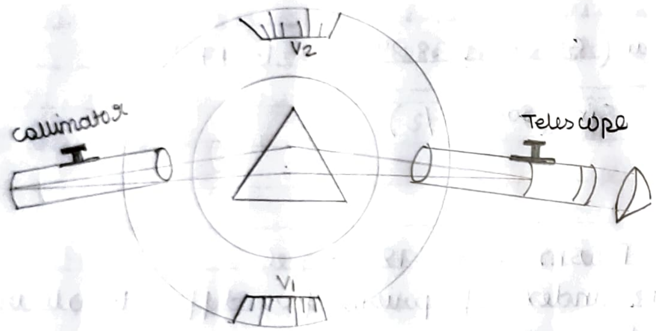
$n(\text{yellow}) = 1.50616°$

$n(\text{violet}) = 1.5179°$

Precautions

1) Avoid the extra light falling on telescope
2) ~~Re~~ The width of slit should be made as narrow as possible reading of both vernier should be taken.

Archana
5-11-19



Spectrometer

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Dispersive Power Of Material Of Prism

Aim – To determine the dispersive power of material of prism by using spectrometer.

Apparatus – Prism, source of mercury light, a spirit level and spectrometer

Theory – The refractive index n of a substance is defined as speed of light in vacuum to in medium

$$n = c/v$$

The light wave of different frequency (and hence different wavelength) move with different speed in a medium, so the refractive index of medium is a function of frequency (or wavelength). The dependence of refractive index of material on freq or wavelength is known as dispersion.

When a ray of light is incident on a prism, it undergoes deviation. For thin prism of angle A, the deviation produced by it is given by

$$\delta = (n-1)A$$

For an isosceles triangled prism the condn when prism is in minimum deviation is

$$n = \frac{\sin\left(\frac{A+\delta}{2}\right)}{\sin(A/2)}$$

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~~If white light~~

If δ_v, δ_y & δ_r are angle of deviation for violet, yellow and red then $\left(\frac{\delta_v - \delta_r}{\delta_y}\right)$ is called dispersive power (ω)

$$\omega = \frac{\delta_v - \delta_r}{\delta_y} = \frac{n_v - n_r}{n_y - 1}$$

Formula

Dispersive power of material of prism is

$$\omega = \frac{n_v - n_r}{n_y - 1}$$

where n_v, n_y, n_r are refractive indices of prism for red, yellow and violet colours.

Procedure:

1) Put a prism on table to set its base parallel to collimator beam and light falls on one face
2) A well focussed spectrum is obtained in field of view
3) Setting for parallel rays - Move a refracting angle of prism slightly toward the collimator. Focus collimator for sharp spectrum.
4) Place the prism so that base becomes parallel to slit focus telescope on other face. Note down vernier (V_1) and (V_2).

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Table: For finding angle of minimum deviation

S.NO	Colours	Vernier	Dispersed Angle			Direct angle			Difference	Mean
			MSR	VSR	Total	MSR	VSR	Total		
1	Red	V_1	19	22	19.366	37	2	57.033	$\delta_{1r} = 37.667$	$\delta_r = 37.483$
		V_2	199	19	199.316	236.5	7	236.616	$\delta_{2r} = 37.3$	
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3	Violet	V_1	18	5	18.083	37	2	57.033	$\delta_{1v} = 38.138$	$\delta_v = 38.845$
		V_2	197.5	22	197.86	236.5	7	236.616	$\delta_{2v} = 38.750$	

5) Remove prism and bring telescope in line with collimator. Record their reading for V_1 & V_2 as direct angle.

Observations

Angle of prism = 60° (degree)

Least count:

main scale = 0.5° (degree)

vernier scale = 1 (minute)

Calculations

Using values of δr, δy & δv in formula calculate refractive indices

$n_r = 1.5034°$, $n_y = 1.50616°$, $n_v = 1.5179°$

Dispersive Power of material of prism

$$\omega = \frac{n_v - n_r}{n_y - 1} = \frac{1.51° - 1.503°}{0.50616}$$

$\omega = 0.02864$

Result

Dispersive power of the material of the prism $\omega = 0.02864$

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Precautions:

1) Avoid extra light falling on telescope

2) Prior to any measurement with spectrometer, the telescope, collimator and prism table should be set properly.

3) The width of slit should be made as narrow as possible

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