Animesh Sharma (2110990187)

Experiment - 1

Aim: To calculate the hall coefficient and the carrier concentration of the sample material.

Apparatus: 2 solenoids, constant current supply, 4 probe Digital Gaussmeter, Hall effect apparatus (CGS, millivoltmeter and hall probe)

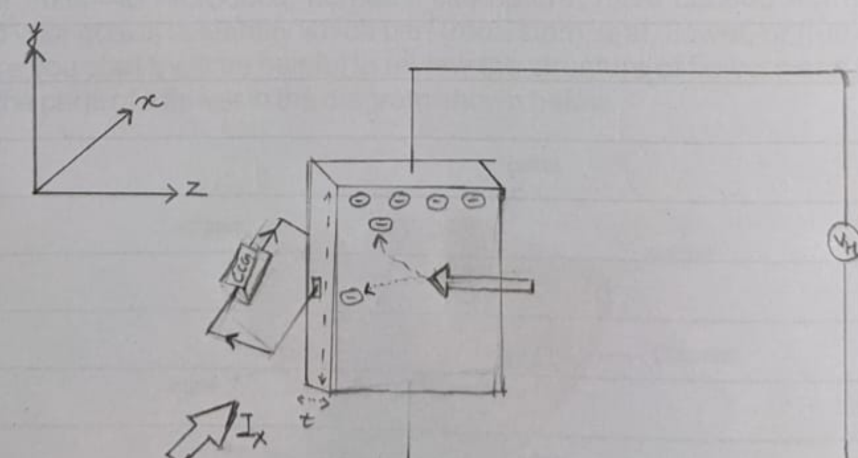
Formula Used:

Hall coefficient is given by,

$$R_H = \frac{V_H \times t}{I \times B}$$

where V_H = hall voltage, t = thickness, I = current, B = Magnetic field

Diagram:



Schematic representation of Hall effect

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Experiment-1

Objective : To determine the halls voltage developed across the sample material.
To calculate the hall coefficient and the carrier concentration of sample material.

Apparatus : Two Solenoids, Constant current supply, four probe, Digital gauss meter, Hall effect apparatus (which consist of constant current generator), digital milli voltmeter and Hall probe.

Theory : If a current carrying conductor placed in a $\perp$ magnetic field, a potential difference will generate in conductor which is $\perp$ both magnetic field and current. This phenomenon is called Hall effect. In solid state physics, Hall effect is an important tool to characterize the materials especial semicond-uctor. It directly determines both the sign and density of charge carriers in a given Sample. Consider a rectanglar conductor of thickness d kept in XY plane. An electric field is applied in X-direction using constant current generator. So that current I

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Observation Table :

S.no.	Hall current (mA)	Hall Voltage (mV)
1	1	17.253
2	1.5	25.880
3	2.0	34.507
4	2.5	43.133
5	3.0	51.760
6	3.5	60.387
7	4.0	67.014
8	4.5	77.640

Calculations:

$I = 1A, \ t = 0.5\ mm, \ B = 0.1482, \ V_H = 17.253$

$$R_H = \frac{2 \times 17.253 \times 0.5 \times 10^{-3}}{1 \times 0.1482}$$

$$= 0.5820 \ m^3/C$$

$$n = \frac{1}{eR_H} = \frac{1}{1.6 \times 10^{-19} \times 0.5820}$$

$$= 1.07 \times 10^{19} \ m^3$$

flows through the sample. If w is the width of sample and t is the thickness. Therefore current density is given by.

$$J_x = \frac{I}{wt} \quad — (1)$$

If the megnetic field is applied along -ve z-axis the Lorentz force moves the charge carriers towards the Y-direction. This results in accumulation of charge carriers at the top edge of sample this develop a potential difference along y-axis is known as hall voltage V_H and this affect is called Hall effect.

A current is made to flow through the sample material and the voltage difference b/w its top and bottom is measured using a voltmeter. When the applied magnetic field B=0, the voltage difference will be zero.

We know that a current flows in response to an applied electric field with the direction of current or movement of e's backward In both cases, under the application of

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magnetic field the magnetic Lorentz force. $F_m = q(v \times B)$ causes the carriers to curve upwards. Since the charge can't escape from the material force and a steady field can be measured as a transverse voltage difference using voltmeter.

In steady state condition the magnetic force is balanced by electric force. Mathematically we can express it as.

$$eE = evB \quad \text{— (2)}$$

where 'e' is electric charge, 'E' is hall electric field developed 'B' the applied magnetic field and 'v' is drift velocity of charge barriers. and the current 'I' can be expressed as.

$$I = neAv \quad \text{— (3)}$$

where 'n' is the number density of e^- in the conductor of length l, breadth 'w' and thickness 't'.

using (1) and (2) the hall voltage V_H can be written as,

$$V_H = E_w = vB_w = IB \quad \text{— (4)}$$

$$V_H = R_H = \frac{IB}{t}$$

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by rearranging eq. (4) we get

$$R_H = \frac{V_H \times t}{I \times B} \quad \text{— (5)}$$

where R_H is called Hall coefficient

$$R_H = \frac{I}{ne} \quad \text{— (6)}$$

Procedure : 1) connect constant current source to the solenoids.

2) four probe is connected to the gauss meter placed at the middle of a solenoids.

3) Switch ON the gauss meter and constant current source.

4) Vary current through the solenoid from 1A to 5A with interval 0.5A, and note corresponding gauss meter reading

5) Switch OFF the gauss meter and constant current source and turn the knob of constant current source towards minimum current.

6) Fix the hall probe on a wooden stand. Connect green wires to constant current generator and connect red wires to milli Voltmeter in hall effect ~~appatas~~ apparatus

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7) Replace the four probe with hall probe and place the sample material at the 2 solenoid

8) Switch ON the constant current source and carefully ↑ the current I from CCG and measure the corresponding Hall voltage V_H. Repeat this step for different megnetic field B.

9) Thickness t of sample is measured using screw gauge

10) Hence calculate the hall coefficient R_H using eq^n 5.

11) Then calculate the carrier concentration n using eq^n 6

Specification of Hall probe (p-type)

Thickness (t) = 0.50 mm

Result: Hall coefficient of material = 0.0194
carrier concentration of material = 3.2216 Scm^{-3} ($\sim 10^{4}$)

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Experiment - 2

Aim: Determination of Plancks constant

Apparatus: 0-10 V power supply, one way key rheostat, digital milli ammeter, a milli voltmeter, a 1K resistor and different known wavelength LED.

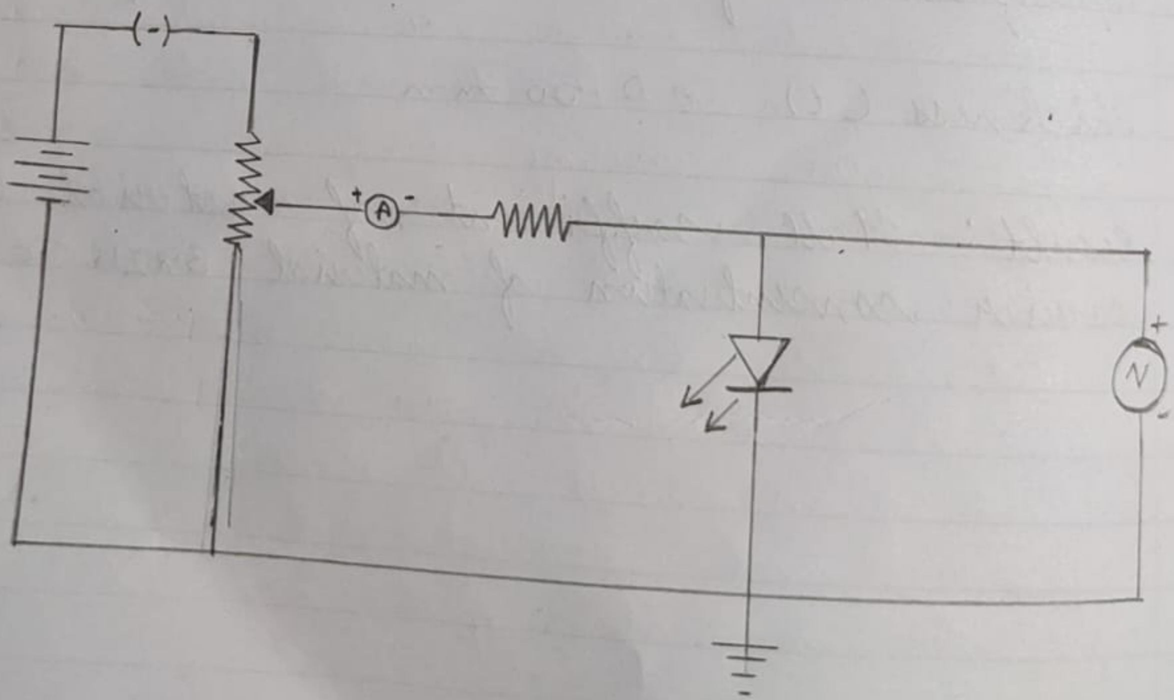
Formula used:

To find the plancks constant (h) is

$$h = \frac{e}{c} \lambda V \Rightarrow h = 5.33 \times 10^{-28} \lambda V$$

where λ = wavelength, V = base voltage

Diagram:



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Experiment - 2

Objective : Determination of Plank's constant

Apparatus : 0-10 v power supply a one way key, a rheostate, a digital millimeter, a digital voltmeter, a 1K resistor, and different known wavelength LED's.

Theory : Plank's Constant (h), a physical constant was introduced german physicist named Max Plank in 1900. The significance of Plank's constant is that 'quanta' can be determined by frequency of radiation and Plank's constant. It describes the behaviour of particle and waves at atomic level as well as particle nature of light.

An LED is a 2 terminal semiconductor light source. In the unbiased condition a potential barrier is developed across the p-n junction of the LED. When we connect the LED starts glowing i.e., in the forward biased condition e crossing the junction are excited, and when they return to their normal state, energy is emitted. This particle voltage is called knee

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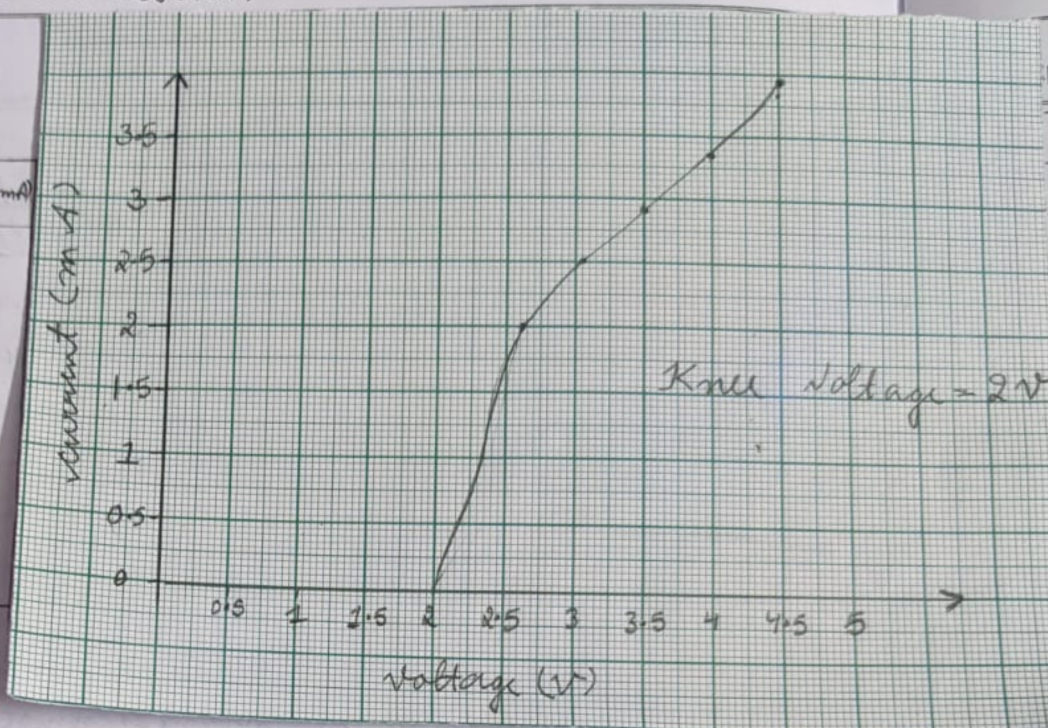
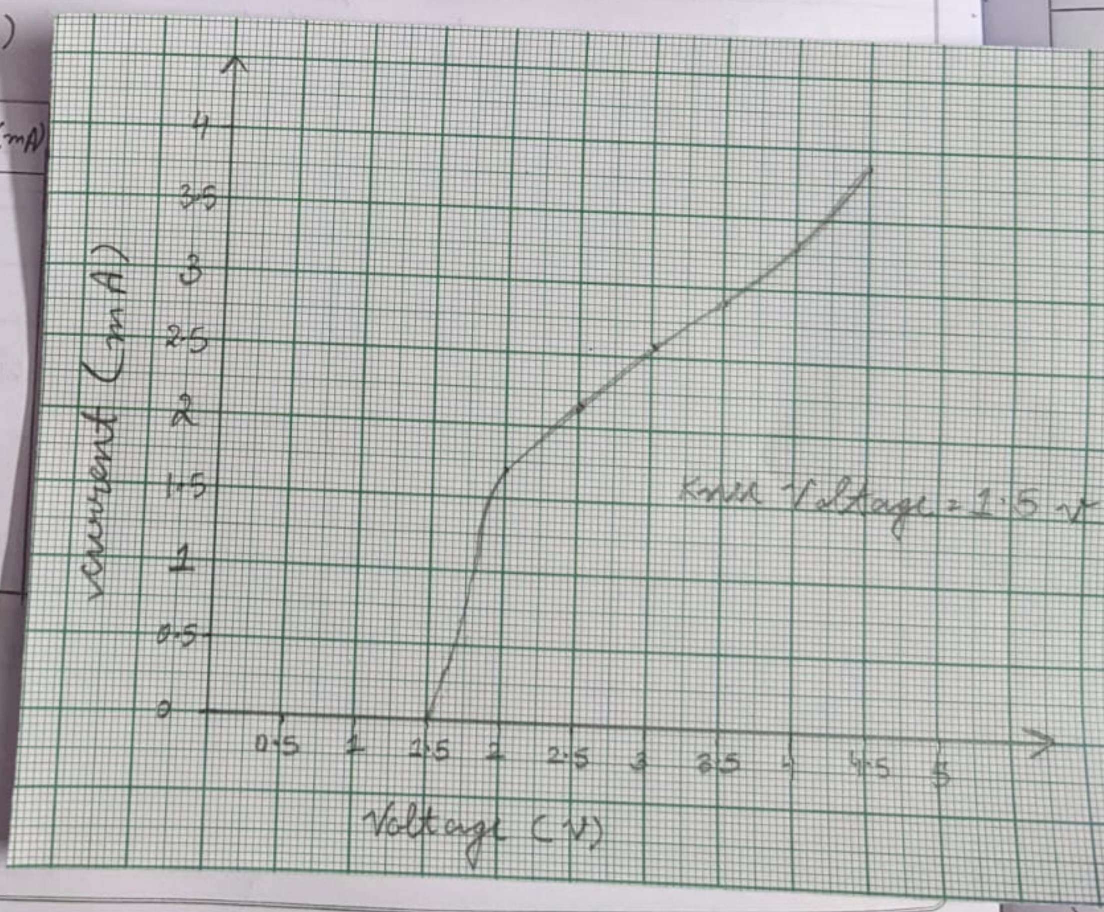
Red ($\lambda = 650 nm$)

Voltage (V)	current (mA)
0.5044	0
1.004	0
1.503	0
2.002	01.669
2.5002	02.085
3.002	02.501
4.000	03.334



Green (510 nm)

Voltage (V)	Current (mA)
0.504	0
1.004	0
1.503	0
2.002	0
2.502	02.005
3.002	02.501
4.00	03.334



voltage or threshold voltage. Once the knee voltage is reached, the current may ↑ but the voltage doesn't change. The light energy emitted during forward biasing is given as

$$E = \frac{hc}{\lambda} \quad \text{— (1)}$$

where

c = velocity of light
h = plankes constant
λ = wavelenght of light

If V is forward voltage applied accross the LED, when it begins to emit light. energy given to e^- crossing the junction is,

$$E = eV \quad \text{— (2)}$$

Equating (1) and (2), we get

$$eV = \frac{hc}{\lambda}$$

The Knee Voltage V can be measured for LED's with different values of λ.

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Calculations:

For Red .

$\lambda = 650 \times 10^{7}\ m$, $V = 1.503\ V$, $e/c = 5.33 \times 10^{-28}$

$$h = \frac{e}{c} \times \lambda \times V$$

$$= 5.33 \times 10^{-28} \times 650 \times 10^{-3} \times 1.503$$

$$= 5207.143 \times 10^{-37}$$

$$= 5.2071 \times 10^{-34}\ Js$$

Result:

Planck's constant $= 5.770 \times 10^{-34}\ Js$

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$$\nu = \frac{hc}{e}\left(\frac{1}{\lambda}\right) \quad \text{—— (4)}$$

Now from eq^n (4), we see that the slope of a graph of ν on verticle axis is $1/\lambda$ on the horizontal axis is

$$S = \frac{hc}{\lambda} \quad \text{—— (5)}$$

To determine Plank's constant h, we take the slope s from our graph and calculate.

$$h = \frac{e}{c} S$$

using the known value

$$\frac{e}{c} = 5.33 \times 10^{-28} \frac{Cs}{m}$$

Alternatively we can write eq^n (3) as

$$h = \frac{e}{c} \lambda \nu$$

~~d~~ calculate h for each LED, and take the average of our result.

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Procedure for Stimulation:

1) After the connections are completed, click on 'Insert key' button.
2) Click on the combo box under 'Select LED' button.
3) Click on the 'Rheostat Value' to adjust the value of rheostat.
4) Corresponding, voltage across the LED is measured using a voltmeter, which is the knee voltage.
5) Repeat, by changing the LED and note down the corresponding knee voltage.

$$h = \frac{eV\lambda}{c}$$

6) Calculate 'h' using equation $\lambda = hc/eV$
7) The wavelength of infrared LED is calculated by using equation.

Procedure for Real Lab:

1) Connections are made as shown in diagram.
2) Insert key to start the experiment.
3) Adjust the rheostat value till the LED glows on in the case of IR diode, until the ammeter indicates that current has begun to increase.

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4) Corresponding voltage across the LED is measured by using a voltmeter, which is the knee voltage.
5) Repeat, by changing the LED and note down the corresponding knee voltage.
6) Using formula given, find the value of the Plancks constant.

Result :

Planck's constant = 5.5770×10^{-34} Js.

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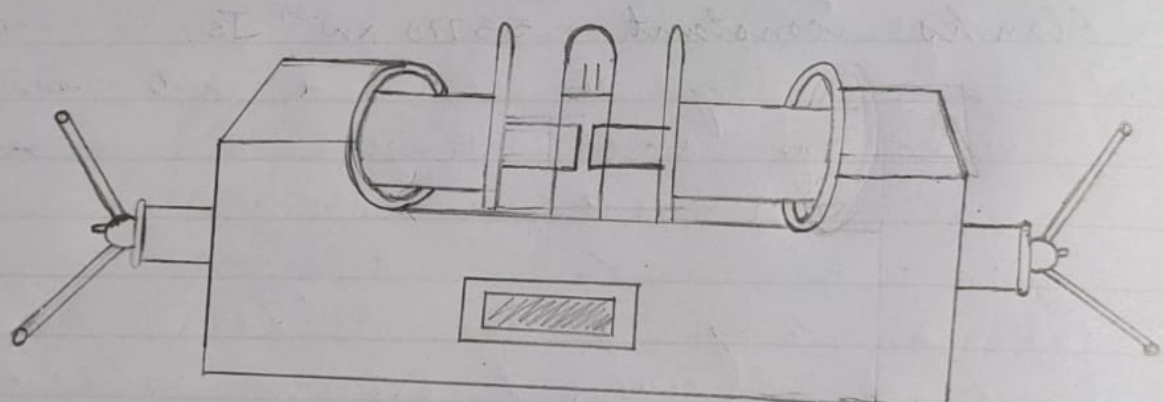
Experiment - 3

Aim: Determine the susceptibility of given sample by using Quinke's method.

Apparatus: An electromagnet capable of producing field of order 10^4 oersted, power supply unit, $FeCl_3$, U-tube, water, funnel, weighing bottle, gauss meter.

Diagram:



Observation table:

S no.	Current	Mag. Field (H)	H^2	Initial Position of miniscus	Final position (m)	Fall in height (m)
1	2.5	0.567	0.32	12.87	12.883	0.013
2	5	1.133	1.2837	12.87	12.921	0.051

Experiment - 3

Objective: Determine the susceptibility of given sample by using Quinke's method.

Apparatus: An electromagnet capable of producing field of the order 10^4 oersted, power supply unit, $FeCl_3$, U-tube, water, funnel, 100 cc cylinder, weighting bottle, weight box, gauss meter.

Theory: If a paramagnetic salt solution (like mangnese chloride) or ferromagnetic salt (like $FeCl_2$) is put in a table and placed between the poles of a magnet then there is a rise in a liquid level. If the rise in liquid level is measured accurately, then this will give information about the susceptibility of the solution.
It was established by Faraday in 1845 that magnetism is universal property of every substance. In magnetic material, source of magnetism are the electrons orbital angular motion around the nuclears, and the electron's intrinsic magnetic moment.
The force of depends on the susceptibility K of the material, i.e. on ratio of

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Calculations:

Current = 0.5 A   Molarity = 0.5 M

$$MSR + (VSR \times LSR)$$

I^{st} case - $12.85 + (20 \times 0.001) = 12.87$

II^{nd} case - $12.85 + (33 \times 0.001) = 12.883$

III^{rd} case - $12.9 + (21 \times 0.001) = 12.921$

$$\chi_1 = 2gh/H^2 = \frac{2 \times 9.8 \times 0.013}{0.32} = 0.79625$$

$$\chi_2 = 2gh/H^2 = \frac{2 \times 9.8 \times 0.051}{1.2837} = 0.77868$$

$$\chi = \frac{\chi_1 + \chi_2}{2} = \frac{0.79625 + 0.77868}{2} = 0.787465 \ m^2 S^2 T^2$$

Result:

Mean mass susceptibility of the solution (0.517) is $0.787 \ m^2 S^{-2} T^2$

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intensity of magnetization to magnetizing field (I/H). evidently it refers to that quantity of substance by virtue of which bodies get magnetized.

The value of the susceptibility K of liquid aqueous solⁿ of a paramagnetic substance in air is given by a well known expression:

$$K = \frac{2(\rho - \sigma) g h}{H^2} \quad —— (1)$$

where, ρ = density of solution

σ = density of air.

g = acceleration due to gravity

h = hieght through which column rises on raising the field.

H = magnetic field at centre of pole piece.

But the density of air (1.22 kg/m³) is very small as compared to the density of water so density of air can be neglected. Hence eqⁿ (1) becomes

$$K = \frac{2\rho g h}{H^2}$$

Then the mass susceplibility of solution is given by

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$$X_s = \frac{K}{c} = \frac{2gh}{H^2}$$

Procedure: 1) Note the variation of megnetic field with current by using the Gauss meter.

2) Fill a U-tube which is throughly cleaned with a solution of $FeCl_3$ in water containing 25g of a $FeCl_3 \cdot 6H_2O$ per cc of the solution.

3) Now insert the narrow lines of U-tube vert. between the pole pieces of the electromagnet and adjust the funnel limb so that when the magnet is energized the meniscus is in the central region of the uniform magnetic field. Also note the corresponding current in the ammeter.

4) Switch off the current and again note the reading of the meniscus and take a reading. note the fall in hieght (h) of the meniscus for a particular current. Repeat the experiment a diff. values of magnetizing current.

Precautions:

1) Check the joints between rubbers and glass tube so that there is no leakage of solution.

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2) Solution should be prepared carefully so that salt is dissolved uniformly.
3) The magnetic field should remain uniform during the experiment.

Source of error:
1) Due to evaporation of water the results obtained are slightly less than the actual values.
2) Due to non-uniformity of the narrow limb bore, error due to surface tension may occur.

Result:
Mean mass susceptibility of the solution is $0.787\ m^2 s^{-2} T^2$.

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Experiment - 4

Aim: Study the angular divergence of laser beam

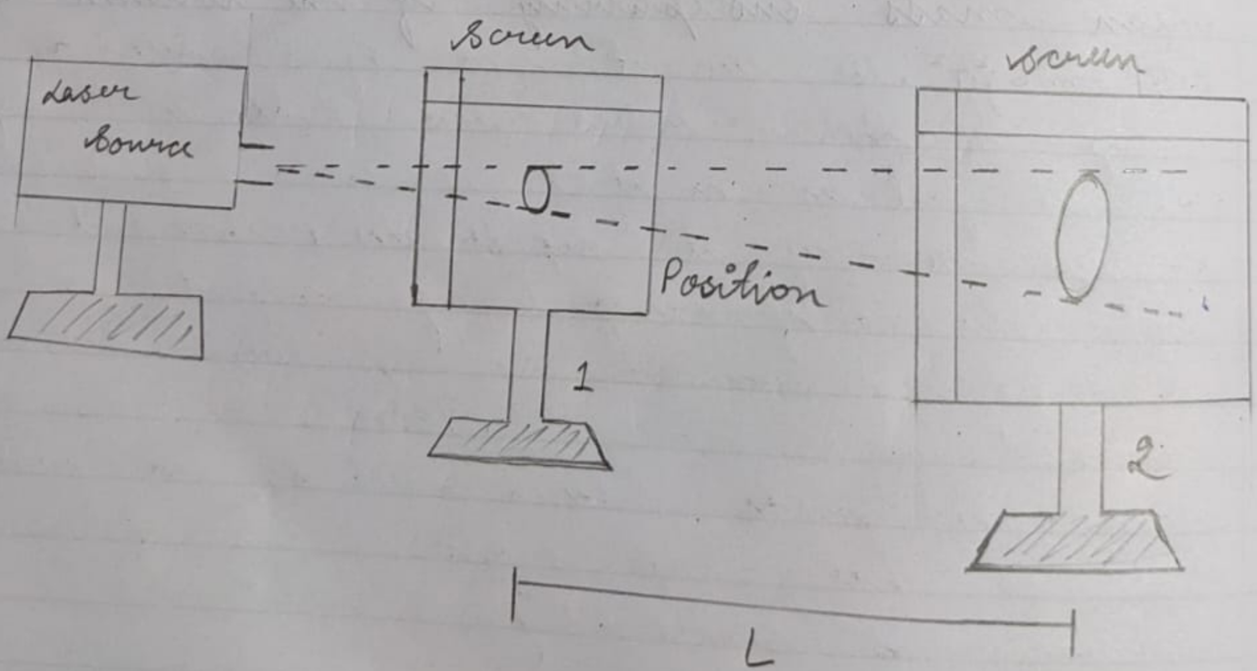
Apparatus: A laser source, optical bench, screen.

Formula Used:

$$\text{Angular divergence } (\theta) = \frac{[D_2^2 - D_1^2]^{1/2}}{L} \times \text{degree}$$

where, D_1 = diameter of spot at 1st position
D_2 = diameter of spot at 2nd position
L = distance b/w 1st and second position

Diagram:



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Experiment - 4

Objective : Study the angular divergence of laser beam

Apparatus : A laser source, optical bench, screen.

Formula used :

Angular divergence $(\theta) = \left[\frac{D_2^2 - D_1^2}{L}\right]^{1/2} \times \frac{180}{\pi}$ degree

where, D_1 = daimeter of spot at 1st position
D_2 = daimeter of spot at 2nd position
L = distance b/w 1st and 2nd position.

Procedure :

1) Place the laser source on an upright of an optical bench.
2) Place the screen on another upright at same known distance.
3) Switch on the laser source. A laser beam coming from the sources from a circular bright spot (red colour) on the screen.
4) Measure the size of the spot on the screen. This is D_1.

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Observation Table :

S NO.	Ist position of spot (a) (cm)	D_1 (cm)	Spot	D_2	L = b - a	θ (degree)
1	455	1.2	536	1.3	81	0.35
2	455	1.2	536	1.3	81	0.90
3	455	1.2	536	1.3	81	0.35

Calculation

for case 1

$$\theta = \frac{[D_2^2 - D_1^2]^{1/2}}{L} \times 180/\pi \text{ degree}$$

$$= \frac{[1.69 - 1.44]^{1/2}}{81} \times \frac{180}{22} \times 7$$

$$= 0.353^\circ$$

for case 2

$$\theta = [1.96 - 1.44]^{1/2} \times \frac{180}{22} \times 7$$

$$= 0.909$$

Result : Angular divergence of laser beam is 0.405°

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5) Now move the screen away from the source by some known value. Again measure the spot, it is D_2.

6) Note down the distance between the two position.

7) Repeat the experiment at least 3 times at different position of the screen and record the observation table.

8) Using above data calculate the angular divergence θ.

Precautions:

1) Do not look directly at laser beam because it is hazardous to the eyes.

2) The laser source is to be switched off after taking observation.

Result:

- The angular diversion of laser beam is 0.405
- The angular divergence of laser beam may vary from 0.2' to 0.5'

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Experiment - 5

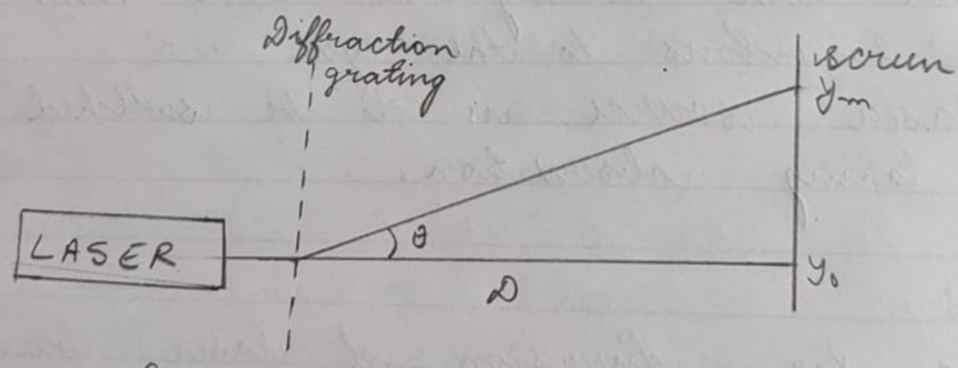
Aim : Determine the wavelenght of the laser light by diffraction grafting method.

Apparatus : A laser source, diffraction grafting with paper, power supply, Optical bench.

Formula :

For normal illumination, the grating equation is,

$$n\lambda = (d + b) \sin\theta$$



Geometry of diffraction grating

Observation :

n_0 diffraction grating with 320 lines/mm is used so that the distance between two lines of grating is

$$d + b = 1/320 \text{ mm}$$

$$= \frac{1}{3200} \text{ cm}$$

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Experiment - 5

Objective: Determine the wavelength of the laser light by diffraction grafting method.

Apparatus: A laser source, diffraction grafting screen with paper, power supply, optical bench.

Theory: When a beam of light is incident on a plane diffraction grafting which constitutes a series of equidistant slits of equal width, the light is diffracted from each slit and these diffracted beams will then interfeounce with each other on different points on the screen.

For normal illumination the grating equation is given as

$$n\lambda = (d+h)\sin\theta$$

where, n = order of maximum or image format

λ = wavelength of light

$d+h$ = distance b/w two lines of the grating i.e. grating element.

θ = angular position of image measured from the normal to the grating or grating element.

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Observation Table :

For $n = 1$

S.No.	D (cm)	Y_1 (cm)		Mean Y_1	$\tan\theta_1 = Y_1/D$	$\theta_1 = \tan^{-1} Y_1/D$
		LHS	RHS			
1	600	1.25	1.25	1.25	0.208	13.075
2	700	145	245	145	0.207	13
3	800	167	165	166	0.206	12.933
4	900	190	185	187	0.207	12.0419

Calculation :

$$n_1\lambda_1 = (d+b)\sin\theta_1$$

$$\lambda_1 = \frac{d+b}{n_1}\sin\theta$$

$$= \frac{1}{3200\times 1}\times 0.2029$$

$$= 6.31\times 10^{-5}\ \text{cm}$$

$$\lambda_{mean} = \frac{\lambda_1+\lambda_2}{2}$$

$$= \frac{6.34\times 10^{-5}\times 6.34\times 10^{-5}}{2}$$

$$= 634\ \text{nm}$$

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Procedure:

1) Switch the laser on.
2) Put the diffraction grating on the stand of the optical bench at some distance from the laser source.
3) A paper is fixed on the screen and put the screen at a suitable distance.
4) The position of the grating is moved so that the laser beam gets diffracted to give the ~~a~~ bright spot on the graph paper fixed on the screen.
5) The position of the differaction spots are marked on the paper with the help of fine pencil.
6) The seperations of bright spots of different order of different from the central maxima are measured and the observations are tabulated as Y's.
7) The distance between the diffraction grating is measured as D.

Precautions:

1) laser should be prepared levelled.
2) Direct exposure to laser must be avoided.
3) The tracing of the diffraction patterns should be made accurately and with great care.

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Result :

1) calculated value of wavelength of laser = 634 nm
2) standard value of wavelength of laser = 632.8 nm

Percentage error -

$$\% \text{ error} = \frac{632.8 - 634}{632.8} \times 100$$

$$= -0.189\%$$

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4) Distance between the screen and laser source should be measured accurately.

Result :

1 The calculated value of the wavelength of the laser is 634 nm.

2 The standard value of the wavelength of the laser is 632.8 nm.

$$\%\ \text{error} = \frac{\text{standard} - \text{calculated}}{\text{standard}} \times 100$$

$$= 0.189\ \%\ (\text{in negative})$$

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Experiment 6

Aim: Study the variation of magnetic field with distance along axis of a circular coil carrying current.

Apparatus: A steward and gee type tangent galvanometer, a strong battery, a rheostat, an ammeter, a commutator and connecting wires.

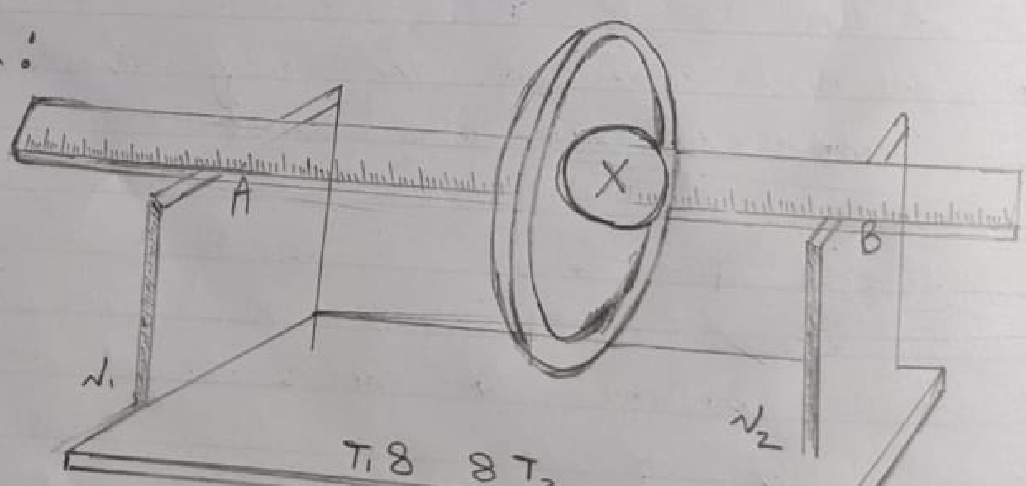
Formula:

$$B = \frac{2\pi n r^2 x_0}{4\pi (x^2 + r^2)^{3/2}}$$

where, n = no. of turns in coil
r = radius of coil,
i = current in Ampere in coil
x_0 = distance of the point from the centre of the coil.

also $B = H \tan\theta$ ($H = 0.345$)

Diagram:



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Experiment - 6

Objective: Study the variation of megnetic field with distance along axis of a circular coil carrying current.

Apparatus: A steward and gee type tangent galvanometer, a strong battery, a rheostat an ammeter, a plug key, a comutator and connecting wires.

Theory: The intensity of magnetic field at a point lying on the axis of a circular coil is given by

$$B = \frac{2\pi r^2 i \mu_0}{4\pi (x^2 + r^2)^{3/2}}$$

where,

n = number of turns in coil

r = radius of coil.

i = current in ampere flowing in coil

x_0 = distance of the point from the centre of coil.

If the magnetic field B is made

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observation table :

S.No	Distance from centre ( )	current in one direction		current in reversed direction		Mean θ	$\tan\theta$	B
		θ_1	θ_2	θ_3	θ_4			
1	25	2°	1°	2°	1°	1°	0.026	0.008
2	-20	4°	2°	3°	2°	2°	0.05	0.017
3	-15	7°	6°	7°	6°	6°	0.114	0.04
4	-10	19°	18°	18°	17°	17°	0.325	0.011
5	-5	52°	52°	52°	52°	51.75	1.27	0.44
6	0	75°	75°	75°	75°	75	3.73	1.26
7	5	50°	51°	52°	52°	51.75	1.27	0.44
8	10	19°	18°	18°	17°	18	0.325	0.11
9	15	7°	6°	7°	6°	6.5	0.114	0.04
10	20	4°	2°	3°	2°	2.75	0.005	0.017

Calculation :

for $\tan\theta = 0.026$, $B = 0.345 \times 0.026 = 0.008$

$\tan\theta = 0.05$, $B = 0.05 \times 0.345 = 0.017$

$\tan\theta = 0.114$, $B = 0.345 \times 0.114 = 0.04$

$\tan\theta = 1.27$, $B = 0.345 \times 1.27 = 0.44$

$\tan\theta = 3.73$, $B = 0.345 \times 3.73 = 1.26$

perpendicular to the horizontal component of earth's magnetic field (H) then

$$B = H \tan\theta \text{ or } B \propto \tan\theta$$

Hence the graph between $\tan\theta$ and x will be similar to graph between B and X.

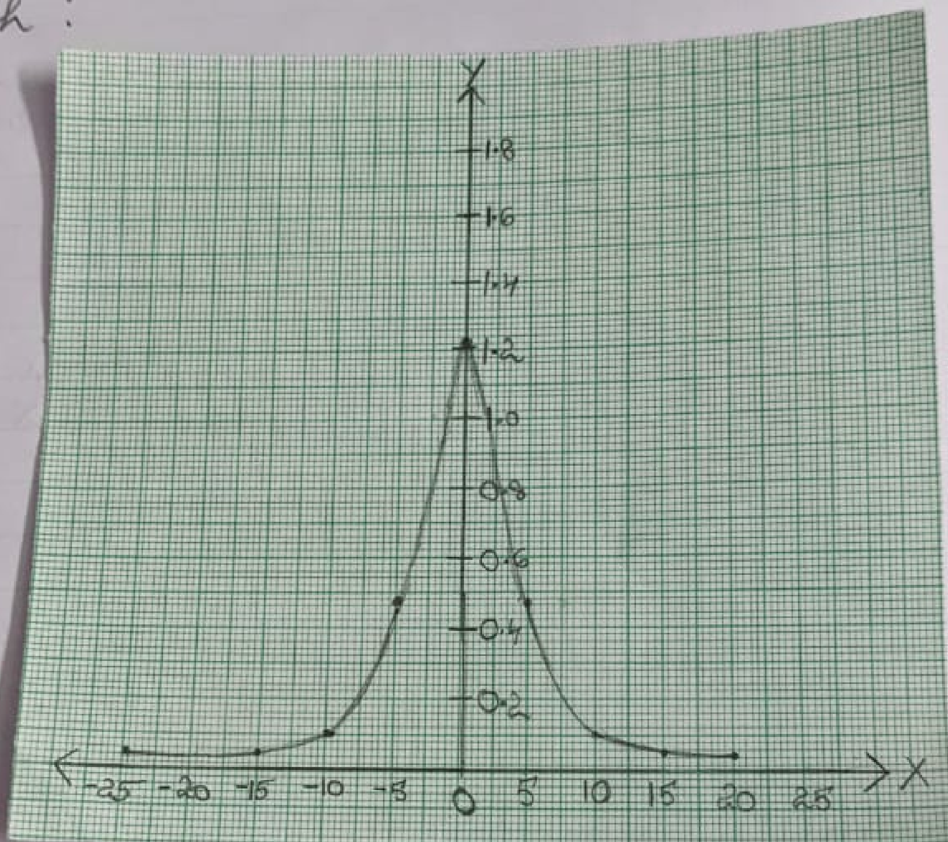
Procedure:

1) Place the magnetometer compass box on the sliding bench so that its magnetic needle is at the centre of the coil. By rotating the whole apparatus in the horizontal plane, set the coil in the magnetic meridian if arms of magnetons lie east and west roughly. Rotate the compass box till the pointer ends read 0-0 on the circular scale.

2) In order to set the coil exactly in the magnetic material set up the electrical connections such that the galvanometer is connected to battery through rheostat, an ammeter, a plug key and a commutator.

3) Send the current in one direction with

graph :



Result :

The graph shows the variation of the magnetic field along the axis of a circular coil carrying current.

the help of comutator and adjust the current such that the deflection of nearly 70° to 75° is produced in the campass needle. Now reverse the current and note down the deflection of the needle. If the deflection are equal then the coil is in mag. meridian otherwise turn the apparatus a little, adjust pointer ends to read 0-0 till these deflections become equal.

4) Now pass the current in the coil and slide the magnetometer along the axis of coil. Find out the position where the deflections becomes maximum. Note the readings of both the ends of the pointer. The mean of four readings will give the mean deflection at $x = 0$.

5) Now shift the compass needle in the steps of 2 cm along the axis of the coil and for each position note down the mean deflection. Continue this process till the compass box reaches the end of the bench.

6) Repeat the measurement exactly in the same manner on the ogher side of the coil.

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7) Plot graph between distance from center of coil x taking along the x-axis and $\tan\theta$ along the Y-axis.

Precautions and Source of Error:

1) The coil should be carefully adjusted in the magnetic meridian.
2) All the magnetic material and current carrying conductors should be at a considerable distances from the apparatus.
3) The current passed in the coil should be of such as value as to produce and deflection of nearly 70°-75°.
4) Current should be checked from time to time and for this purpose an ammeter should be connected in series with the battery.
5) The eye should be kept vertically above the pointer to avoid any error due to parallax.
6) The curve should be drawn smoothly.

Result:

The graph shows the variation of the magnetic field along the axis of a circular coil carrying current.

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Experiment - 7

Aim : Determine the value of specific charge (e/m) of an electron by Thomson method.

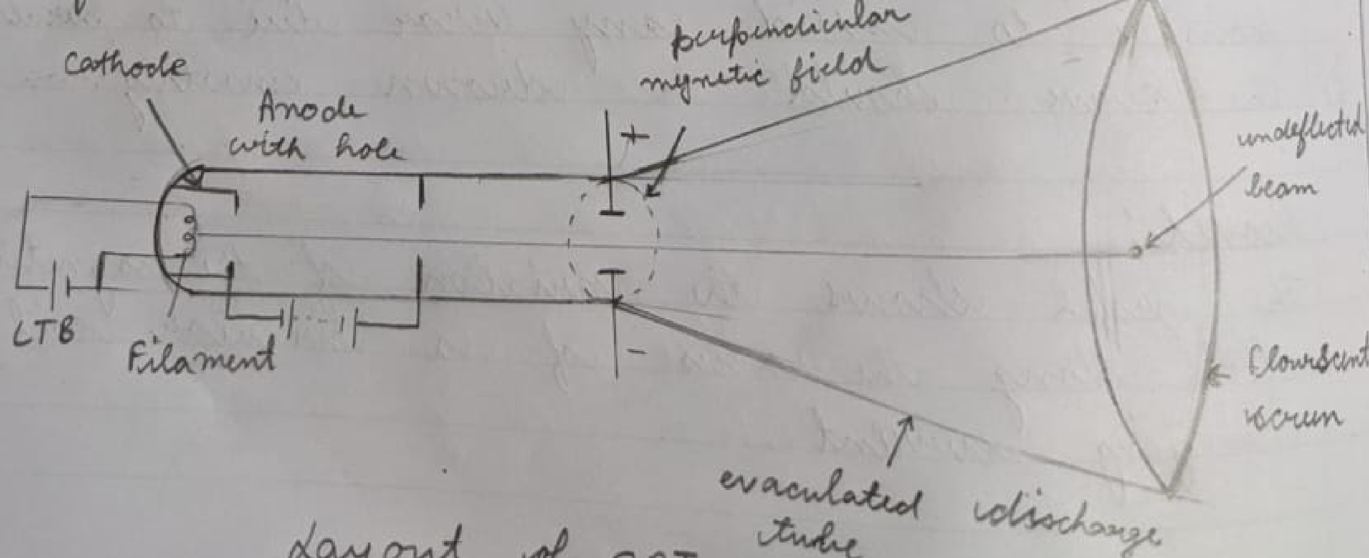
Apparatus : CRT mounted on wooden stand power supply fitted with voltmeter to measure the deflection voltage, Bar magnets compass box, wooden stand having 2 arms.

Formula :

$$\text{specific charge } (e/m) = \frac{V\lambda}{ILH^2 d} \times 10^7 \text{ emu/gm}$$

where,
$H = H_e \tan\theta$
I = length of Horizontal pair of plates
L = distance of screen
V = voltage applied to the plates
λ = Total deflection of the spot

Diagram:



Layout of CRT

Experiment - 7

Objective : Determine the value of specific charge e/m of an electron by Thomson Method.

Apparatus : CRT mounted on wooden stand, power Supply fitted with voltmeter to measure the deflecting voltage, Bar magnets one pair. Compass box (one set), wooden stand having 2 arms, fitted with scales to measure the distance of the poles of the magnets.

Formula Used : The specific charge for an electron can be calculated using following reaction:

$$\text{Specific charge } e/m = \frac{VY}{ILH^2 d} \times 10^7 \text{ emu/gm} \quad -(1)$$

where $H = H_e \tan\theta$ (here H_e is the horizontal component of earth magnetic field of the place where experiment is performed, usually we take its value $= 0.345$ G).

also, I = length of horizontal pair of plate

l = distance of screen from the edges of plate

V = Voltage applied to the plates.

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λ = Total deflection of the spot on the screen.
H = Intensity of the applied field.
d = Seperation between the plates.

Procedure:

1) Mount CRT in armed wooden stand such that the CRT faces towards north and south direction while arms of this stand towards east and west direction
2) Connect the CRT plug to the power supply socket mounted on the front pannel.
3) Switch on the instrument using ON/OFF toggle switch provided on the front pannel.
4) Set the deflection voltage to ON and x shift control potentiometer to meter position. Adjust the intensity and focus the spot on screen of CRT through the deflection selector switch towards forward position.
5) Read the initial reading of spot on the scale attached on the screen of the CRT, say its -0.2 cm. Now give a deflection to the spot in the upward direction by applying deflection voltage such that the final reading is +0.8 cm. So that total deflection on the

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screen of the spot is (0.2 to 0.8) ≈ 1 cm. Note down this applied voltage (v) and deflection of spot (x) in observation table.

6) Now place has magnets on both sides of the wooden stand arms such that their opposite poles face each other and their common axis is perpendicular to the axis of CRT. the magnets should be kept in such a modes that these may be made to slide along the scales.

7) Adjust distance and polarity of the magnets so that the spot traces back to its initial position (which was -0.2 cm).

8) Remove CRT stand and place a magnet meter compass box mounted in a stand in center of the armed wooden stand. Adjust the pointer of the compass box to read 0-0 without disturbing the direction of armed wooden.

9) Note the reading of deflection angle (θ) through compass box and note down it is the observation table and calculate the value of magnetic field (H).

10) Calculate the value of e/m using equation 1.

11) Repeat step 5 to 10 for other values of spot deflections.

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12) Calculate mean value of e/m for different set of reading.

Note - For better accuracy apply deflection voltage from 0 to 20 volts constant of the cathode ray tube ÷

Discription of CRT and 3SIS-

(a) Seperation between the plates (d) = 1 cm

(b) Length of horizontal pair of plate (l) = 3 cm

(c) distance of the screen from the edge of the plates (L) = 5.5 cm.

(d) Horizontal components of earth's magnetic field (B) = 0.345 G.

Precautions:

1) The movement of bar magnet should be slow to detect the minor deflection.
2) Reading on the CRT should be checked carefully.
3) Handle the CRT with proper care.

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