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Faculty of Engineering & Technology

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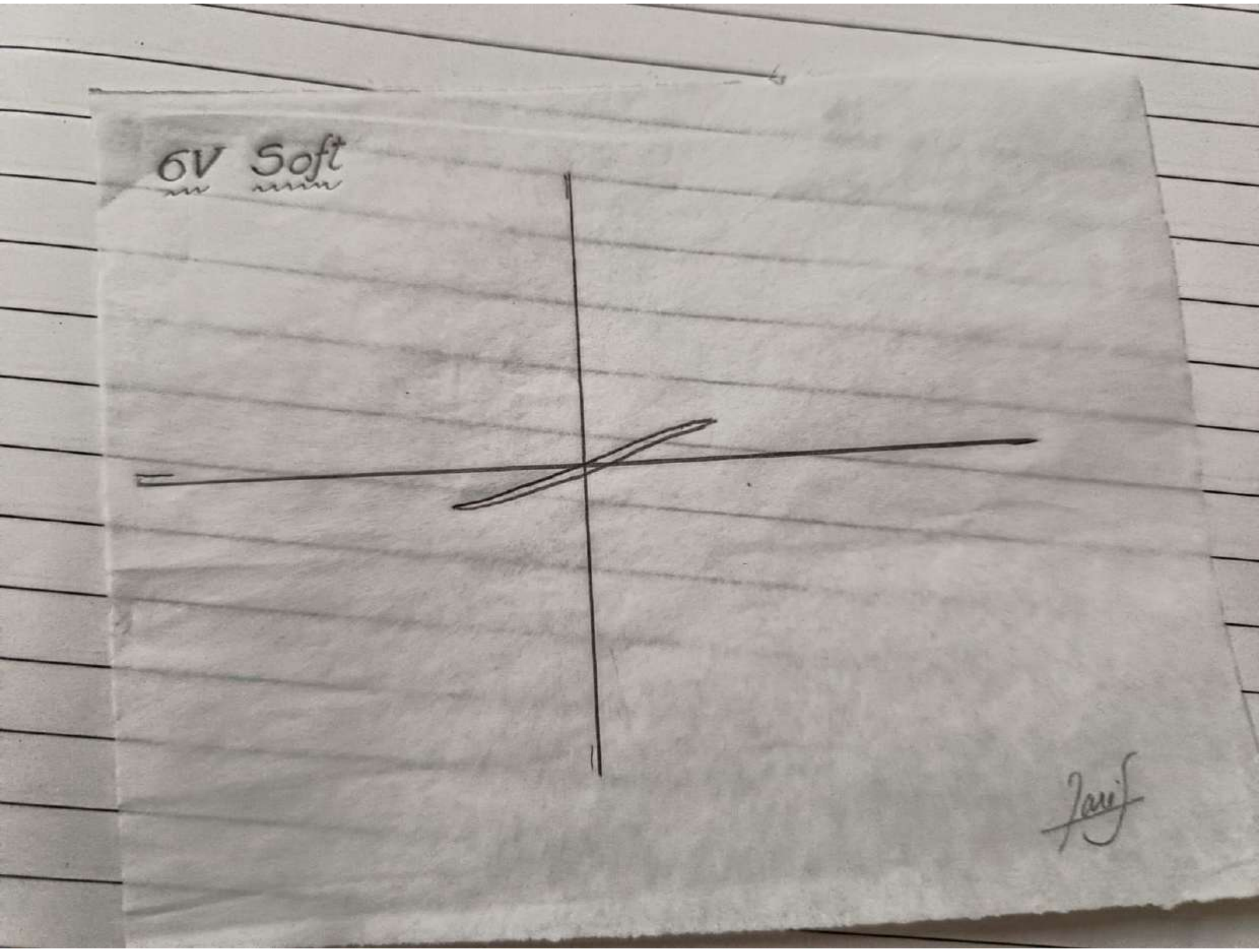
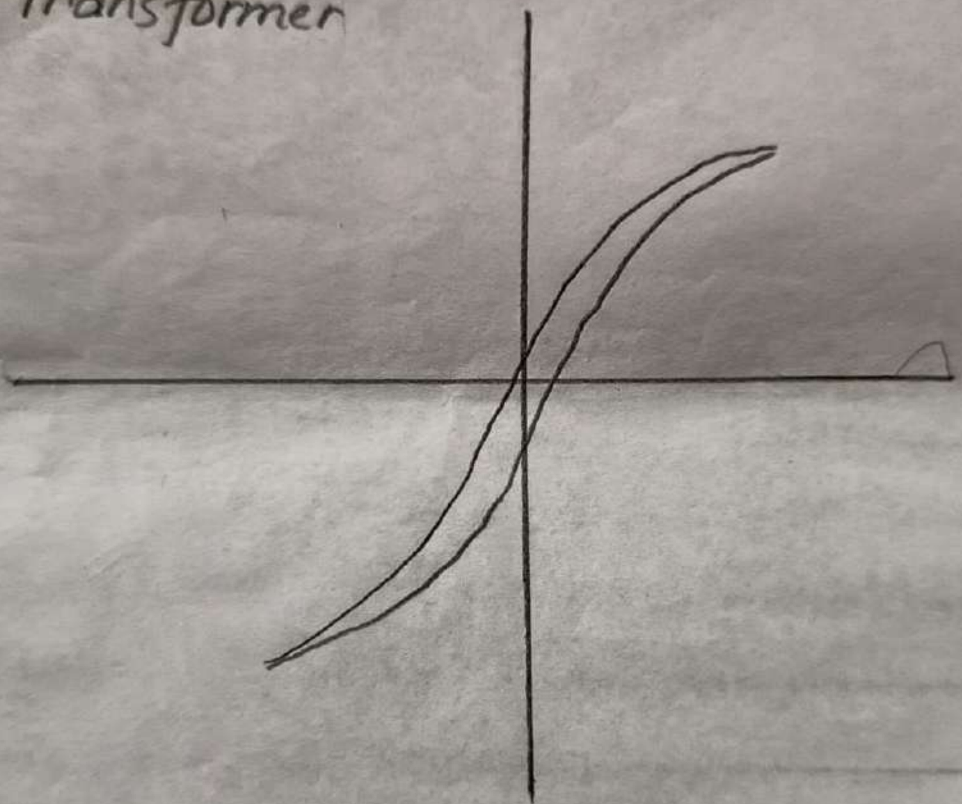

6V Soft

9V Transformer



called domains.
· When an external magnetic field is applied, these domain allign in the direction of the field resulting in a strong overall magnetization.

2. Paramagnetic
· have no intrinsic magnetic moment but possess unpaired electrons, which align with an external magnetic field.
In the absence of an external magnetic field, the dipole are randomly oriented.
When a magnetic field is applied, the dipoles align partially with the field, resulting in weak magnitization.

3. Diamagnetic
Have no permanent magnetic moment and are weakly repelled by both poles of a magnet.
Their dipole arrangement consists of paired electrons with opposite spins, resulting in cancelling of their magnetic moments.
When subjected to an external magnetic field, the dipole align in the opposite direction of the field leading to a weak induced magnetization opposing the applied field.

Q. Difference between soft and hard magnetic materials.

→

Soft	Hard.
• Easily magnetized and demagnitized	• Difficult to magnetic and demagnetize.
• Low coercivity ie they require low magnetic field strength to change their magnetization	• High coercivity ie. requiring a significant magnetic field strength to change their magnetization
• Used in application where rapid & reversible magnetization changed are required.	• Used in application where a strong and permanent magnitization is desired.

Q. Types of magnetic materials and explain them with the help of its dipole arrangement?

There are 3 main types of magnetic material.

1. Ferromagnetic.

• have spontaneous magnetic moments even in the absence of an external magnetic field.

• Their dipole arrangement consists of aligned atomic magnetic moments within small region

4. The closed curve represents the cyclic variations of B which is called magnetic hysteresis or BH curve or hysteresis loop.

5. Trace the curve on tracing power (paper) after making it symmetrical with respect to X-axis and Y axis marked on the screen of CRO. Mark these two axis on trace paper along the B-H curve.

6. Trace the curves for different voltage keeping frequency constant and for various frequency keeping the voltage constant.

CONCLUSION

i) BH curve tracing :- As we increase the magnitization force (H) by voltage varying the applied voltage we obtained / observed a corresponding increased in the magnetic induction (B). This relationship as demonstrated by the B-H curve indicated that material exhibits ferromagnetic properties where the magnetic Induction depend on the applied field.

Where A : Cross-section of iron core, N_2 is Number of turns

In the present setup, the magnetization curve and Hysteresis curve as function of the magnetic field strength H is plotted

PROCEDURE :-

1. Connect the CRO to AC mains and switchs it on Adjust the intensity and focusing controls so that fine and bright spot is observed on the screen when it is used in X-Y mode by setting it to the external input.

2. Supply the voltages from the power supply to the X plates and Y plates of CRO and switch on the supply connected to the primary of the U core

3. Adjust the horizontal and vertical gain controls of CRO to get B-H curve of proper shape and size on the screen of CRO.

Exp 5

BH Curve

AIM:- To trace the BH curve for an iron core and to study the effect of varying the voltage and frequency on hysteresis loop.

APPARATUS:- Power supply, U and I core, coil with 300 turns, BNC connector code/cable, 50 cm lead, CRO

THEORY:- In a Feromagnetic material the magnetic induction Field B is not a linear Function of the magnetic field H. The magnetic induction Field, For a given H, depends on the previous history of the specimen. The curve of B vs H. is shown in Figure.

When the magnetic field H is very large in the positive or negative direction, the magnetic induction Field B saturates at a value $\pm$ BS called the saturation magnectic field. At any given value of magnetic field H, there are two values for B, one when the magnetic field H is decreasing and another while the magnetic field H is increasing. Thus B depends on the history and phenomenon is called hysteresis.

11. To measure the bending loss, First measure the power (P_{01}) at the end of the Fiber without any twist and turns.

12. Wind one turn of the fiber on the mandrel and note the new reading of the power as P_{02}. Now the loss due to bending and strain on the plastic Fiber is $P_{01} - P_{02}$ dB. For more accurate readout set the power meter to the -20dB to -10dB range and take the measurement.

13. Wind second turn of the fiber on the mandrel and note the new reading of the power as P_{03}.

14. Find the difference $P_{02} - P_{03}$. This also gives loss per turn of the fiber.

RESULT :-

From this experiment.

→ Propagation loss in the fiber is measured as

$= -39.2$ dBm

$= -39.2 \times 10^{-3}$ dB/km.

reading of 150mV corresponding to 15dBm)

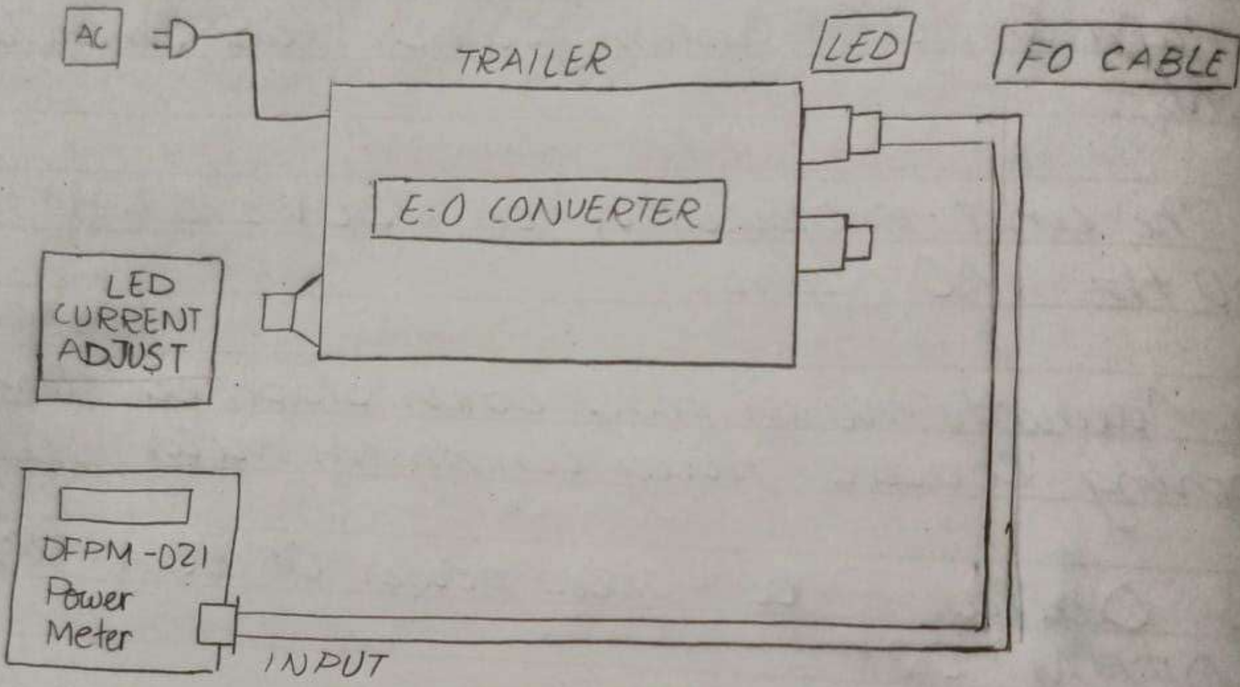
6. Now remove the other end of 1m cable from power meter slots and connects it to another cable of 5m length through in line adapter. And connect the other end of the 5m cable to power meter and measure the volt meter reading. Divide the volt meter reading by 10 to get the power at the end of the combination of 1m and 5m cable as P_{o2}.

7. $P_{o1} - P_{o2}$ - (loss in adapter) gives ~~power~~ power loss in 5m cable. Genarally the loss in in-line adapter is up to maximum 1dBm

8. Now connect one end of the 5m cable to LED port and other end to power meter and measure P_{o1} (power at the end of 5m cable)

9. Connect one end of 1m cable with 5m cable through adapter and other end to power meter measure power at the end of combination as P_{o2}.

10. $P_{o1} - P_{o2}$ - (loss in adapter) gives power loss in 1m cable



SET UP FO LOSS MEASUREMENT

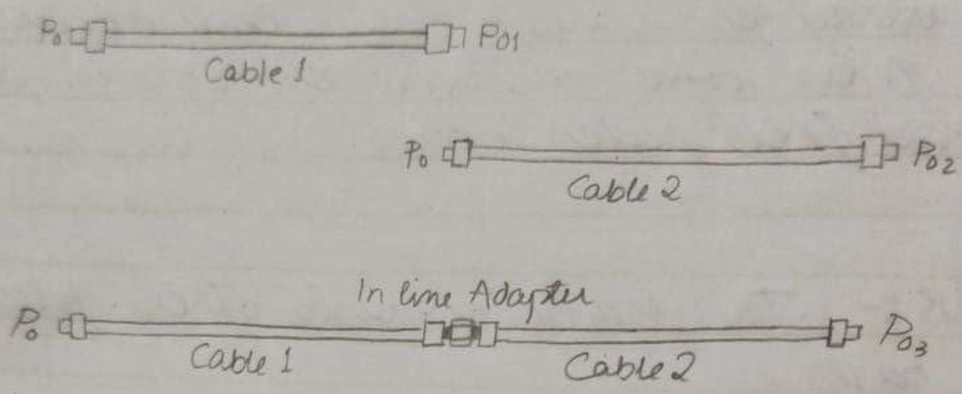


Fig. Propagation loss

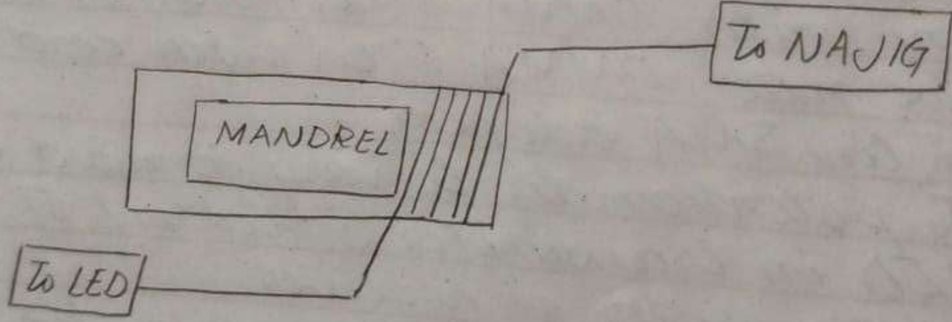


Fig: Bending Loss

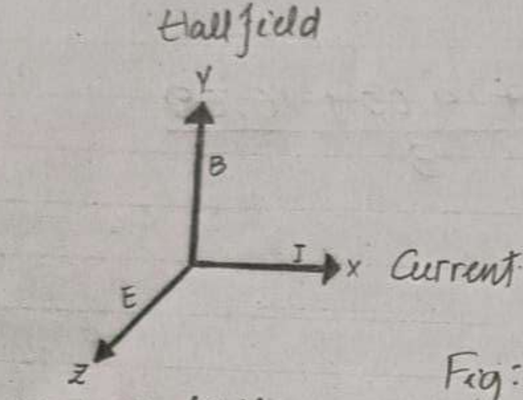


Fig: Direction

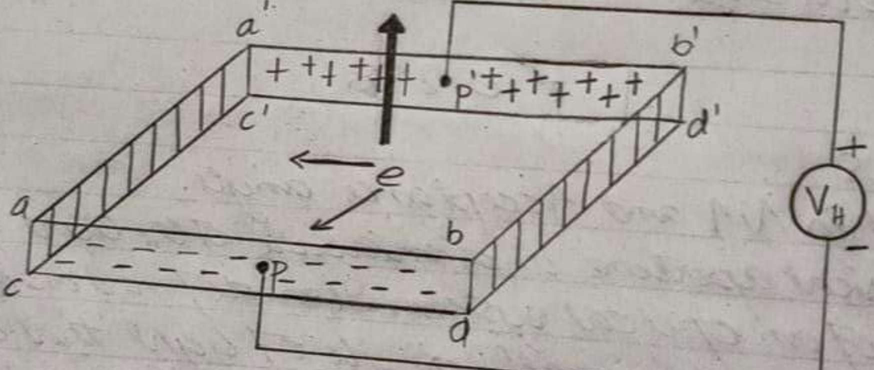


Fig.

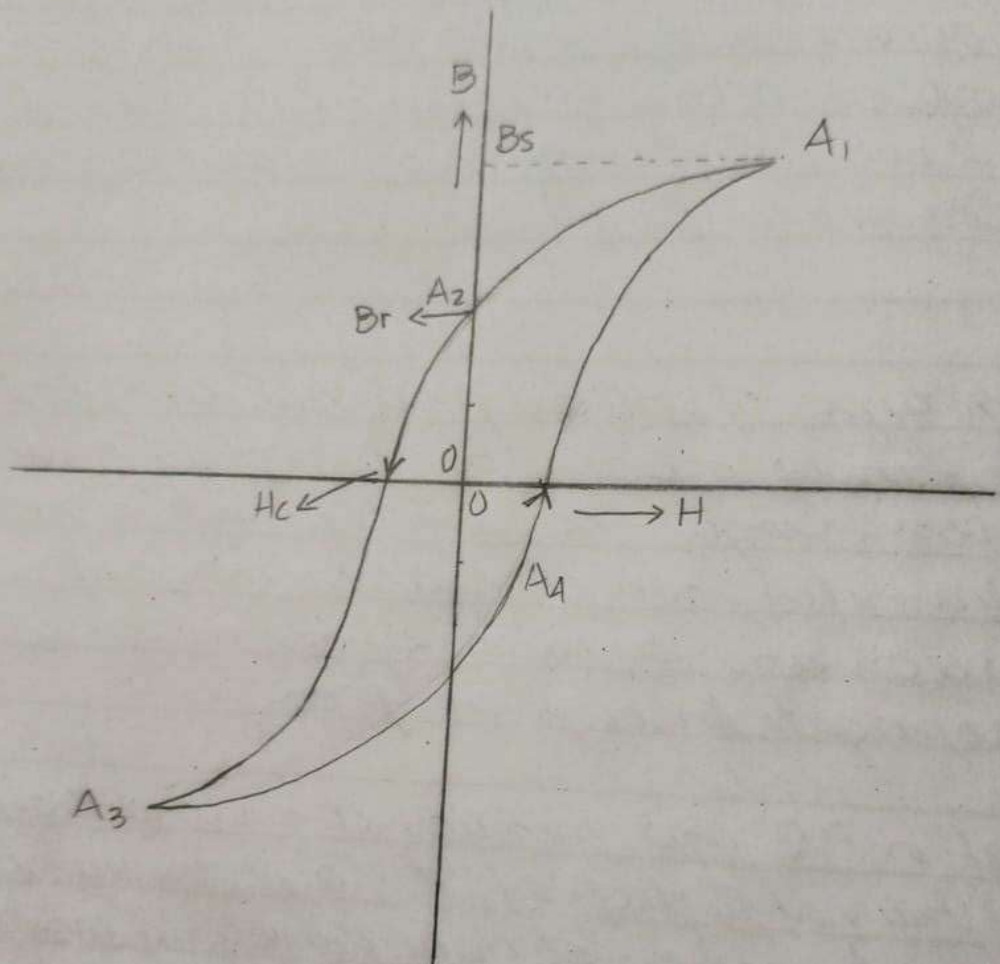
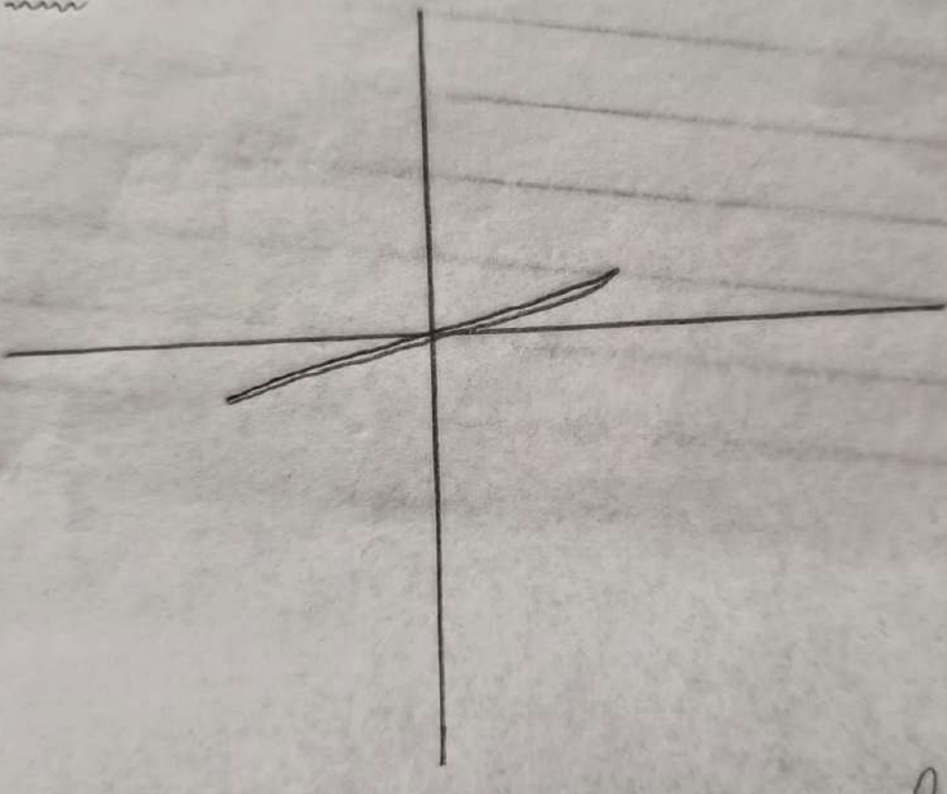
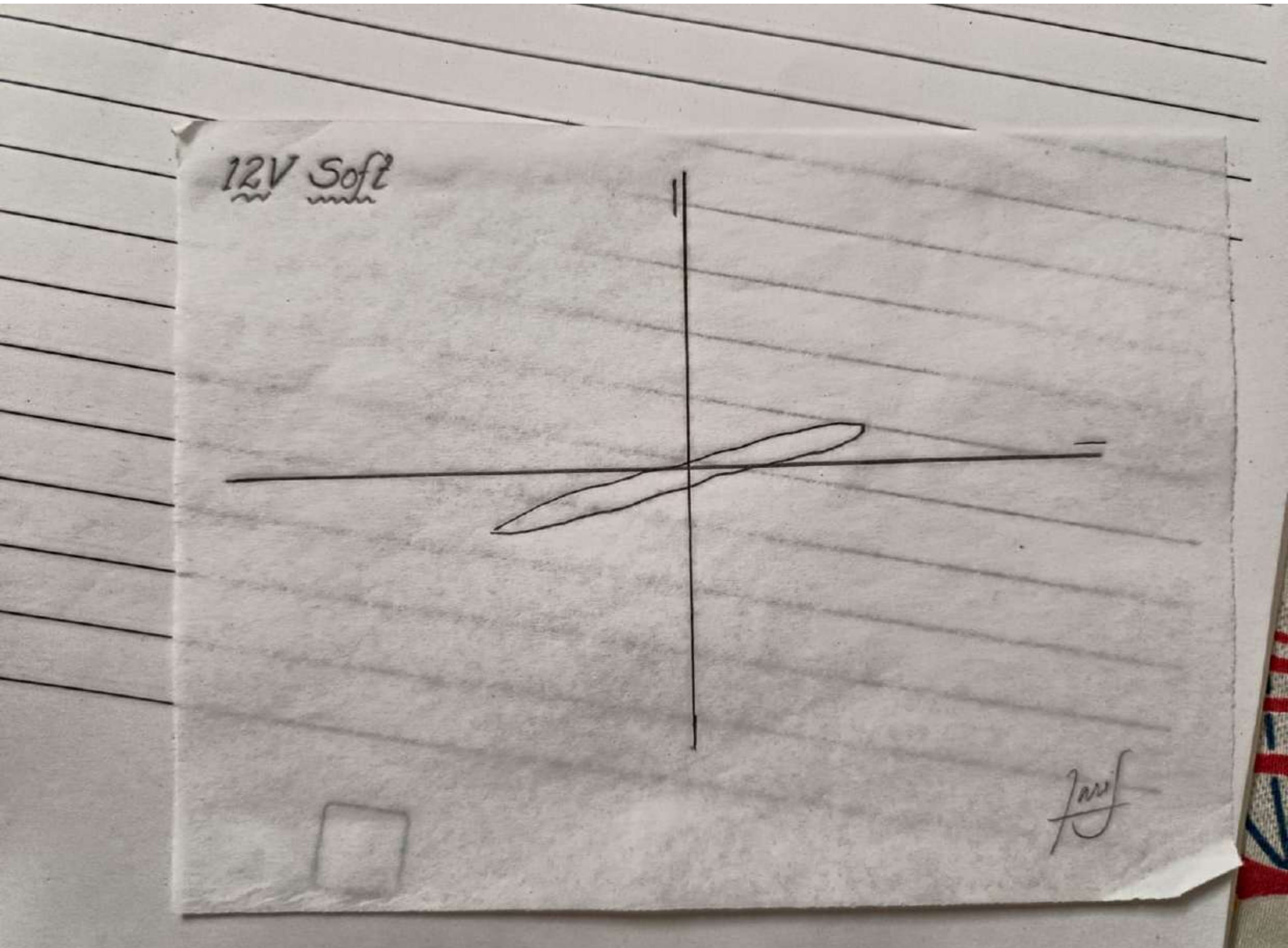


Fig. B.H Curve

9V Soft



Jasif


12V Soft

CALCULATION:-

Loss in 5m Cable = P_{O3} (Output of 5m) − P_{O1} (Output of 1m) − Collector Loss

$= -43.5 - (-39) - 0.5$

$= -43.5 + 39 - 0.5$

$= -5$ dBm

Loss in 1m Cable = P_{O3} (Output of 1m cable) − P_{O1} (Output of 5m) − Collector loss

$= -47.3 - (-13.6) - 0.5$

$= -34.2$ dBm

Total loss in 6m = Loss in 5m + Loss in 1m

$= -34.2 + (-5\text{ dBm})$

$= -39.2$ dBm

Loss per meter = $\frac{\text{Loss of 6m}}{6}$

$= -6.533$ dBm

perpendicular to the magnetic field. It causes the accumulation of electron on one side of the crystall and is deficient on the other side. Thus an electric field is developed in Y direction, which is called Hall field (E_H). Under the equilibrium the Lorentz force on the electrons and hall force (the force on the electron due to hall field) balance each other.

ie. $qE_H = q v_x B_z$

where v_x is the velocity of electrons in x direction

$$E_H = v_x B_z$$

The magnitude of current density $J_x = nqv_x$, where n is the number of charge carriers per unit volume

$$v_x = \frac{J_x}{nq} = J_x R_H$$

Here $R_H = \frac{1}{nq}$ is known as hall coefficient.

RESULT :-

Average of Acceptance Angle $= \frac{19.65 + 14.03 + 16.69}{3}$

$= 16.79$

Average of Numerical Aperature $= \frac{0.336 + 0.242 + 0.287}{3}$

$= 0.288$

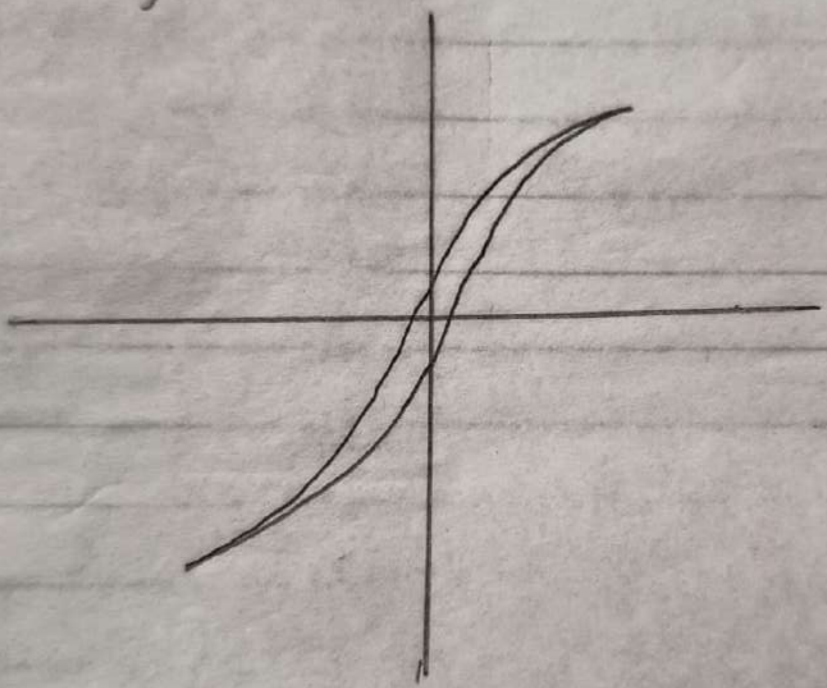
QUESTIONS

Q. What is NA and Acceptance angle.

Numerical aperture is a measure of the light gathering ability of an optical system. It is defined as the sine of the maximum half-angle of light that can enter or exit the optical system, multiplied by the refractive index of the medium in which the system operates.

The angle (maximum) at which light can enter/exit an optical fiber while still being efficiently transmitted.

6V Transformer



OBSERVATION TABLE :-

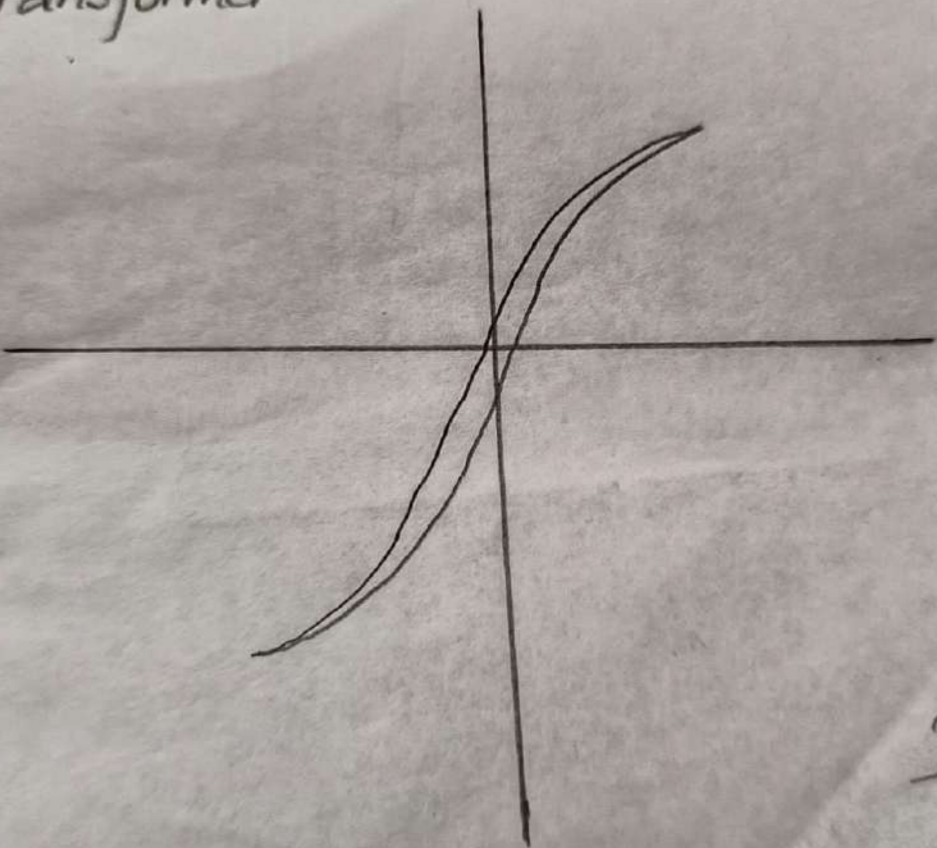
Loss in 5m Cable.
Input → 1m cable
Output → 5m cable

Po1 (Output of 1m) (dBm)	Po2 (Input of 5m) (dBm)	Po3 (Output of 5m) (dBm)	Connector Loss	Loss in 5m Cable
-39 dBm	-39	-43.5	0.5	•5 dBm

Loss in 1m cable
Input → 5m cable
Output → 1m cable

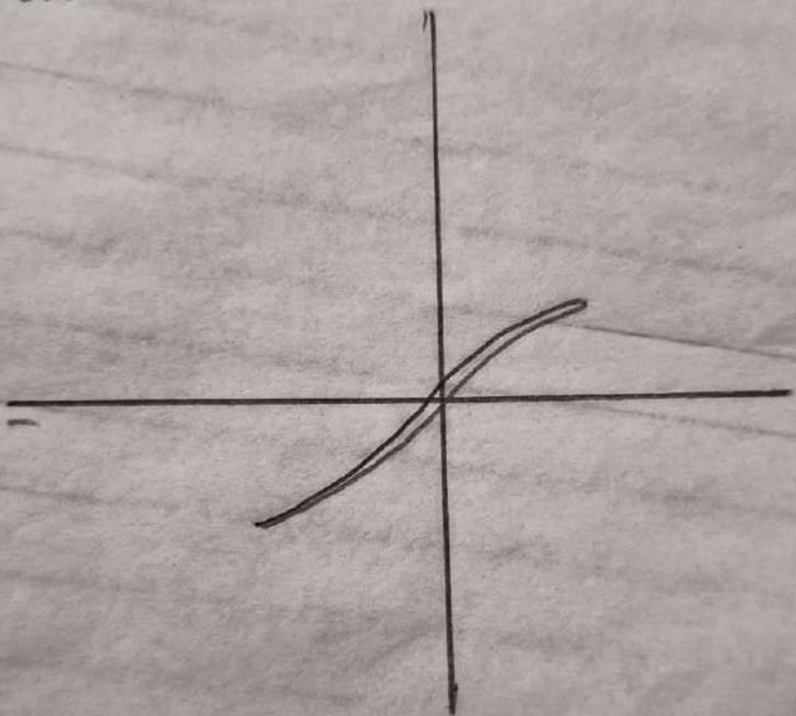
Output of 5m cable (P_{01})	Input of 1m cable (P_{02})	Output of 1m cable (P_{03})	Connector Loss	Loss in 1m Cable
-13.6	-13.6	-47.3	0.5	-342

12V Transformer



Tarif

6V Ferro



Zarif

CALCULATION :-

$$R_H = \frac{b}{B_Z} \times \frac{V_H}{I_x} = \frac{0.0006}{0.15} \times \frac{V_H}{I_x}$$

$$= 0.004 \times \frac{V_H}{I_x}.$$

$$R_{H1} = 0.004 \times \frac{6.6}{0.74} = 0.0356756 \ m^3C^{-1}.$$

$$R_{H2} = 0.004 \times \frac{10}{1.10} = 0.03636 \ m^3C^{-1}$$

$$R_{H3} = 0.004 \times \frac{14.1}{1.52} = 0.0371052 \ m^3C^{-1}$$

$$R_{H4} = 0.004 \times \frac{20}{2.12} = 0.037735 \ m^3C^{-1}$$

$$R_{H5} = 0.004 \times \frac{24.6}{2.52} = 0.039047 \ m^3C^{-1}$$

$$R_{H6} = 0.004 \times \frac{29.5}{3.01} = 0.0392026 \ m^3C^{-1}$$

$$R_{H7} = 0.004 \times \frac{35}{3.55} = 0.0394366 \ m^3C^{-1}$$

$$R_{H8} = 0.004 \times \frac{39.6}{4.01} = 0.03950124 \ m^3C^{-1}$$

If the magnetic field is reduced from a maximum value to zero, the magnetic induction field does not go to zero. It has a value ± Br depending on whether the magnetic field H is brought to 0 from a position value or from a negative value. The value of Br is called the residual magnetic induction on field. To make the magnetic induction field B zero one has to apply a magnetic field ± H. This field Hc is called the coercive field. The values of H and Br are characteristics of ferromagnetic material.

If the ferromagnetic material is subjected to an AC magnetic field H, the area enclosed by the BH curve gives that amount of heat generated per cycle per unit volume in the material. So hysteresis leads to wastage of electrical energy, as heat.

Examples of ferromagnetic materials are Fe, Ni and Co at room temperature and ceramic materials which are oxides of iron or Ni and other elements like Zn. One can use materials with properties suited for a particular application. For example if one wants a ferromagnetic core material for winding a transformer, one should reduce the hysteresis

Exp 4

Power Loss

AIM :- To study the various losses that occurs in optical fiber and measure the loss in dB of 2 Optical fiber patch cords.

APPARATUS :- The trainer consists of the following built in parts :

1. IC integrated DC power supply
2. Fiber - optic Analogue Transmitter @ 660 nm
3. Fiber - optic Analogue Transmitter @ 850 nm
4. Fiber - optic receiver.
5. One meter PMMA Fiber patch cord.
6. Five meter PMMA Fiber patch cord.
7. In line SMA adaptor
8. To potentiometer to vary forward current of LED in transmeter & current of phototransistor in receiver.
9. SPDT switch for selecting wavelength 660 nm and 850 nm.

10. NA JIG with scale marked on it to measure length.
11. Mandrel.

OBSERVATION TABLE :-

SR. No.	Distance b/w sample & screen f(cm)	Order of spot (m)	Distance b/w maxima and 1st order		mean(X_m) $= \frac{x_1+x_2}{2}$ (cm)
			LHS(x_1)(cm)	RHS(x_2)(cm)	
1	20 cm	1	6.4 cm	6.6 cm	6.5 cm
2	15 cm	1	5 cm	4.9 cm	4.95 cm
3	10 cm	1	3 cm	3.2 cm	5.1 cm

CALCULATION

$$\lambda = \frac{dx}{m\sqrt{x^2+f^2}}$$

$$\lambda = \frac{1.69\times10^{-4}\times3.3}{1\times\sqrt{(3.3)^2+(10)^2}} = \frac{5.58\times10^{-4}}{\sqrt{110.89}} = 0.529\times10^{-4}\,cm$$

$$= 5220\,A^\circ$$

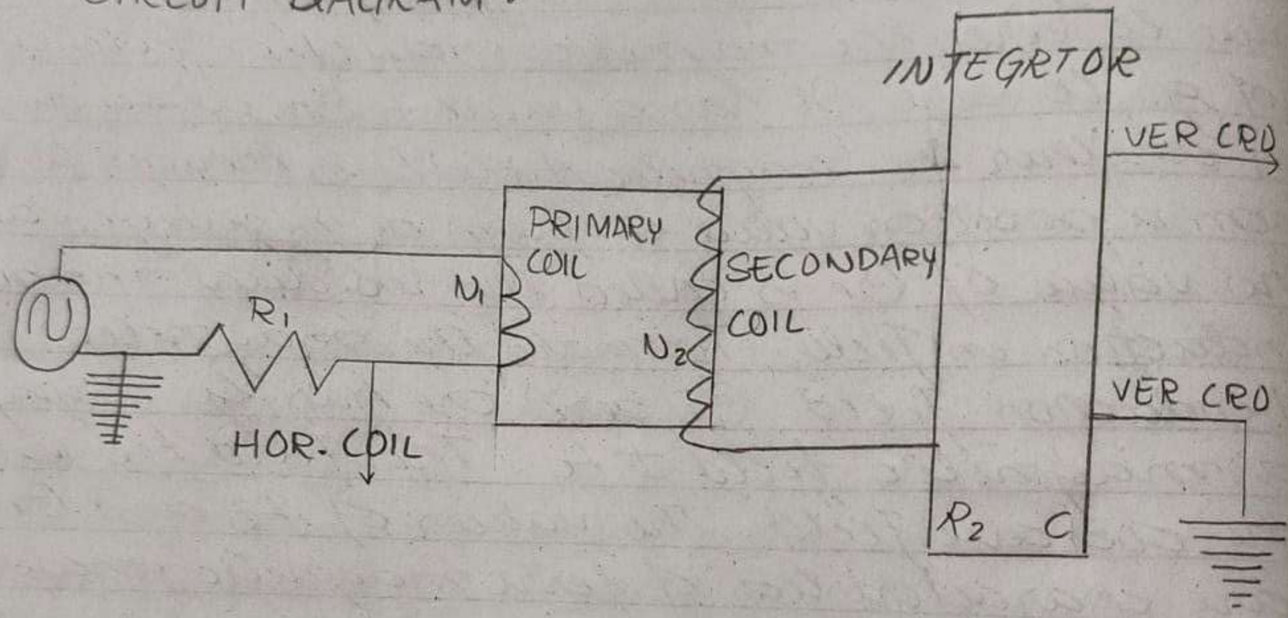
$$\lambda = \frac{1.69\times10^{-4}\times5.1}{1\times\sqrt{(5.1)^2+(15)^2}} = \frac{8.619\times10^{-4}}{\sqrt{251.01}} = 0.544\times10^{-4}\,cm$$

$$\lambda = \frac{1.69\times10^{-4}\times6.75}{1\times\sqrt{(6.75)^2+(20)^2}} = \frac{11.467\times10^{-4}}{\sqrt{445.56}} = 0.540\times10^{-4}\,cm$$

Mean of 3 readings are:-

$$= \frac{5220A^\circ + 5296A^\circ + 5150A^\circ}{3} = 5222\,A^\circ$$

CIRCUIT DIAGRAM :—



loss. On the other hand if one would like to make a permanent magnet. the magnetic the material must have a large residual magnetization and a large coercive field. Such a material is hard iron. If one wants to use a ferrite material for computer memorial then it should have a square hysteresis loop with a small coercive field. The state $+B_r$ will be called the state 1 and the state $-B_r$ will be called the state 0. A large variety of magnetic materials tailor - made for a number of applications are now commercially available.

A Magnetic field is generated in an U & I shape iron core by continuous wave to primary coil which generates the magnetic field strength H is

$$H = (N_1/L)I_1$$

Where L: Effective length of iron core N_1 is Number of turn.

The corresponding magnetic induction B is obtained through integration of the voltage V induced in second coil as:

$$B = (1/N_2 \cdot A) \cdot \int V \cdot dt$$

ii)
When we alter the frequency of applied voltage we observed that the higher frequency led to narrow histeresis loop. This consist with the well known Edde current losses in ferromagnetic material.

iii) Impact of Voltage. Varying the amplitude of apply voltage showed that higher voltage results in larger histeresis loop. This can be attributed to increased magnetic saturation at higher voltage level.

QUESTIONS :-

Q. What is hysteresis loss?
Hysteresis loss refers to the energy dissipates in a material when its is subjected to a varying magnetic field, such as in transformers or magnetic materials used in electrical devices. This loss occurs due to the lag between the magnetization and demagnetization and demagnetization of the magnetic material, leading to energy being convert into heat.

Because the spacing between the slits is generally very small, the angles θ are generally quite large we cannot use the small angle aproximation for relating wavelength and the position of the maxima on a screen for gratings, but have to use.

$$\sin\theta = z/(L^2+z^2)^{1/2}$$

PROCEDURE :-

Place the LASER source on holder and mount on the heavy base.

Hold the grating and screen in their respective holders and bases.

Place the grating between LASER source and screen as shown is Fig.

The LASER beam after passing through the grating will split into zero order, first order and second order beam as shown in Fig.

Mark zero order, Firstorder and second order spots on screen and measure the distance between first order & zeroth order spot and half of this distanse.

Principle of operation.

An optical Fiber is a cylindrical dielectric waveguide (non conducting waveguide) that transmits light along its axis, by the process of Total Internal Reflection. The Fiber consist of a core surrounded by a cladding layer both of which are made dielectric materials

The boundary between the core and cladding may either be abrupt, in step-index Fiber or gradual, in graded-index Fiber.

Numerical Aperture (NA)

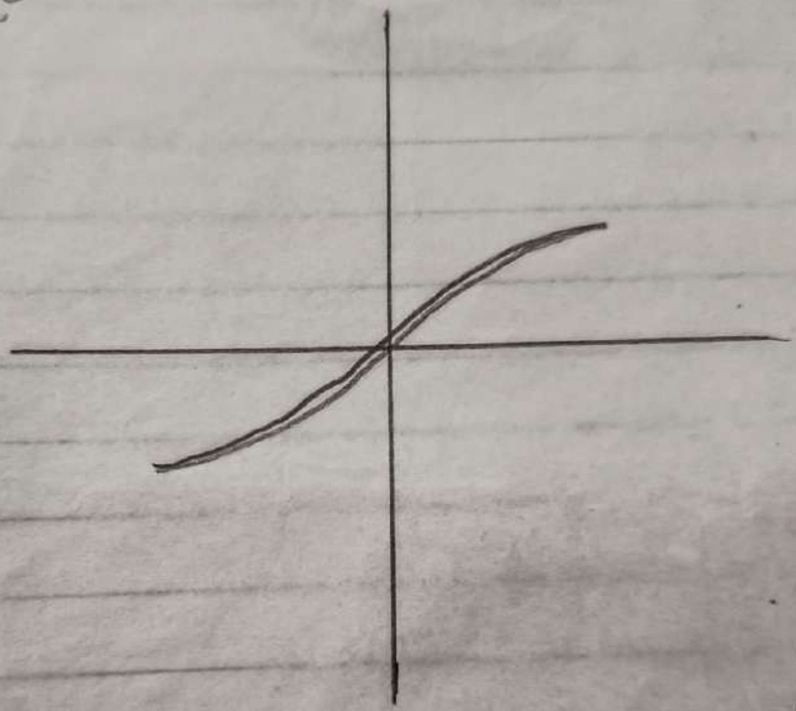
The Numerical aperture (NA) of an optical system is a dimensionless number that characterise the range of angles over which the system can accept or emit light. Fiber with a larger NA requires less precision to splice and work with than Fiber with a smaller NA. Single mode Fiber has a small NA

The Numerical Apperature of an optical system such as an objective lens is defined by

$NA = n_i \times \sin\theta_{max}$ n_i is 1 for air

Hence $NA = \sin\theta_{max}$

12V Ferro



QUESTIONS :-

Q. Mention the types of losses occuring in optical fibre?
Losses occuring in optical fiber include :-
• Absorption loss, Scattering Loss, Bend loss
Splice Loss, Connector Loss, Modal Dispersion
Loss, Chromatic Dispersion Loss.

Q. Which types of optical fiber has least lost?
Single - mode optical fibers typically have the least loss, Single - mode fibre have a smaller core diameter, which reduces modal dispersion and allow only one mode of light to propagate through the fiber.

Q. What is TIR and mention it's condition?
Total Internal Reflection. It is a phenomenon that occurs when a ray of light travelling within a medium encounters a boundary with another medium of lower refractive index at an ~~index~~ angle greater than the critical angle.

Condition are;
- The light must travel from higher refractive index medium to lower refractive index medium.
- $\sin(\theta c) = n2/n1$ where θc is the critical angle and n1 is RI of first medium and R2 is RI of second.

6. ~~to~~ Now switch on the electromagnet and select the range of the Gauss meter as X10 and measure the magnetic flux density at the center between the pole pieces. The tip of Hall probe and the crystall should be placed between the centers of the pole pieces. For carrying out the experiment the magnetic Flux density should be maximum ie. between 2000 to 3500 Gauss.

7. Vary the current through the constant source in small incremants. Note the value of current passing through the sample and the Hall voltage as recorded by the multimeter

8. Reverse the direction of magnetic flux field by interchanging the '+' and '-' connections of the coils and repeat the step 1 to 7.

CALCULATION :-

$$\phi = \tan^{-1}\frac{D}{2L}$$

$$\phi_1 = \tan^{-1}\left(\frac{10}{2\times 8}\right) = \tan^{-1}\left(\frac{10}{16}\right) = 32.005^\circ$$

$$\phi_2 = \tan^{-1}\left(\frac{20}{2\times 20}\right) = \tan^{-1}\left(\frac{1}{2}\right) = 26.56^\circ$$

$$\phi_3 = \tan^{-1}\left(\frac{30}{2\times 30}\right) = \tan^{-1}\left(\frac{30}{76}\right) = 21.54^\circ$$

$$NA = \sin\phi$$

$$NA_1 = \sin\phi_1 = \sin(32.005) = 0.529$$

$$NA_2 = \sin\phi_2 = \sin(26.56) = 0.449$$

$$NA_3 = \sin\phi_3 = \sin(21.54) = 0.337.$$

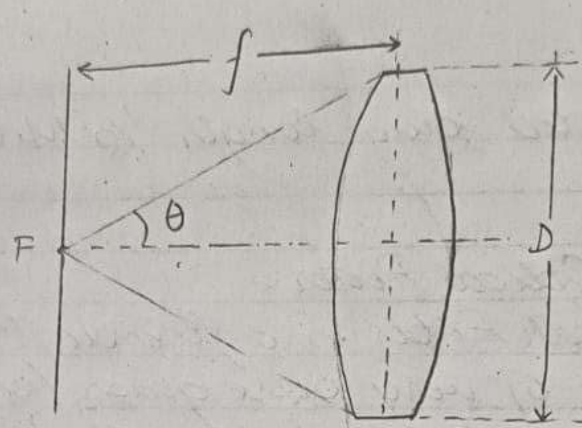


Fig. Numerical Aperature of thin films

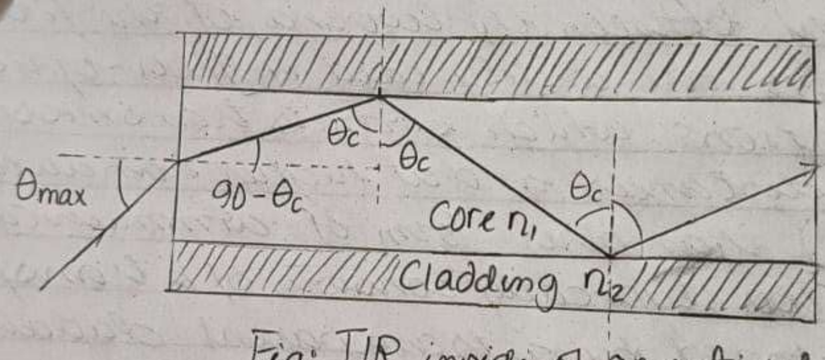
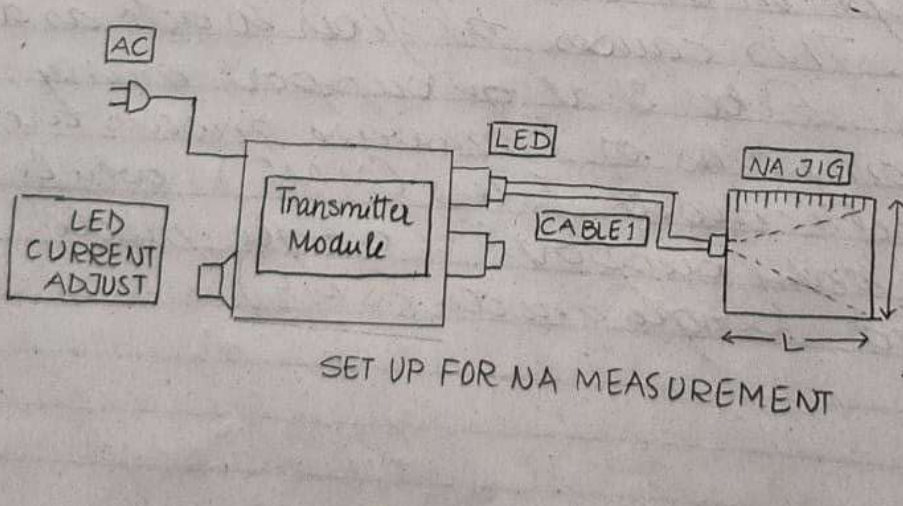


Fig: TIR inside of an optical fibre.



SET UP FOR NA MEASUREMENT

RESULT :-

Wavelength of laser using diffraction of light is measured as
$= 5222 A^{\circ}$

Questions:-

Q. Explain constructive and destructive interference?
→ Constructive interference occurs when two wave meets in phase, meaning their peaks and troughs align, resulting in a wave with an amplitude equal to the sum of the individual waves. Destructive interference occurs when waves meet out of phase, causing cancellation and a resultant wave with reduced amplitude.

Q. What is diffraction of light and what is the condition to occur?

Diffraction of light refers to bending of light waves around obstacles or through narrow oppenings. It occurs when light encounters an obstacle or aperture that is comparable in size to the wavelength of the light. The phenomenon is more pronounced with smaller wavelengths and larger obstacles or oppennings.

spring loaded plug length 1/2 Meter

THEORY :- Optical Filter:

Optical Fiber is a flexible, transparent fiber made of very pure glass (silica) not much bigger than a human hair that acts as a wavelength (wave guide ~~w~~) or "light pipe". to transmit light between the two end of the fiber Optical Fibers are widely used in fiber-optic communications, which permits transmission over longer distances and at higher bandwidth (data rates) than other form of communication

Optical fiber typically consists of a transparent core surrounded by a transparent cladding material with a lower index of refraction. Light is kept in the core by total internal reflection. This causes the fiber to acts as a waveguide. Fiber that ~~gi~~ support many propagation paths or transverse modes are called multi mode fibers (MMF.), while those that only support a single mode are called single mode (SMF) unit length

P_0 is the launched power & P_L is the power after covering distance L in the fibre.

PROCEDURE :-

1. Connect the one end of 1m cable to the LED port of the trainer and the other end to the power meter.
2. A digital multi-meter is connected to measure the power in dBm unit directly, keeping the voltage range of 200mV or 2000mV.

3. Put the wavelength selector switch to particular wavelength (as 660 nm) position.

4. Plug the AC mains. Neon light will glow indicating that instrument is ready for use

5. Make sure that the optical fiber patch cord is connected securely, as shown after relieving all twists and strains on the fiber Adjust the LED CURRENT ADJUST knob to set P_0 of the LED to a suitable value (around 15 or 20 dBm) and note this as P01 (voltmeter)

For a step index fiber the Numerical aperture is given by

$$NA = \sqrt{(n_{core}^2 - n_{cladding}^2)}$$

For very small differences in refractive indices the equation reduced into

$NA = n_{core}\sqrt{(2\Delta)}$, where Δ is the fractional difference in refractive indices.

PROCEDURE :-

1. Connect one end of the cable 1 (1 meter PO cable) to LED port of the trainer and the other end to the NA JIG as shown in fig.

2. Put the wavelength selector switch to 660 meter position.

3. Plug the AC mains to ON position; neon light will come ON indicating that instrument is ready for use. Light should appear at the end of the fiber on the NA JIG. Turn the LED CURRENT ADJUST knob ~~challeng~~ clockwise to set to maximum Po. To light intensity

Exp2. Numerical Aperature

AIM :- To determine Numerical Aperature of an optical Fibre

APPARATUS :- The trainer consists of the following build in parts :-

1. IC integrated DC power supply
2. Fibre optic Analogue Transmitter @ 660nm
3. Fibre-optic Analogue Transmitter @ 850nm
4. Fiber-optic receiver
5. One meter PMMA Fiber patch cord.
6. Five meter PMMA Fiber patch cord.
7. On line SMA adaptor.
8. To potentiometer to vary forward current of LED in transmitter & current of photo transistor in receiver.
9. SPDT switch for selecting wavelength 660nm and 850nm.
10. NAJIG with scale marked on it to measure length.
11. Mains On/OFF Switch, Fuse and jewel light.
12. The unit is operative on 230V ± 10% AT 50Hz AC. Mains.
13. Adequate no of patch cords stackable 4mm

OBSERVATION

1. Thickness of Specimen $(b) = 0.6\,mm$
2. Magnetic flux density $(B_Z) = 1500$ Gauss
$= 0.15T$

OBSERVATION TABLE :-

Sr.No.	Current I (mA)	Voltage V_H (mV)	Hall Coefficient $R_H = \frac{V_H b}{I \times B_Z}$
1	0.74	6.6	0.0356756 m^3C^{-1}
2	1.10	10	0.03636 m^3C^{-1}
3	1.52	14.1	0.0371052 m^3C^{-1}
4	2.12	20.0	0.0377850 m^3C^{-1}
5	2.52	24.6	0.039047 m^3C^{-1}
6	3.01	29.5	0.0392026 m^3C^{-1}
7	3.55	35	0.0394366 m^3C^{-1}
8	4.01	39.6	0.03950124 m^3C^{-1}
9	4.53	45.1	0.0398233 m^3C^{-1}
10	5.03	50.4	0.0400079 m^3C^{-1}
			0.0400079 m^3C^{-1}

$E_H = J_x R_H B_z$

but $E_H = \frac{V_H}{t}$

and $J_x = \frac{I_x}{A} = \frac{I_x}{bt}$

Substitude the value of E_H and J_x

$$R_H = \frac{V_H b}{I_x B_z}$$

Here t is the dimension of the crystal in y direction and 'b' is the definition of the central in z direction. The number of charge carriers per unit volume i.e charge carrier density is given by

$$n = \frac{1}{eR_H}$$

If the conduction is primarily due to one type of charge carries, then conductivity is related to mobility as

$$\mu_m = \sigma R_H$$

Exp1 Wavelength of Laser

AIM :- To determine wavelength of laser using diffraction of light.

APPARATUS :- Diode Laser Source, Screen, Scale, Holders and Bases, Diffracting Grating (100/300/600 - Lines/meter)

THEORY :- When waves pass through apertures or arround obstacles, they spread out into regions which would be in shadow if they travelled in straight lines. This is called diffraction and can be described in terms of Hugyens Principle. Hugyens proposed that every point on a wave front may be regarded as a source of secondary spherical wave lets. Where those waves cross, they constructively and destructively add (Fig1). Diffraction is regarded as being due to the addition (superposition) of Huygen's secondary wavelets. Imagine that a slit consists of strips of equal width, parallel to the length of this slit. The total effect in a particular direction is then found by adding the wavelets emitted in that direction by all the strips.

When parallel waves of light are obstructed by a very small object (ie. sharp edge, slit, wire.

OBSERVATION TABLE :-

Sr. No.	Distance of spot from the screen L (mm)	Diameter of spot D (mm)	Acceptance angle ϕ $\phi = \tan^{-1}\left(\frac{D}{2L}\right)$ (degree)
1	1.4	1	$\theta_1 = \tan^{-1}\left(\frac{1}{2.8}\right)$ $= 19.65$
2	4	2	$\theta_2 = \tan^{-1}(1/4)$ $= 14.03$
3	5	3	$\theta_3 = \tan^{-1}(3/10)$ $= 16.69$

Sr. No.	$NA = \sin\theta$
1	0.336
2	0.242
3	0.287

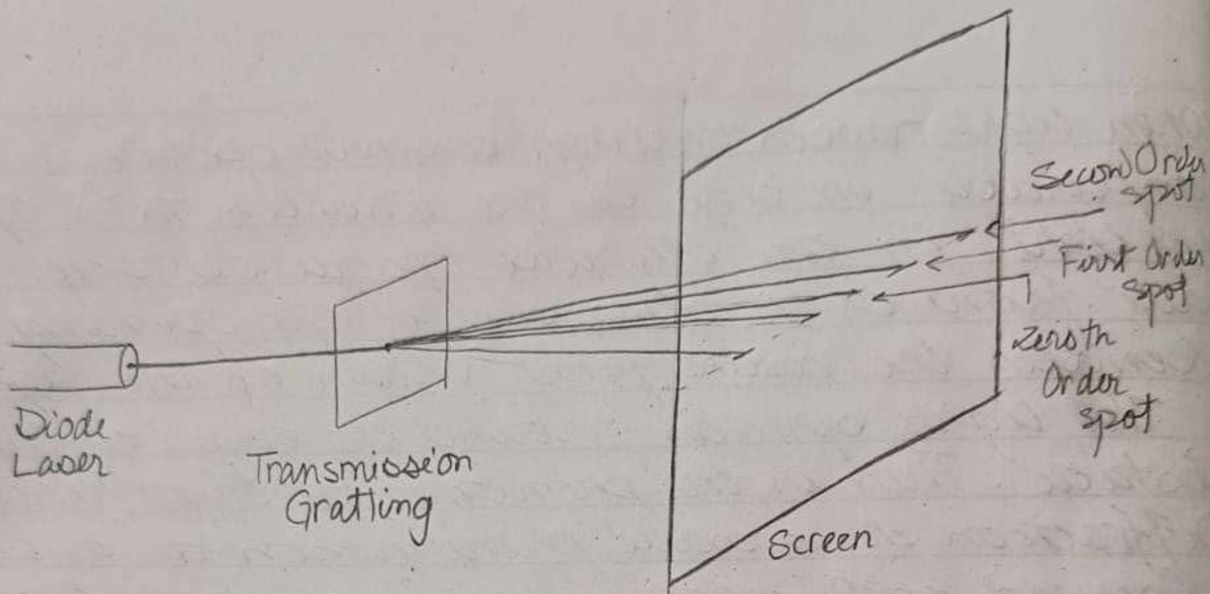


Fig: Set up.

OBSERVATION :-

No. of lines/slits present in 1cm :-

1inch = 15000 lines / shifts

1 inch = 2.54 cm

1 cm = $\frac{15000}{2.54}$ lines / slits

Grating elements = 5905 lines/cm.

• Resolution of Grating (d)

$$d = \frac{1}{\text{Grating Element}} = \frac{1}{5905}$$

$$= 1.69 \times 10^{-4} \text{ cm/lines}$$

i.e

$$x_m = \left| \frac{X_{mr} + X_{ml}}{2} \right|$$

$$\sin\theta_m = \frac{X_m}{\sqrt{X_m^2 + f^2}}$$

Put $\sin\theta_m$ in Formula $m\lambda = d\sin\theta_m$

$$\lambda = \frac{d x_m}{m\sqrt{X_m^2 + f^2}}$$

where, m = Order of spots
λ = Wavelength of LASER beam (nm)
d = Resolution of a grating (=1/grating element)
(i.e $1 \times 10^{-3}/100$ or $1 \times 10^{-3}/300$ or $1 \times 10^{-3}/600$) meter/lines

X_m = Distance between zero order & spot and first/second spot (meter)

f = Distance between screen and grating element (meter) should increase.

4. Hold the white screen with the 4 concentric circles (10, 15, 20 and 25 mm diameter) vertically at a suitable distance to make the red spot from the emitting fiber with the 10 mm circle (The circumference of the outermost) must coincide with the circle.

5. Record the distance "L" of screen from the fiber end and note the diammeter (D) of the spot.

6. Compute NA from the formula. Tabulate the reading and repeat the experiment for 15, 20, 25 mm diameter too.

7. In case of under filled, the intensity within the spot may not be evenly distributed To ensure even distribution of light in the fiber, first remove twists on the floor and then wind 5 turn of the fiber on to the mandrel as shown in fig (5). Use an adhesive tape to hold the winding in position. Now view the spot. The intensity will be more evenly distributed within the core.

PROCEDURE :-

1. Mount PCB (with crystal) and hall probe on pillars and complete all the connection.

2. Switch on the Gauss meter and place hall probe away from the electromagnet. Adjust the reading of the Gauss meter as zero

3. Switch on the constant current source and set the current, say 5 mA. Keep the magnetic field at zero as recorded by Gauss meter

4. Set the voltage range of the multimeter at 0-200 mV. When a current of 5 mA is passed through the crystal without application of magnetic field the hall voltage recorded by the multimeter should be zero.

5. Bring the current reading of the constant current source to zero by adjusting the knob of the constant current source.

etc.), the waves spread around the edges of the obstruction and interfere, resulting in a pattern of dark and light fringes. When light diffracts off of the edge of an object, it creates a pattern of light referred to as a diffraction pattern. If a monochromatic light source, such as a laser, is used to observe diffraction, a diffraction pattern is created by a slit (as shown in fig).

Diffraction is the tendency of a wave emitted from a finite source or passing through a finite aperture to spread out as it propagates. Diffraction results from the interference of an infinite number of waves emitted by a continuous distribution of source points.

According to Huygen's Principle every point on a wave front on light can be considered to be a secondary source of spherical wavelets. These wavelets propagate outward with the characteristic speed of the wave. Huygen's Principle also holds for electromagnetic waves. When studying the propagation of light we can replace any wave front by a collection of sources distributed uniformly over the wave front, radiating in phase.

$$R_{H9} = 0.004 \times \frac{45.1}{4.53} = 0.0398233 \ m^3C^{-1}$$

$$R_{H10} = 0.004 \times \frac{50.4}{5.03} = 0.040079 \ m^3C^{-1}$$

Exp 3 Hall Effect

AIM :- To determine the Hall Coefficient and charge carrier density of a Semiconductor crystal.

APPARATUS : Electromagnets, Electromagnets constant power supply, Hall probe, Gauss Meter, Semiconductor crystall mounted on PCB, multi meter.

THEORY : When a current carrying conductor is placed in a magnetic field perpendicular to the direction of current then an electro motive force is developed perpendicular to both the current and magnetic field applied. This effect is known as Hall Effect and the voltage developed is known as Hall Voltage.

Suppose an electric current (I_x) flows in the x direction and the magnetic field (B_z) is applied normal to this electric field in the z direction. Each electron is then subjected to a force called Lorentz force perpendicular to the direction of flow of electron as well as

When light passes through a small opening, comparable in size to the wavelength λ of the light, in an otherwise opaque obstacle, the wave front on the other side of the opening resembles the wave front shown on the right.
The lights spreads around the edges of the obstacle. This is the phenomenon of diffraction. Diffraction is a wave phenomenon as is also observed with water waves in a ripple tank.

Diffraction Grating :-
We have seen that different pattern can be produced by a single slit or by two slits. When light encounters an entire array of identical, equally-spaced slits, called a diffraction grating, the bright fringes which come from constructive interference of the light waves from different slits, are found at the same angles they are found if there are only two sliths. The width of all sliths is 30 micro meters and the spacing between all slits is 15 micro meters. The single slits pattern acts as an envelope for the multiple slits patterns. They produce interference maxima at angles θ is given by

$$m\lambda = d\sin\theta$$

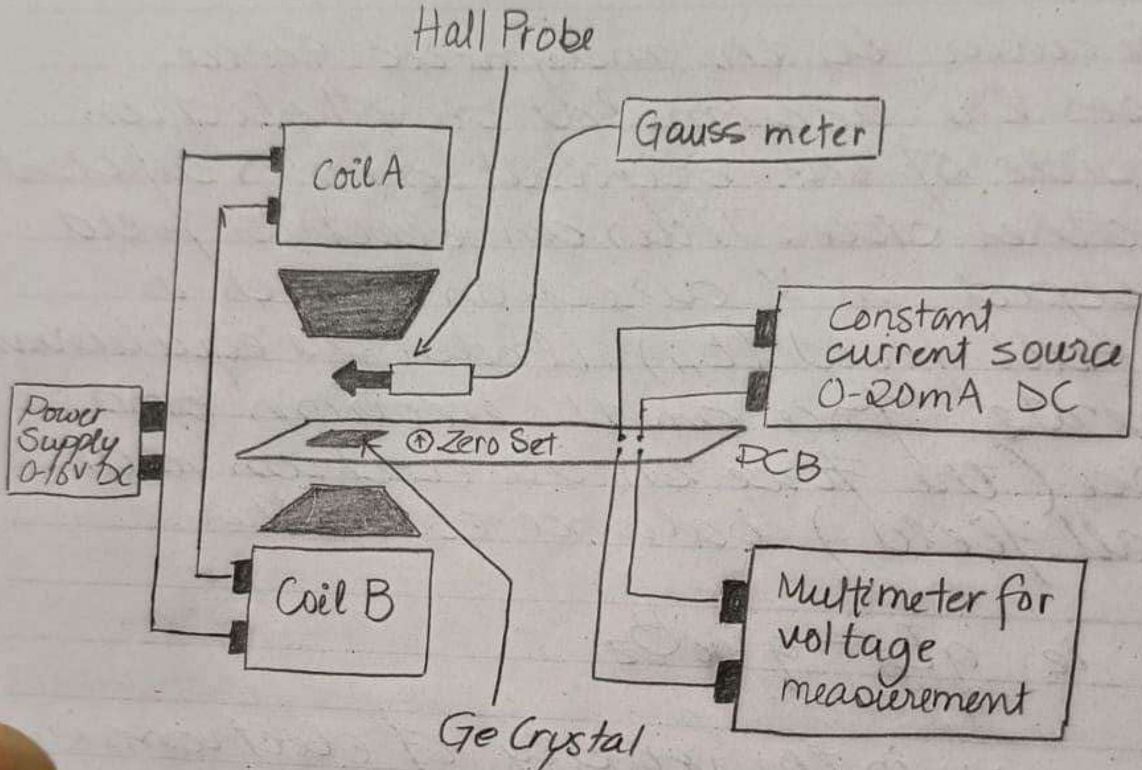
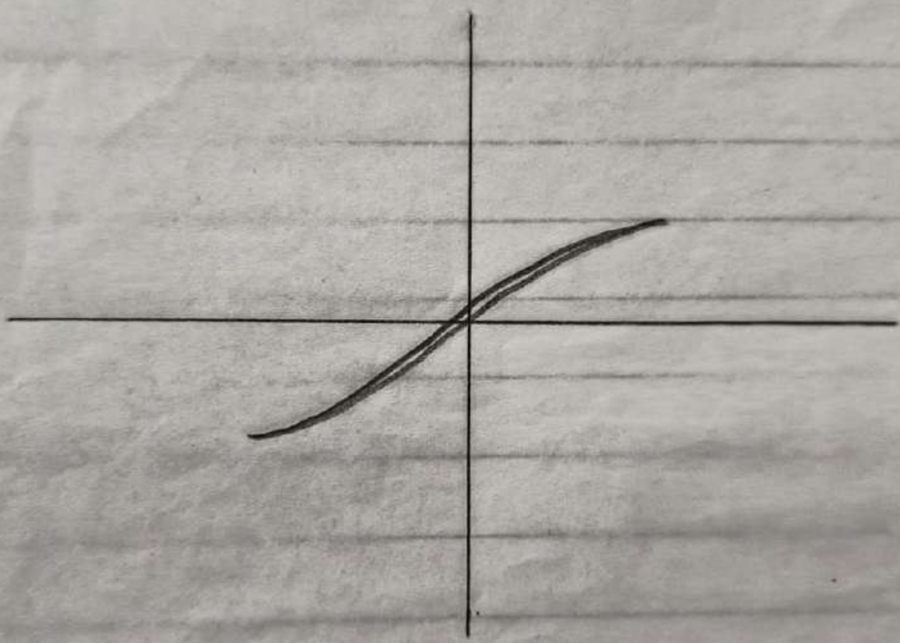

Hall Probe
Gauss meter
Coil A
Constant current source 0-20mA DC
Power Supply 0-16V DC
Zero Set
PCB
Coil B
Multimeter for voltage measurement
Ge Crystal

Fig. SET UP

9V Ferro



9. PRECAUTIONS :-

1. The Hall probe should be placed between the poles pieces such that maximum Hall voltage is generated.

2. Current through the Hall powder probe should be strictly within the limits.

3. Hall voltage developed should be measured very accurately.

RESULT :-

The Value of Hall coefficient for the given semiconductor crystal is

= Average Hall Coefficient

$= \frac{0.38396554}{10} = \frac{0.038396554}{10}$

$= 0.038396554 \ m^3C^{-1}$

12. Adequate no. of other electric component

13. Main On / OFF System Switch, Fuse and Jewel light.

14. The unit is operative on 230V ± 10% AT 50 Hz, AC. Mains.

15. Adequate no of patch cords stackable 4mm spring loaded plug length 1/2 Meter

16. Digital Fiber - optic power OMEGA TYPE DFPM - 021

17. Digital Multimeter OMEGA TYPE DMM-201

THEORY :- Loss or Attenuation in optical fibers occur at fiber - fiber joints or splices due to axial displacement angular displacement, seperation (air-core), mismatch of cores diameter, mismatch of Numerical Apertures, improper cleaving and cleaning at the ends

The optical power at a distance L in an optical fiber a is given by $P_l = P_0 10^{(aL/10)}$ where

a is attenuation coefficient in dB per