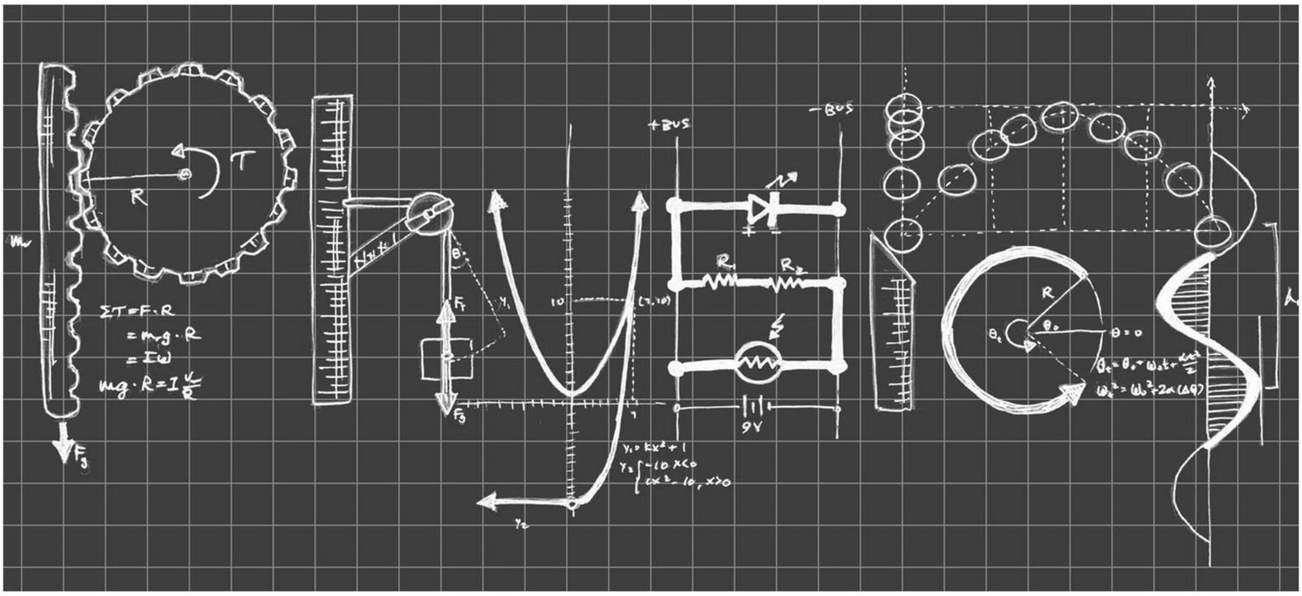
MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
Accredited by NBA and NAAC with 'A' Grade & Recognized Under Section2(f) & 12(B)of the UGC act,1956

DEPARTMENT OF FRESHMAN ENGINEERING

APPLIED PHYSICS LABORATORY (24200071)MANUAL
COMMON
TO
ALL BRANCHES



A.Y : 2024-2025

CERTIFICATE

This is to certify that this manual is a bonafide record of practical work in the **APPLIED PHYSICS LABORATORY** in I/II **Semester of I-year B. Tech Programme** during the academic year **2024-2025.** This book is prepared by **Team physics** Department of Freshman Engineering.

LAB I/C

Head of the department

PREFACE

This book entitled “Applied Physics Lab Manual” is intended for the use of First year B.Tech students of Marri Laxman Reddy Institute of Technology and Management, Dundigal, Hyderabad. The main objective of the Applied Physics Lab Manual is to furnish the conceptual understanding of the basic principles. The experiments are selected from various areas of Physics like Lasers, Fiber Optics, Electricity & Magnetism and Basic Electronics.The lab manual was written as per the new syllabus prescribed by the JNTUH University in a simple language. Viva voice questions also included in the manual. These experiments will help the students to expertise in the analysis of various concepts in Optical,Magnetic and Electronics related topics.Hence we hope this lab manual serve for better understanding by the student community with all experimental details.

By,

Team physics

ACKNOWLEDGEMENT

It was really a good experience, working with Applied physics laboratory**.** First we would like to thank Dr.K. Ashok , Assoc. Professor, HOD of Department of Freshman Engineering, Marri Laxman Reddy Institute of technology & Management for his concern and giving the technical support in preparing the document.

We are deeply indebted and gratefully acknowledge the constant support and valuable patronage of Dr. Ravi Prasad, Dean, Marri Laxman Reddy Institute of technology & Management for giving us this wonderful opportunity for preparing the Applied physics laboratory manual.

We express our hearty thanks to Dr.R.Murali prasad, Principal, Marri Laxman Reddy Institute of technology & Management, for timely corrections and scholarly guidance.

At last, but not the least I would like to thanks the entire Freshman Department faculty those who had inspired and helped us to achieve our goal.

By,

Team physics

GENERAL INSTRUCTIONS:

1. Students are instructed to come to Applied Physics laboratory on time. Late comers are not entertained in the lab.

2. Students should be punctual to the lab. If not, conducted experiments will not be repeated.

3. Students are expected to come prepared at home with the experiments which are going to performed.

4. Students are instructed to display their identity cards and apron before entering into the lab.

5. Students are instructed not to bring mobile phones to the lab.

6. The instruments used in Applied Physics should be handled with care and responsibility.

7. Any damage to equipment during the lab session is student's responsibility and penalty or fine will be collected from the student.

8. Students should update the records and lab observation books session wise. Before leaving the lab the student should get his lab observation book signed by the faculty.

9. Students should submit the lab records 2-3 days in advance to the concerned faculty members in the staff room for their correction and return.

10. Students should not move around the lab during the lab session.

11.If any emergency arises, the student should take the permission from concerned faculty member in written format.

12.The faculty members may suspend any student from the lab session on disciplinary grounds.

13.Never cook up the result by recording false observations or by making manipulated calculations.

14.All the data should be prettified with the relevant units.

SAFETY PRECAUTIONS:

1. While working in the laboratory suitable precautions should be observed to prevent accidents.

2. Always follow the experimental instructions strictly.

3. The laboratory apron should be worn while working in the laboratory .

4.Use the first aid box in case of any accident/mishap.

6. Never work in the laboratory unless a demonstrator or teaching assistant in present.

7. All the equipments must be carefully handled.

8. Keep all the doors and windows open while working in the laboratory .

INSTITUTION VISION AND MISSION:

VISION :

To be a globally recognized institution that fosters innovation, excellence, and leadership in education, research, and technology development, empowering students to create sustainable solutions for the advancement of society.

OUR MISSION :

1.To foster a transformative learning environment that empowers students to excel in engineering, innovation, and leadership.

2.To produce skilled, ethical, and socially responsible engineers who contribute to sustainable technological advancements and address global challenges.

3.To shape future leaders through cutting-edge research, industry collaboration, and community engagement.

DEPARTMENT VISION, MISSION, PROGRAMME EDUCATIONAL OBJECTIVES AND SPECIFIC OUTCOMES

VISION AND MISSION

VISION:

To empower the students to be technologically adept, innovative, self-motivated and responsible global citizen possessing human values and contribute significantly towards high quality technical education with ever changing world.

MISSION:

M1:To offer high-quality education in the computing fields by providing an environment where the knowledge is gained and applied to participate in research, for both students and faculty.

M2:To develop the problem solving skills in the students to be ready to deal with cutting edge technologies of the industry.

M3:To make the students and faculty excel in their professional fields by inculcating the communication skills, leadership skills, team building skills with the organization of various co-curricular and extra-curricular programmes.

M4:To provide the students with theoretical and applied knowledge, and adopt an education approach that promotes lifelong learning and ethical growth.

PEO's & PO's

PROGRAMME EDUCATIONAL OBJECTIVES:

PEO1 : To induce strong foundation in mathematical and core concepts, which enable them to participate in research, in the field of computer science.

PEO2 : To be able to become the part of application development and problem solving by learning the computer programming methods, of the industry and related domains.

PEO3 : To gain the multidisciplinary knowledge by understanding the scope of association of computer science engineering discipline with other engineering disciplines.

PEO4 : To improve the communication skills, soft skills, organizing skills which build the professional qualities, there by understanding the social responsibilities and ethical attitude.

Program Outcomes (PO'S):

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and engg. specialization to the solution of complex engineering problems.
PO 2: Problem analysis: Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.
PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4: Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
PO 8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO 9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
PO 10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO 11: Life-Long Learning: Recognize the need for, and have the preparation and ability for

i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

PSO 1:Applications of Computing: Ability to use knowledge in various domains to provide solution to new ideas and innovations.
PSO 2: Programming Skills: Identify required data structures, design suitable algorithms, develop and maintain software for real world problems.
PSO 3: Entrepreneur and higher studies: Make use of computational and experimental tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.

COURSE OUTCOMES:

After successful completion of the Course the students should be able to

- Know the determination of the Planck's constant using Photo electric effect and identify the material whether it is n-type or p-type by Hall experiment.
- Appreciate quantum physics in semiconductor devices and optoelectronics.

- Gain the knowledge of applications of dielectric constant.
- Understand the variation of magnetic field and behavior of hysteresis curve.
- Carried out data analysis.

COURSE OBJECTIVES:

The student will learn :

- Capable of handling instruments related to the Hall effect and photoelectric effect Experiments and their meaurments.
- Understand the characteristics of various devicesbsuch as PN junction diode,Zener diode,BJT,LED,Solar cell,Lasers and optical fiber and measurement of energy gap and Resistivity of semiconductor materials.
- Able to measure the characteristics of dielectric constant of a given material.
- Study the behavior of B-H curve of ferromagenetic material.
- Understanding the method of least squares fitting.

COURSE STRUCTURE:

Applied Physics lab will have a continuous internal evaluation(CIE) for 40 Internal marks and 60 marks for Semester End exams.

Out of the 40 marks for internal evaluation, day-to-day work in the laboratory shall be evaluated for 20 marks and internal practical examination shall be evaluated for 10 marks, innovative experiment 10 marks .

Course Outcomes (CO's)–Program Outcomes (PO's)Mapping

Course Outcomes	**PSOs**													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
	3	8	7	9	4	3	3	2	3	8	3	3	5	3
CO1	3	6				2	2				3			2
CO2	3	6				2	3				3			2
CO3	3	6				0	2				3			2
CO4	3	6				2	2				3			2
CO5	3	6				2	2				3			2

DEPARTMENT OF FRESHMAN ENGINEERING

I BTECH I/II SEM **L T P C**

0 0 3 1.5

COURSE STRUCTURE

Level	Credits	Periods/Week	Prerequisites
UG	1.5	3	Subject related experiments

EVALUATION SCHEME:

MID Term Examination	10 marks
Day to day evaluation	20 marks
CAT	10 marks
End Semester Lab external Examination	60marks

The end semester examination shall be conducted with an external examiner and internal examiner.

The external examiner shall be appointed by the principal / Chief Controller of examinations

INDEX

1. Hall effect

AIM:

To determine the Hall co-efficient of a given semiconductor Specimen.

APPARATUS:

Hall effect panel, Hall probe, Electromagnet, Constant current power supply, Digital gauss meter with hall probe, Hall probe stand (wooden).

PRINCIPLE:

When a piece of current carrying semiconductor placed in a transverse magnetic field, It expels the charge carriers to top and bottom surefaces of the material, which leads to generation of Voltage across the material which is perpendicular to both electric and magmetic fields. This generated voltage is known hall voltage. This phenomenon is knowns as Hall effect.

The electric field (E_H) which depends on the cross product of the magnetic intensity, H, and the current density, J .

$E_h = R\ J \times H$

Where R is called the Hall coefficient.

Then the Hall coefficient can be written as

$$\mathbf{R_H} = \frac{dV_H}{B.I}\ \text{cm}^3\ \text{Coulomb}^{-1}$$

B - Magnetic flux density

I - Current through the semi conductor

d - Thickness of the conductor 0.7 mm

V_H - Hall voltage

EXPERIMENT 1: Hall current Vs Hall Voltage at constant Magnetic field.

PROCEDURE:

1. Connect the IC regulated power supply terminals to Electromagnetic coils in their respective sockets.

2. Connect Hall probe to Gauss meter. Switch "ON" the Gauss meter, set the Gauss meter reading to "0.00" by adjusting the knob.

3. Now place the Hall probe in the magnetic field exactly at the center of the electromagnet cores. Set the gauss meter reading to 0.5KG magnetic field. This is achieved by applying suitable current to electromagnets & by simultaneously positioning the electromagnet cores by turning the knobs.

4. Connect the crystal mounted PCB to constant current power supply to their respective sockets.

5. Remove Hall probe from the magnetic field and place crystal in the same position without disturbing the position of magnetic cores.

6. Switch "ON" the constant current power supply & apply current in steps of 0.1mA, rotate the crystal till it becomes perpendicular to magnetic field. Hall voltage will be maximum in this adjustment, note the corresponding Hall voltage at constant magnetic field.

7. Plot the graph between current (I) and hall voltage (V_H) which is a straight line & find the slope.

8. Repeat the above steps from 3 to 7 for different values of magnetic fields say 0.75KG, 1KG, 1.25KG, 1.5KG, 1.75KG & 2KG.

S.no	Magnetic Field (KG) X10^3	Current I (mA)	Hall voltage V(mV)

NOTE:

1.There may be some voltage even outside the magnetic field. This is due to the imperfect alignment of the four contacts of the crystal and is generally known as the "Zero Field Potential". In all the cases this error should be subtracted from the Hall voltage reading. 2. Gap between the magnetic cores should remain fixed for one set of readings.

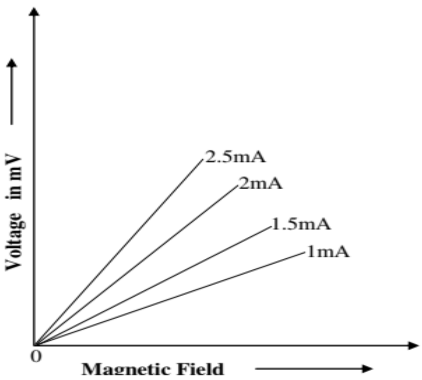
EXPERIMENT 2: Magnetic Field Vs Hall Voltage at constant current across the Semiconductor.

PROCEDURE:

1. To demagnatise the coils, place the sensor mounted PCB exactly at the center of the core. Apply reverse current through the coils till the Gauss meter reads '0.00'
2. Switch "OFF" all the sources, set the IC regulated power supply (to the magnetic coils) knob to minimum.
3. Increase the gap between magnetic cores to maximum by turning the core knobs.
4. Place crystal & sensor mounted PCB together in the magnetic field exactly at the center of the magnetic cores gap.
5. Connect the crystal mounted PCB to constant current power supply to their respective sockets.
6. Connect Hall probe to Gauss meter. Switch "ON" the Gauss meter, set the Gauss meter reading to "0.00" by adjusting the knob.
7. Switch "ON" IC regulated power supply to the magnetic coils & constant current power supply.
8. Set the current across the crystal to 1mA, vary magnetic field (starting from 0.00 KG) in steps of 0.25KG.This can be achieved by applying current to electromagnetic coils & simultaneously changing the position of electromagnetic cores.
9. Note the corresponding Hall voltage at constant current through semiconductor sample.
10. Plot the graph between magnetic field (B) and hall voltage (VH), which is a straight line & find the slope of the line.
11. Repeat the above steps from 2 to 6 for different values of current applied to semiconductor crystal say 1mA, 1.5mA, 2mA & 2.5mA.

TABULAR COLUMN:

S.NO	Current I (mA)	Magnetic Field (KG) X10^3	Hall Voltage V (mV)



Ideal graph

DESCRIPTION OF EXPERIMENTAL SETUP:

Fig (1) shows the experimental set up consisting of IC Regulated Power Supply of 2 Amps for Magnetic Coils, Constant Current Source of 2mA for Crystal, Gauss Meter, Semiconductor Crystal mounted on PCB, Hall Sensor mounted on PCB Coil arrangement with magnetic coils mounted on the wooden base, handles provided the coils moves the cores of the magnetic coils to change the magnetic field as desired. Brass bars provided on either side of the coils is used to hold the crystal & sensor PCB.

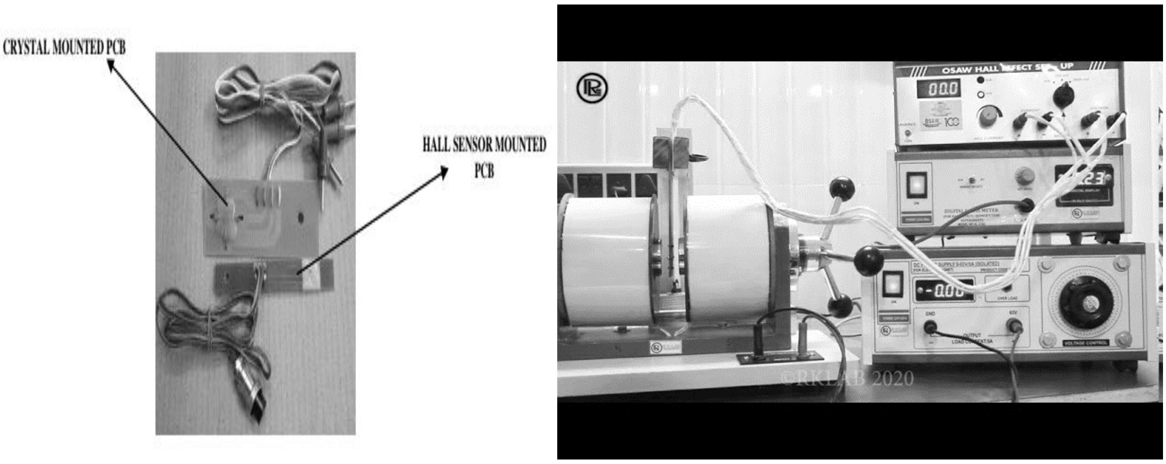


Fig. 1. Hall effect Setup

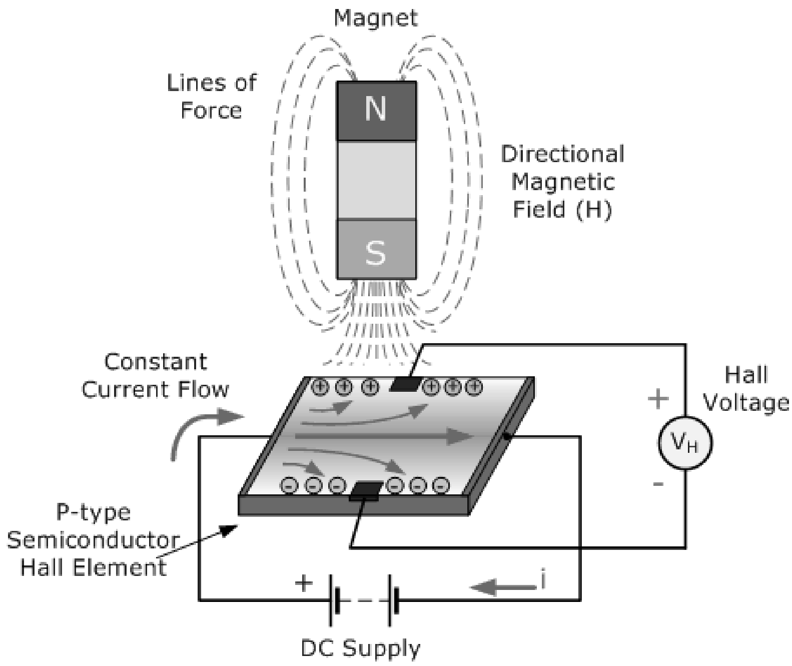


Fig. 2. Hall effect

Result:

Hall coefficient of the given semiconductor is $\mathbf{R_H} =$

VIVA QUESTIONS:

1. What is Hall Coefficient?
2. Mention the applications of Hall Effect?
3. Define Hall Effect.
4. Write the Hall Coefficient equation.
5. What is the difference between Electric field and Magnetic field?
6. List the different materials used for the Hall Effect?
7. Define magnetic induction.
8. How many types of magnetic materials are there.
9. Differentiate between Soft and Hard magnetic materials.
10. Define n-type semiconductor.
11. Define p-type semiconductor.
12. How are solids classified based on band theories.
13. What are majority and minority charge carriers in a p-type semiconductor?
14. What are majority and minority charge carriers in a n-type semiconductor?
15. What is meant by forward biasing?
16. What is meant by reverse biasing?
17. Explain ohm's law.

20. What are the units for current?
21. Write the units for Hall coefficient.
22. Define magnetic field intensity.
23. Explain the term magnetization.
24. Define energy gap in solids.
25. What is the energy gap value in semiconductors?

27. Define voltage.
28. Which instrument we are using to measure current.
29. What are the applications of Hall Effect?
30. What are the uses of Hard magnetic materials ?

2.V-I CHARACTERISTICS OF A P-N JUNCTION DIODE AND ZENER DIODE

AIM:
To study the V-I Characteristics of Zener Diode and PN Junction Diode.

APPARATUS:

Variable power supply (0-2V) and (0-10v),

Dual range Digital Ammeter,

Dual range Digital Voltmeter,

Set of PN diode and Zener diodes,

Resistors.

THEORY:

Forward Bias Characteristics

The Junction is said to be forward biased when the “P” sections of the diode is to positive terminal and “N” section of the diode is connected to negative terminal of the source, with an increase in the voltage the current also increase, for silicon diode Knee Voltage rises from 0.5 – 0.75 V & for Germanium 0.2 – 0.3V.

PROCEDURE:
FORWARD BIAS OF PN JUNCTION DIODE:

1.The circuit connections are made as shown in the diagram.

2.Switch on power supply note zero on meters.

3.Vary the power supply note down the readings of voltage and the correspondingly current in milli amps.

4.Plot a graph between voltage and current.

5.Note the forward voltage at which a significant amount of current starts flowing through the diode is the knee voltage of the diode.

6.Diodes IN4007&IN4148 are silicon diodes OA79 is Germanium diode.

-

V_{TH} FOR SILICON DIODE 0.5V-0.7V

V_{TH} FORGERMANIUMDIODE 0.2V-0.3V

REVERSE BIAS CHARACTERISTICS:

The Junction is said to be reverse biased when the “P” section of the diode is connected to Negative terminal and”N”section of the diode is connected to positive terminal of the source,with an increase in the voltage there is a small change inthe current, reverse current increases to higher value withan increase in the voltage.

REVERSE BIAS OF PN JUNCTION DIODE:

1.The circuit connections are made as shown in the diagram.

2.Switch on power supply, note zero on meters.

3.Vary the power supply & note down the voltage and its correspondingly current in micro amps.
4.Plot a graph between voltage and current.

TABLE1:V–I characteristics of PN junction diode.

S.no	Forward Bias		Reverse Bias	
	Voltage mV	Current mA	Voltage mV	Current µA
1				
2				
3				
4				
5				
6				
7				
8				
9				

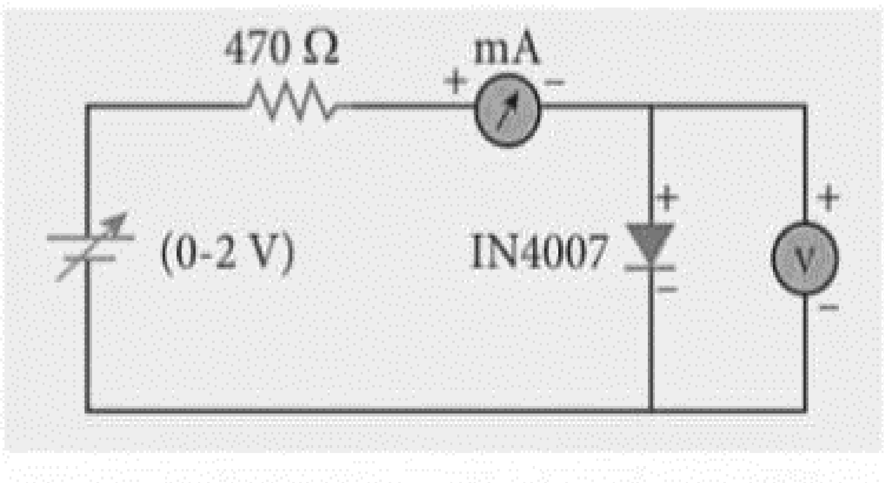


Fig:PN Junction diode in Forward Bias

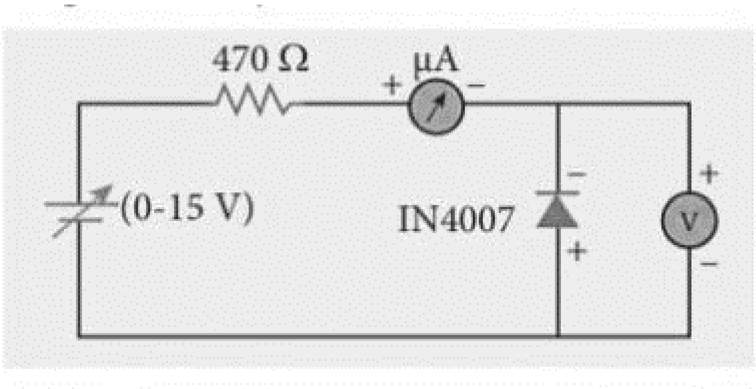
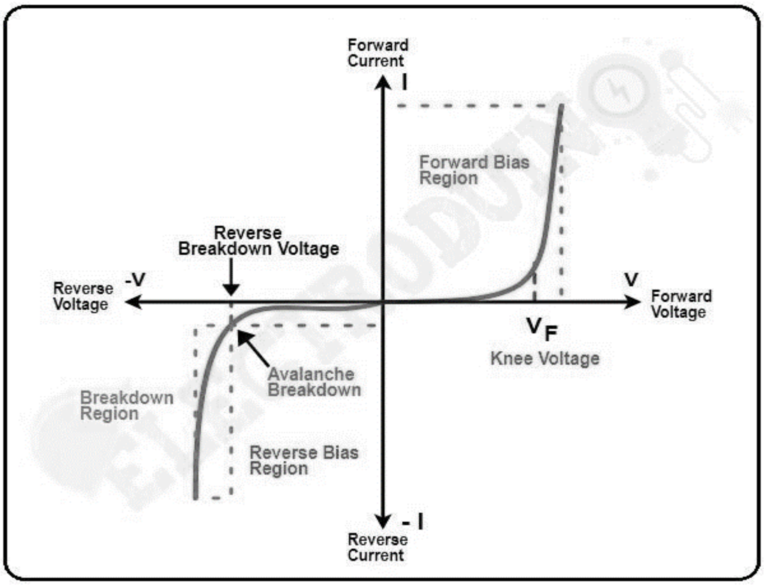


Fig:PN Junction Diode in Reverse Bias



GRAPH:V-I Characteristic of pn junction diode in forward and Reverse bias.

ZENER DIODE:

THEORY:

Zener diode is a heavily doped PN junction diode. Due to heavily doped, its depletion layer is very thin and is orderof micrometer. The forward bias characteristic ofZener diode is same as the normal PN junction diode but in reverse bias it has different characteristic. Initially, a negligible constant current flow through the Zener diode in its reverse bias but at certain voltage, the current becomes abruptly large. This voltage is called as Zener voltage. This sudden and sharp increase in Zener current is called as Zener breakdown.

TABLE2:V-I characteristics of Zener diode

S.no	Forward Bias		Reverse Bias	
	Voltage mV	Current mA	Voltage mV	Current μA
1				
2				
3				
4				
5				
6				
7				
8				
9				

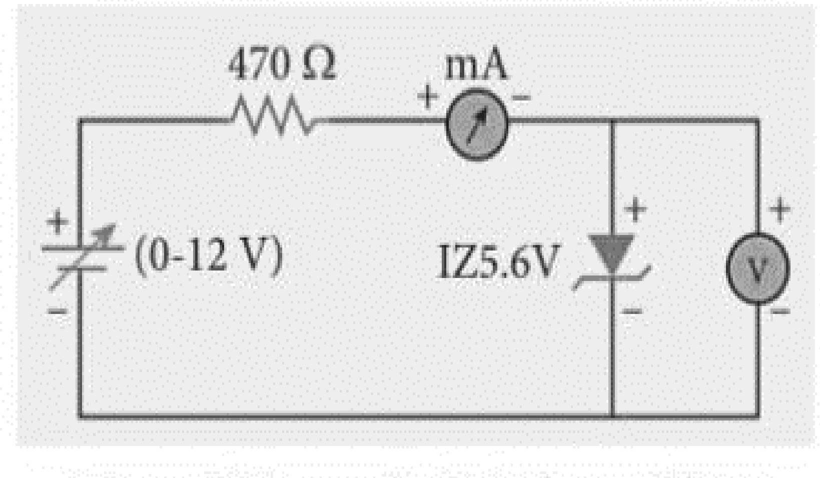


Fig: Zener Diode in Forward Bias

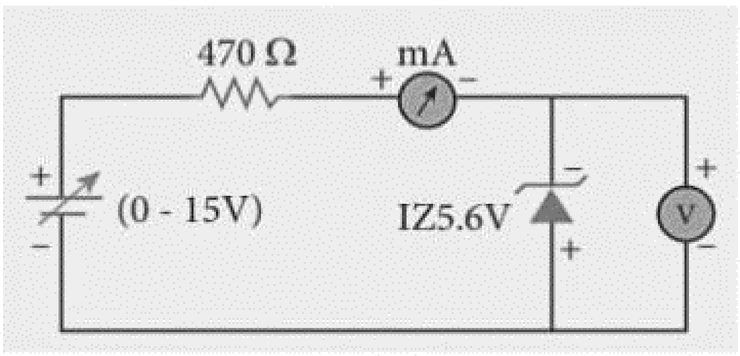
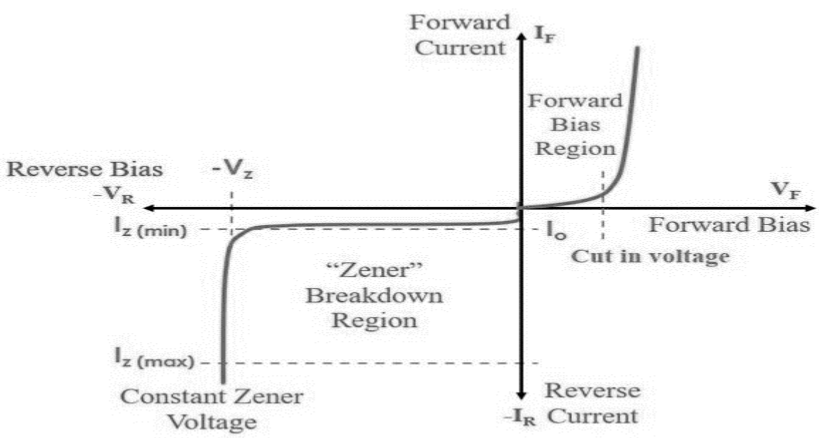


Fig: Zener Diode in Reverse Bias



V-I Characteristics of Zener diode in forward and Reverse bias.

RESULT:
V-I characteristics of PN junction and Zener diode have been studied and verified

VIVA QUESTIONS:

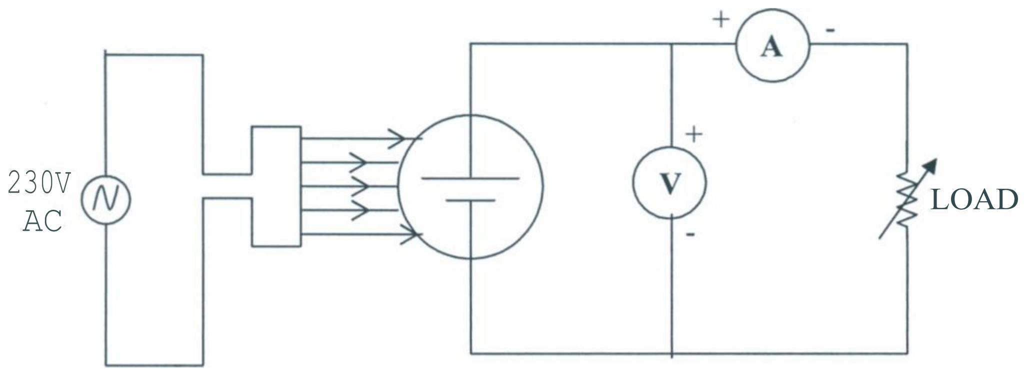
1. Define semiconductor.
2. What are the different types of semiconductors.
3. Define Intrinsic semiconductor.
4. Define Extrinsic semiconductor.
5. What are the majority charge carriers in P type and N type semiconductos.
6. What are the minority the charge carriers in P type and N type semiconductors.
7. Define PN junction diode.
8. Define Zener diode.
9. What is forward bias and reverse bias?
10. Difference between avalanche break down and Zener Break down.
11. Define an intrinsic semiconductor.
12. Distinguish between an N-type semiconductor and a P-type semiconductor.
13. Explain the formation of P-N junction in a diode.
14. What is the depletion layer in P-N junction?
15. Explain conduction band and valence band in an intrinsic semiconductor.
16. Define energy gap in an intrinsic semiconductor.
17. On what factors energy gap depends.
18. What is forward bias and reverse bias?
19. Explain the formation of covalent bonds in an intrinsic semiconductor.
20. write the applications of P-N junction diode.
21. Explain the semiconductor nature at 0^oC temperature.
22. Explain the semiconductor nature at 0^oC temperature.
23. What is the Hall coefficient for n-type semiconductor?
24. Write the example of n-type n-type semiconductor.
25. Write the Fermi energy formula for p-type semiconductor.
26. What are the best examples of intrinsic semiconductor?
27. What is the insulator?
28. What is the Fermi energy?
29. Explain the Fermi energy level in p-type semiconductor.
30. What are two different types of impurities?

3. SOLAR CELL

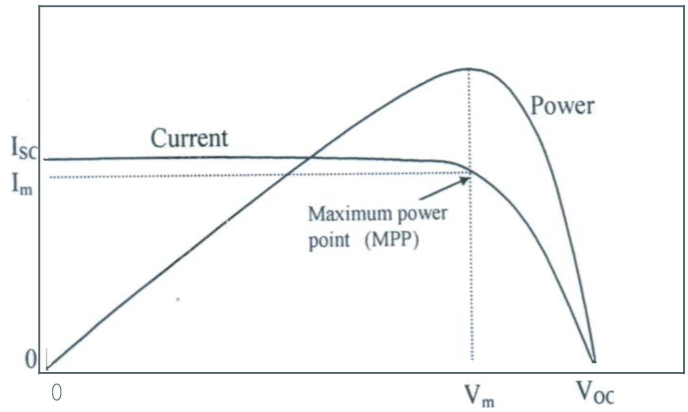
AIM: To Study the V-I and P-I characteristics of a Solar cell.

APPARATUS: Solar panel, Illuminator, Voltmeter, Milliammeter and Potentiometer, etc.

CIRCUIT DIAGRAM:



MODEL GRAPH:



PROCEDURE:

Complete the idealized equivalent circuit of solar cell connections. Then place the light source S at a distance of 15 cm from solar cell. Adjust the potentiometer R_L until you obtain the zero voltage in voltmeter and maximum current in the ammeter (if it shows out of scale then decrease the light intensity). This maximum current is called the short circuit current Isc. Then, with the help of potentiometer increase the voltage in equal steps and note down the corresponding current till you get maximum voltage in the voltmeter. Now remove all the connections of the circuit and find out the open circuit voltage (Voc) [i.e. connecting +ve of cell to the +ve of voltmeter and –ve of the cell to the -ve of the voltmeter]. Repeat the experiment for other intensities placing the light source at 20 cm and 25 cm, plot the graphs between V and I.

OBSERVATION TABLE:

S.NO	Voltage (V) (V)	Current (I) (mA)	Power (V x I)W

Short circuit current value I_{sc}= --------------

Open Circuit Voltage V_{oc}= ---------------

RESULT: V-I and P-I characteristics of a solar cell are studied.

VIVA QUESTIONS:

1.What is solar cell?

2.Mention the other name of solar cell?

3.What is the principle of solar cell?

4.Draw the schematic symbol of solar cell.

5.Define semiconductor.

6.What are the types of semiconductors?

7.Explain extrinsic semiconductor.

8.What are the types of semiconductors?

9. What type of impurities is present in intrinsic semiconductor?

10.What type of impurities is present in extrinsic semiconductor?

11.What is the difference between solar cell and a photodiode?

12.What are the types of semiconductor materials used for solar cell?

13.How can be a PN junction is formed.

14.Define intrinsic semiconductor.

15.What is the meaning of valence and conduction band in semiconductor?

16.How is the Fermi energy level in a semiconductor defined.

17.Give some practical uses of the solar cell.

18.Define direct band gap semiconductor.

19.What is the depletion region?

20.Define energy gap.

21.What are the units for energy gap?

22.When will be a PN junction is said to be forward bias.

23.What is meant by reverse bias of a PN junction?

24.In this experiment, the diode is connected, in which bias.

25.Creation of holes in the valence band leads to.

26.Write a formula to calculate the power.

27.Write the condition for an intrinsic semiconductor.

28.Draw the rough graph of VI- characteristics of solar diode.

29.Draw the rough graph of PI- characteristics of solar diode.

30.What is drift current in solar cell?

4. LCR CIRCUIT

AIM:

To study the characteristics of LCR Circuit in series and parallel and to find resonance frequency and quality factor.

APPARATUS:

LCR Circuit board contains set of resistors, capacitors, inductors and Milliammeter, Connecting Wires.

THEORY: In this LCR circuit, it consists of inductor(L), capacitance (C), and resistance(R), are connected in series with a sinusoidal frequency of e.m.f of source, electromagnetic oscillations are set in the circuit and it behaves as an oscillator. As the circuit is driven by the external A.C. power source, it behavior is similar to the force oscillations in spring mass system. Therefore the study of the LCR circuit allows us to study the phenomenon of forced oscillations and hence resonance. The conditions for resonance in the circuit can be obtained. When L and C are connected in series with R, at a particular frequency, the capacitive reactance X_C is equal in magnitude with inductive reactance X_L and they are out of phase by 180^0. At this frequency the current through the circuit is maximum, and this frequency is called resonance frequency.

The frequency of oscillations in series is given by

$$f_{series} = \frac{1}{2\pi\sqrt{LC}} \text{ Hz}$$

Where inductance L Henry,capacitane C Farad

In a parallel resonance circuit, at resonance, the circuit does not allow the current to flow and works as a perfect choke for A.C, such a circuit is called rejecter circuit, which is shown in the figure 1. In a parallel circuit, the impedance maximum at the resonant frequency and consequently the current is minimum.

The parallel resonant frequency is given by

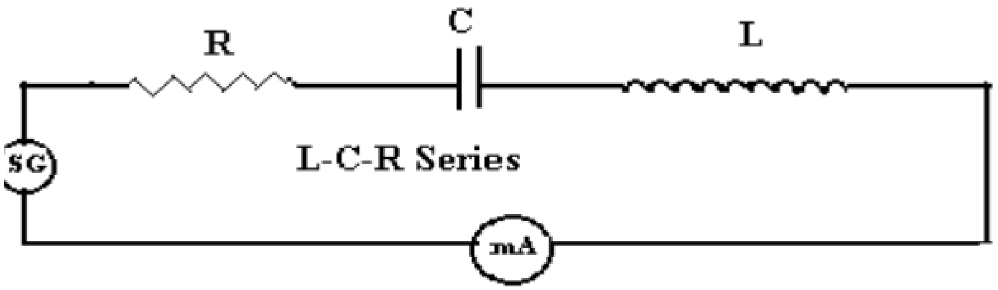
$$f_{parallel} = \frac{1}{2\pi\sqrt{1/LC - (R/L)^2}} \text{ Hz}$$

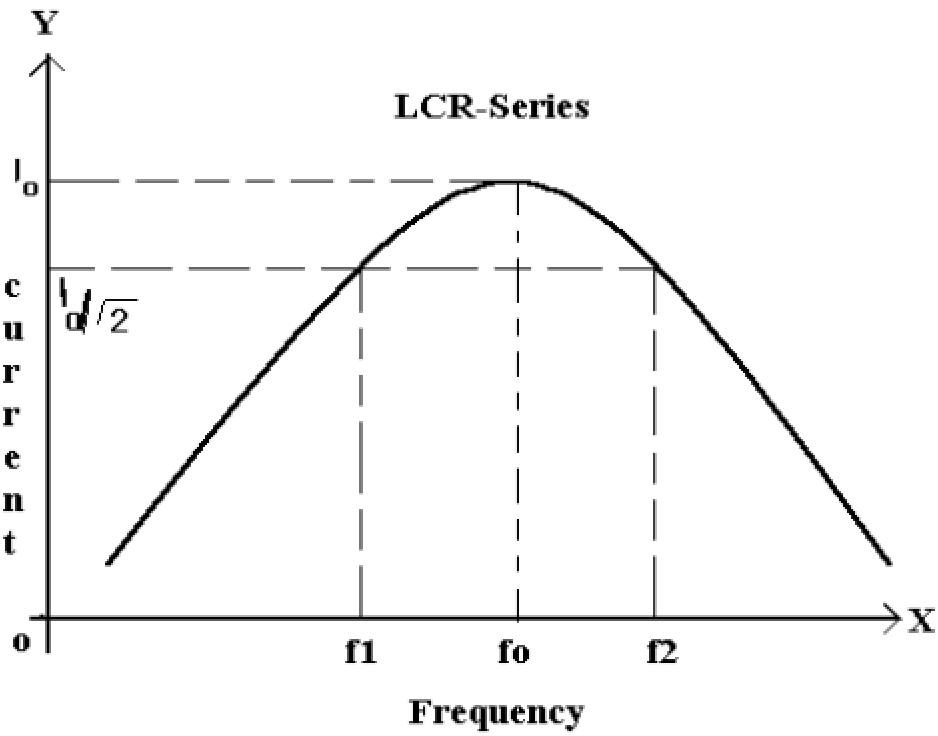
PROCEDURE:

SERIES RESONANCE OF LCR CIRCUIT:

1.Connect the circuit as shown in the circuit diagram.Apply input signal using signal OR function generator.
2.In this case the output should be 10 V only. Take the output across the resistor and set it to Ammeter input sockets.
3.Change the frequency till the ammeter readings should be a sharp rise and fall, adjust the signal such that the maximum possible ammeter readings should be a sharp rise and fall.
4.Adjust the signal such that the maximum possible Ammeter deflection is to be counted. This is the resonant frequency of the connected combination of the circuit.
5.Again adjust the amplitude of the function generator such that the full scale deflection. Now reduce the frequency till the deflection falls in ammeter.
6.After that increase the frequency in regular intervals & note down the ammeter readings.
7.Plot the graph between the deflection readings and frequency and repeat the same study how resonant frequency depends up on the different combination of L.C.R. the readings are tabulated as follows

LCR SERIES CIRCUIT





LCR SERIES RESONANCE

PARALLEL RESONANCE:-

Connect the circuit as per the parallel resonance circuit diagram.

Apply the input signal from a reliable signal generator. The output should be 10 V only. Take the output across the tank circuit connect to input ammeter sockets.

Change the frequency till the ammeter readings sharp fall and adjust the signal such that the deflection falls down considerably then increase the frequency generator amplitude such that to get full scale deflection.

Now reduce the frequency till the deflection till the deflection falls down and then increase the frequency in regular intervals and note down the deflection.

Plot the graph between the metre deflection divisions and frequency and repeat the procedure for different values of R and study how Q is affected & also study the how the resonant frequency depends on different combinations of L.C.R.

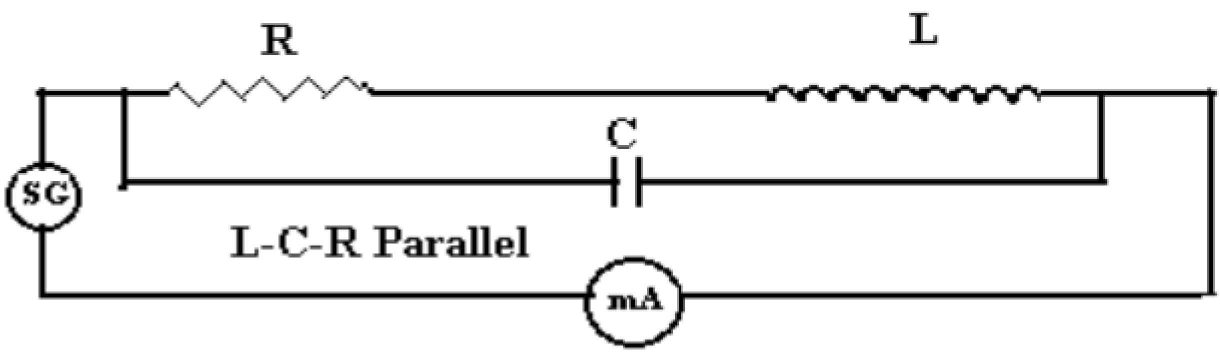
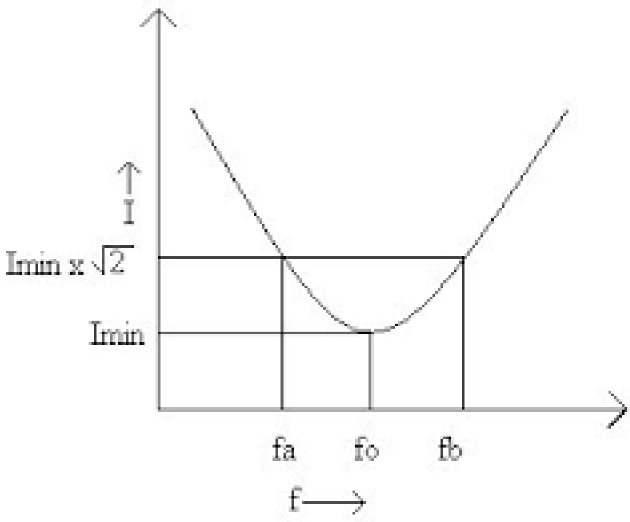


FIG. LCR CIRCUIT IN PARALLEL



LCR PARALLEL RESONANCE

Band width BW = $f_1 - f_2$ = ------------------------------Hz

Resonant frequency = $f_r = 1/2\pi\sqrt{LC}$ =---Hz

Quality factor Q = f_r/BW =---

TABLE 1: FREQUENCY VERSUS CURRENT IN LCR SERIES:

S.No	**L,C,R**	
	Frequency (Hz)	Current (mA)

TABLE 2: FREQUENCY VERSUS CURRENT IN LCR PARALLEL:

S.No	**L ,C,R**	
	Frequency (Hz)	Current (mA)

RESULT:-

Resonace frequency of LCR circuit in series (f_r) from theory= ________________ Hz

Resonace frequency of LCR circuit in series (f_r) from experiment = ________________ Hz

Quality factor of LCR circuit in series Q =

Resonace frequency of LCR circuit in Parallel (f_r) from thoery= ________________ Hz

Resonace frequency of LCR circuit in Parallel (f_r) from Experiment= ________________ Hz

Quality factor of LCR circuit in Parallel Q=

VIVA QUESTIONS:

1. Write the condition for resonance.
2. Define Capacitance.
3. Define Resistance.
4. Define Inductance.
5. Difference between series resonance & parallel resonance.
6. Write the SI unit of Resistance, Capacitance and Inductance.
7. Differentiate between A.C & D.C.
8. Define Frequency.
9. Write the Formula for quality factor .
10. Define resonant frequency.
11. On what factors the capacity of a capacitor depends.
12. Explain the importance of band width.
13. What are f1, f2?
14. What is meant by impedance in LCR circuit?
15. Define band width.
16. Write equation for resonant frequency.
17. On what factors does quality factor depends.
18. Write equation to calculate quality factor of an LCR circuit.
19. Difference between series and parallel connections in a LCR circuit.
20. The frequency at which the maximum Current occurs is known as.
21. Express the value of pico farads into micro farads.
22. Write the units of current.
23. What does a series circuit specifies?
24. Write the equation for energy stored in a capacitor.
25. Write the difference between capacitor and Resistor.
26. Write the full form of LCR.
27. List out types of semiconductors.
28. Classify types of solids based on band gap.

29. What are the types of impurities present in n-type semiconductors?

30. According to Ohms law V=-------

5. INPUT AND OUTPUT CHARACTERISTICS OF BJT (CE CONFIGURATION)

AIM: To Study the input and output Characteristics of both PNP and NPN transistors for CE configurations.

APPARATUS: MICRO BOARD CONSISTS OF:

1.Variablepowersupply(0-3V) -01,(0-10V)-01

2.Dualrange Digital Ammeter.µA/mA-01

3.DigitalVoltmeter-02

4.DigitalAmmeter(mA)–01

5.SL100–NPNTransistor

6.SK100–PNP Transistor

7.Resistors

COMMON EMITTER CONFIGURATION:

INPUT CHARACTERISTICS: - It is the curve between the base current I_B and base emitter voltage V_{BE} at constant collector-emitter voltage V_{CE}.

The input characteristics of a CE connection can be determined by the circuit shown in fig (3). Keeping V_{CE} constant, note the base current I_B for various values of V_{BE}. Then plot the readings obtained on the graph, taking I_B along Y-axis and V_{BE} along X-axis. This gives the input characteristics at constant V_{CE} at some voltage. Following a similar procedure, a family of input characteristics can be drawn. The following points may be noted from the characteristics.

1.The characteristic resembles that of a forward biased diode curve. This is expected since the base-emitter section of transistor is a diode and it is forward biased.

2.As compared to CB arrangement, I_B increases less rapidly with V_{BE}. Therefore, input resistance of a CE circuit is higher than that of CB circuit.

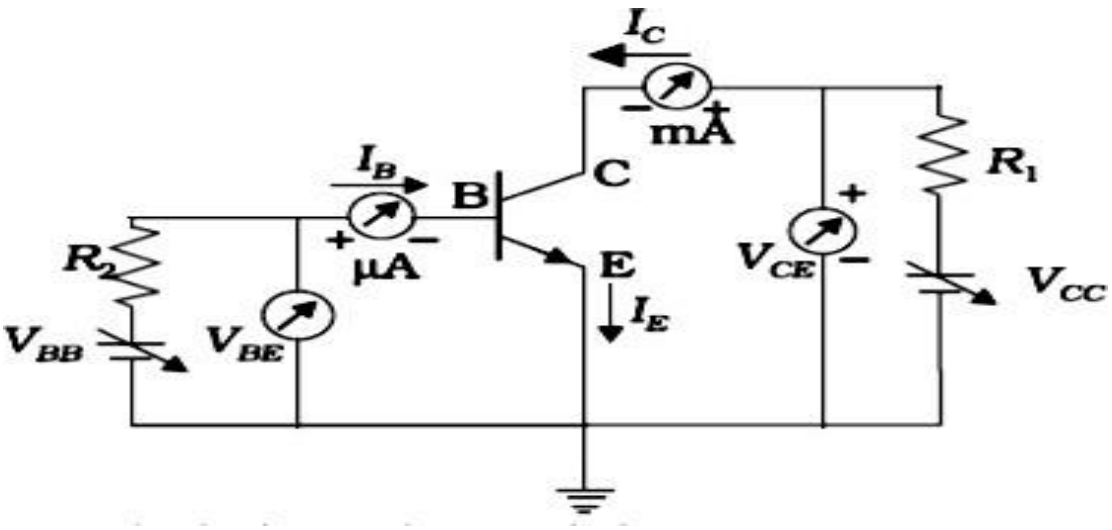


Fig:NPN Transistor in CE Mode

TABLE1:Input Characteristics of NPN Transistor

S.no	Constant Voltage		Constant Voltage	
	Voltage (mV)	Current (mA)	Voltage (mV)	Current (mA)
1				
2				
3				
4				
5				
6				
7				
8				
9				

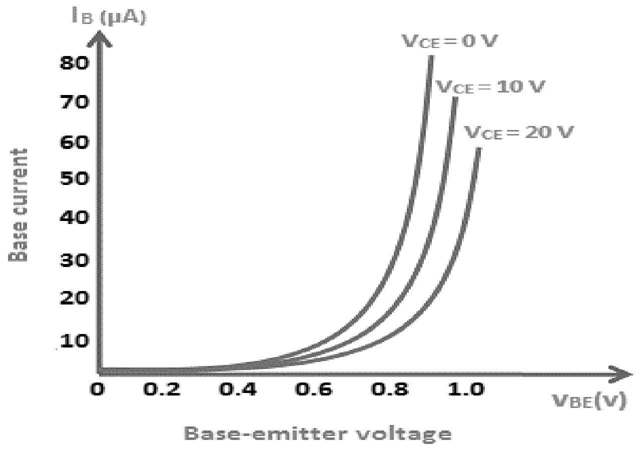


Fig:Input characteristics of NPN transistor in CE mode.

OUTPUT CHARACTERISTICS:

It is the curve between collector current IC and collector emitter voltage V_{CE} at constant base current.

The output characteristics ofCE circuit canbe drawnwiththe help ofthe circuit shown in fig (2). Keeping the base current IB fixed to some value, note the collector current IC for various values of V_{CE}. Then plot the readings on a graph taking IC along Y-axis and V_{CE}. along X-axis. This gives the output characteristics at different values of IB. following the same procedure, a family of output characteristics can be drawn as shown in fig .

The following points may be noted from the characteristics.

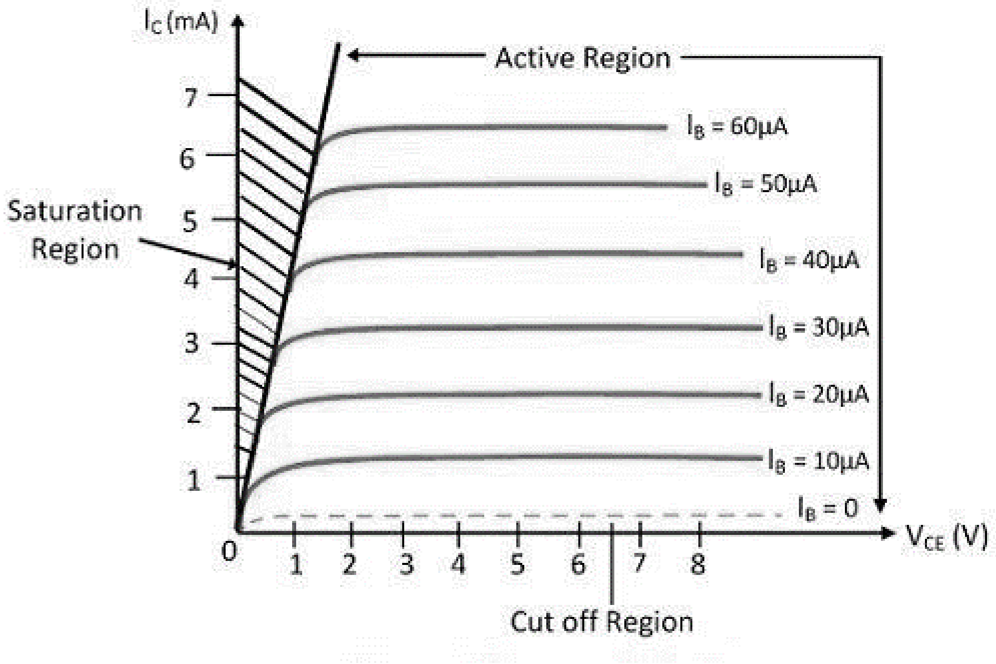
The collector current IC varies with V_{CE} for V_{CE} between 0&1V only. After this, collector current becomes almost constant and independent of V_{CE}.. This value of V_{CE} upto which the collector current IC changes with V_{CE} is called the knee voltage (Vknee). The transistors are always operated in the region above knee voltage.

Above knee voltage, IC is almost constant. However, a small increase in IC with increasing V_{CE}. is caused by the collector depletion layer getting wider and capturing a few more majority carriers before electron hole combinations occur in the base area.

1.For any value of V_{CE} above knee voltage,the collector current I_C is approximately equal to βx I_B.

TABLE2:Output Characteristics of NPN Transistor

S.no	Constant Current		Constant Current	
	Voltage (mV)	Current (mA)	Voltage (mV)	Current (mA)
1				
2				
3				
4				
5				
6				
7				
8				
9				



PRECAUTIONS:

1.Care should be takento connect the terminalsof ammeters, voltmeters, and dc power supplies with right polarity.

2.The collector and emitter terminals of the transistor must not be interchanged.

RESULT: Input and Output characteristics of NPN transistor in CE mode have been studied and verified.

VIVA QUESTIONS:

1.Define BJT

2.What are the different modes of BJT

3.What are the different configurations of BJT

4.Draw the symbols of NPN and PNP transistor

5.Mention the applications of BJT

6.Draw the scematic diagram of Transistor

7.What are main regions in transistor

8.What is the use of Collector.

9.Which region is highly doped.

10.What is the use of BASE region.

11.Sketct the circuit symbol for NPN transistors.

12.Draw the circuit symbol for PNP transistors.

13.List the applications pn junction diode.

14.What are the applications of BJT ?

15.How many operating regions of BJT ?

16.What is Active region in BJT ?

17.How many junctions are there in BJT ?

18.What is current ?

19.Define semiconductor.

20.What are the different types of semiconductors.

21.Define Intrinsic semiconductor.

22.Define Extrinsic semiconductor.

23.What are the majority charge carriers in Ptype and Ntype semiconductos.

24.What are the minority the charge carriers in P type and N type semiconductors.

25.Define PN junction diode.

26.Define Zener diode.

27.What is forward bias and reverse bias?

28.Define Depletion region.

29.What is resistance ?

30.Where the transistor can be used ?

6.TORSIONAL PENDULUM

AIM :

To determine the modulus of rigidity (η) of the material of the given wire using a Torsional pendulum.

APPARATUS:

A circular brass disc provided with a chuck and nut at its centre, steel wire, a rigid clamp, stop watch, meter scale, screwguage, and Vernier calipers.

PRINCIPLE:

Rigidity Modulus: $\eta = \frac{4\pi MR^2}{a^4}\left(\frac{L}{T^2}\right)$ dynes/cm^2

M - Mass of the disc.

R - Radius of the disc.

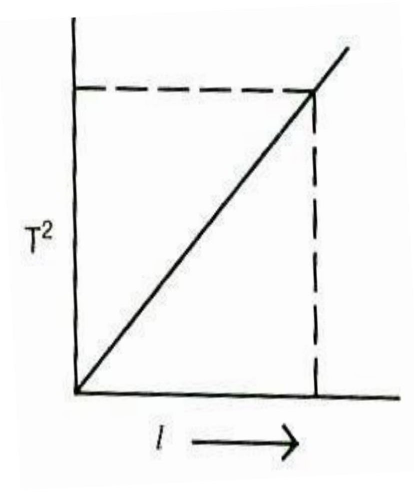
a - Radius of the wire.

L - Length of the pendulum.

T - Time period.

DESCRIPTION: The Torsional pendulum consist of a uniform circular metal disc of about 8 to 10 cm diameter with 1 or 2cm thickness, suspended by a wire at the centre of the disc as shown in figure. The lower end is gripped into another chuck, which is fixed to a wall bracket.

GRAPH:



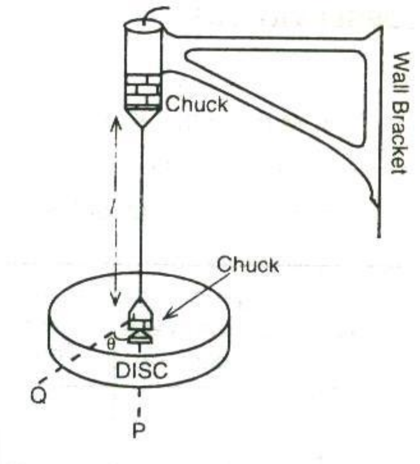


Figure 1 : *Torsional Pendulum*

PROCEDURE:

The circular metal disc is suspended as shown in above figure. The length of the wire between the chucks is adjusted to different lengths(ex 40cm ,50cm,60cm). when the disc is in equilibrium position; a small mark is made on the curved edge of the disc. This marking will help to note the number of oscillations made by slowly turning the disc through a small angle. Care is to be taken to see that there is no lateral movement of the disc.

When the disc is oscillating the time taken for 10 oscillations is noted with the help of a stopwatch and recorded in the observations table in trail 1. The procedure is repeated for the same length of the wire and again the time taken for 10 oscillations is noted and noted as trail2 in the observation table. From trail 1 & 2 the mean time for 10 oscillations is obtained. The time period (T), i.e., the time taken for one oscillation is calculated.

The experiment is repeated by decreasing the length of the wire in steps of10cm and the results are tabulated in the table.

By using the Vernier calipers the radius of the disc (R) is calculated, the radius of the wire (a) is calculated by means of screw gauge and the mass of the disc (M) is found by means of rough balance and these values are substituted in the formula. The mean value of (l / T^2) is calculated from the observations and hence η is determined.

A graph is drawn with ‘l’ on X-axis and T^2 on Y-axis. It is a straight line graph and the value of (l / T^2) is calculated and the rigidity modulus of the material of the wire η is calculated .

PRECAUTIONS:

1.The wire should not have any bending.

2. The chuck nuts should be tight because the wire becomes loose and the oscillations may not be perfect.

3.The time period between the oscillations must be uniform.

OBSERVATIONS:

TO DETERMINE THE RADIUS OF THE DISC:

Least count of the Vernier calipers= $\frac{\text{One Main scale division}}{No.of Vernierscaledivisions}$ =

S.No	Main scale reading(a)cm	Vernier coincidence	VernierReading (b=L.C*V.C)	Total Reading (a+b)cm
1				
2				
3				

TO DETERMINE THE RADIUS OF THE WIRE:

Least count of the Screw Gauge = $\frac{\text{pitch of the screw}}{No.of Head scale divisions}$ =

Screw Gauge Error - Correction:

S.No	P.S.R (a)	H.S.C	Correction	H.S.R (b=L.C*H.S.C)	Total (a+b) (mm)
1					
2					
3					

Mass of the disc (M) = gm

Radius of the disc (R) = cm

Radius if the wire (a) = cm

TIME PERIOD OF THE PENDULUM:

S.No	Length of the wire'L' (cm)	Time taken for 10 oscillations			Time for one Oscillation (Timeperiod) $T=\frac{t}{10}$ sec	T^2 sec^2	$\frac{L}{T^2}$ $({}^{cm}/_{sec^2})$
		Trail 1	Trail 2	Average (t) sec			

RESULT :

The rigidity modulus of the given wire is ______________dyne/cm^2

VIVA QUESTIONS:

1.Distinguish between elastic materials and plastic materials.

2. State Hook's law?

3. What is Elastic limit?

4. Define Young's modulus.

5. Explain Rigidity modulus

6. What is the S.I. Unit of Rigidity modulus?

7. On what factors Rigidity modulus depends?

8. The shape of l - T^2 graph in this experiment is _______________

9. Define the term time period (T).

10.What is the difference between a Simple pendulum and Torsional pendulum?

11. Write the formula for bulk modulus?

12. Write the relation between three moduli of elasticity?

13. What is the equation for energy stored in a stretched wire?

14. Define stress.

15. Define strain.

16. What are the different types of Stresses?

17. Define least count.

18. What is Torsional Oscillation?

19. Write two applications of torsional pendulum.

20. Define young's modulus.

21. Explain elasticity.

22. Describe yielding point of material.

23. What is the difference between elastic and plastic materials?

24. Explain the behavior of a material under stress.

25. What are different types of stresses?

26. Describe elastic limit of a material.

27. Write the relation between three moduli.

28. What is the unit for stress?

29. Define moment of inertia.

30. Explain elastic modulus.

7. V-I AND L-I CHARACTERISTICS OF LIGHT EMITTING DIODE LED AND LASER

AIM:

To Study the V-I and P-I characteristics of LED& Laser.

APPARATUS:

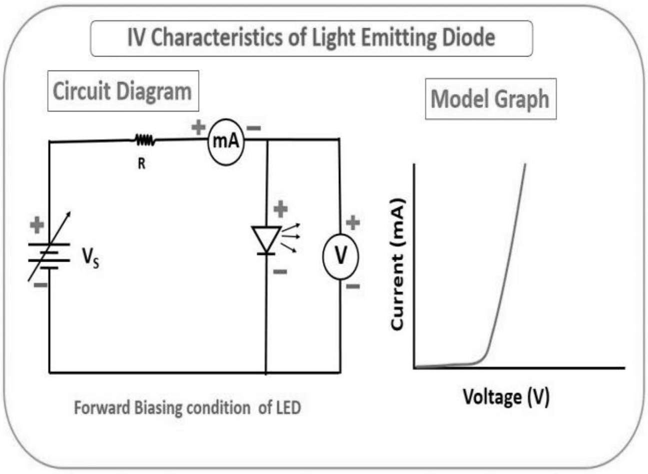
LED trainer kits, digital multimeter.

THEORY:

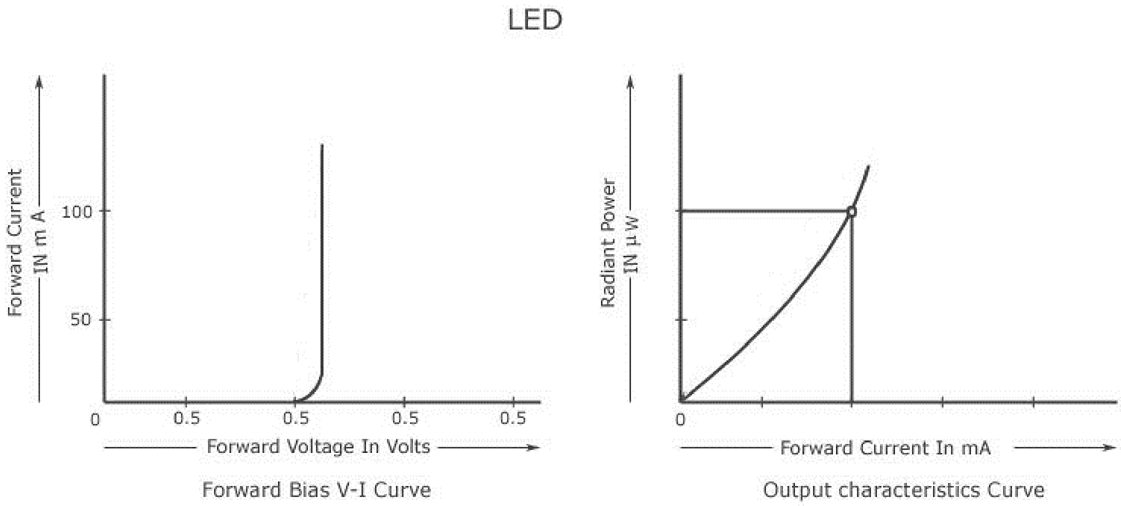
A p-n junction diode, which emits lightin forward biasing is known as light emitting diode.The emitted light may be in the visible range or invisible range and the intensity of light depends on the applied potential. In this experiment LED is represented by standard diagram along with its source of resistance. The V-I characteristics of the diode are measured by applying sweep voltage by a source V to the diode. It is monitoring the current by ammeter. In general the V-I characteristics curve of a diode gives the relationship by the following equation

$$I=I_s[\exp(ev/KT)-1]$$

Where I_s is the saturation curre



MODEL GRAPH:



PRINCIPLE:

In a P-N junction charge carrier recombination takes place when the electrons cross from the n-layer to the p-layer. The electrons are in the conduction band on the p-side while holes are in the valence band on the p-side. The conduction band has a higher energy level compared to the valence band and so when the electrons recombine with a hole the difference in energy is given out in the form of heat or light. In case of silicon or germanium, the energy dissipation is in the form of heat, where as incase of the gallium-arsenide and gallium phosphate, it is in the form of light. But this light is in the invisible region & so these materials cannot be used in the manufacture of LED. Hence gallium-arsenidephosphate which emits light in the visible region is used to manufacture and LED.

CONSTRUCTION:

An n-type layer is grown on a substance and a p-type layer is grown over it by diffusion process. The p-layer is kept at the top because carrier recombination takes place in it. The terminals anode and cathode are taken out of the n-layer and p-layer respectively. The anode connections are made at the edge in order to provide more surface area for the emission of light. A metal film is applied to the bottom of substance to reflect light to the surface of the device and also to protect them from destruction.

PROCEDURE: Connect one end of the optical fiber cable to the output terminal of LED and the other end is coupled to the power supply as shown in above fig.

1.It consists of P-N diode and then switch on the power supply.

2.Adjust the set knob to extreme end into anticlock wise direction.

3.It gives the minimum output in the power meter and observes the output power in the power meter.

4.Next slowly turn the set knob into clock wise direction then note down the current I_L .Through the LED terminals again note down the reading in the power meter(p_0) then tabulate the readings in the following tableRepeat the same method for nothing the various of I_L and power meter readings and next plot the graph between I_L and P_0

1.For P-I values note down the Power values by increasing the I value.

V-I VALUES OF LED

S.no	**V_L(mv)**	**I_L(mA)**

P-I VALUES OF LED

S.no	I_L (mv)	P_L(mW)/ mcd

PROCEDURE FOR V-I AND P-I CHARACTERISTICS OF A LASER:

1.Connect one end of the optical fibre to the output terminal of the LASER and the other end is coupled to the power meter.

2.It consists of P-N diode then switch on the power supply.

3.Adjust the set knob of power meter to the extreme end in the clock wise direction and it gives the minimum output in the power meter. Observe the power in the power meter.

4.Slowly turn the set knob in to clock wise direction the note down the current I_L across the LASER input terminals.

5.Note the readings in the power meter and tabulated following table and repeat the procedure for finding the various values of I_L and the P_0.

6.Plot the graph between I_L and the P_0 from the experiment and determine the slope before and after the value of the threshold current.

7.For P-I values note down the Power values by increasing the I value.

V-I VALUES OF LASER:

S.no	V_L(mv)	I_L(mA)

P-I VALUES OF LASER:

S.no	I_L(mv)	P_L(mW)/ mcd

PRECAUTIONS:

1.Make sure that the volt meter is measuring the voltage across the LED only.

2.Increase the power supply very slowly until led just starts to glow.

3.Continously monitor the current so that it do not exceed the maximum current, with this the damage of the LED with high current can be avoided.

RESULT:

V-I and P-I characteristics of LED and LASER diodes are studied and Verified.

VIVA QUESTIONS:

1.What is n-type semiconductors?

2.What is p-type semiconductors?

3.Define conduction and valence band in a semiconductor?

4.What are LED materials and give some examples.

5.What is the basic mechanism of LED?

6.What are the input and output energies of LED?

7.What are the majority charge carriers in a p-type semiconductor?

8. What are the majority charge carriers in a n-type semiconductor?

9. What are different types of lasers?

10. What is laser? Explain?

11. What is the difference between laser and conventional light?

12. What is stimulated emission?

13. Write the characteristics of laser.

14. What are the applications of laser in industry, research?

15. What are the different types of semi conductors?

16. How is a PN junction formed?

17. What is meant by forward biasing?

18. What is meant by reverse biasing?

19. Give an example of a solid state laser.

20. Write the differences between spontaneous and stimulated emission?

21. What are direct band gap semiconductors?

22. What are indirect band gap semiconductors?

23. Define semiconductor.

24. Give examples of conductor, semiconductor and insulator.

25. Define doping.

26. Write two applications of LED.

27. Write the Laser applications in communications.

28. Define intrinsic semiconductor.

29. Define extrinsic semiconductor.

30. Explain Recombination.

8. R-C CIRCUIT

AIM:

To study the charging and discharging of voltage in a circuit containing resistance and capacitor and compare the experimental RC time constant with theoretical RC time constant.

APPARATUS:

Power supply, Resistors, Electrolyte, capacitors, voltmeter, stop watch, commutator, connecting wires.

Principle:

The charging voltage across the capacitor is given

$$\mathbf{V} = V_o\,(1 - e^{-t/RC})$$

The discharging voltage across the capacitor is given

$$\mathbf{V} = V_o e^{-t/RC}$$

Where

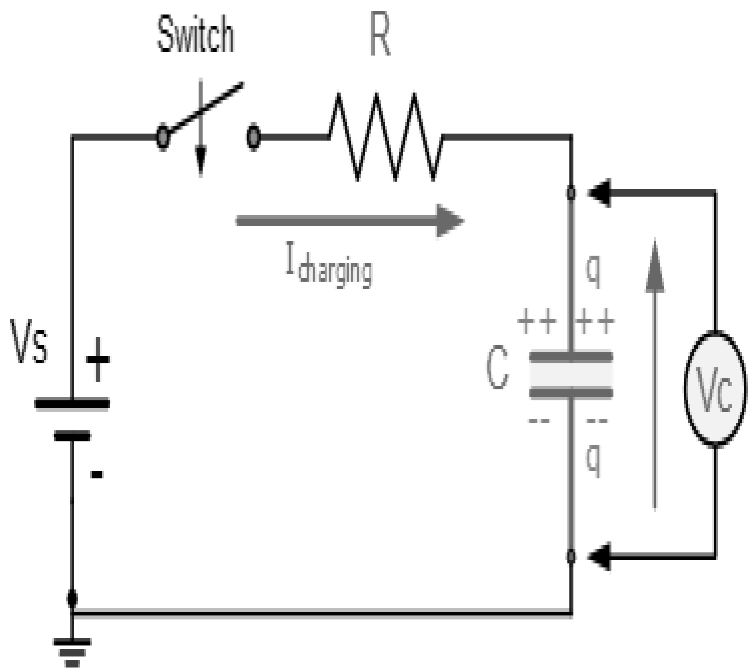
t – Time constant

R - Resistance

C - Capacitance

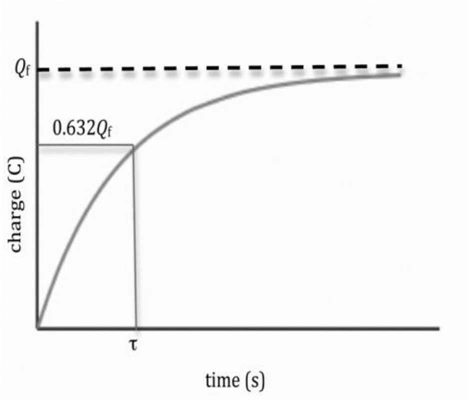
Theoretical Time constant of RC circuit **T =RC sec**

CIRCUIT DIAGRAM:

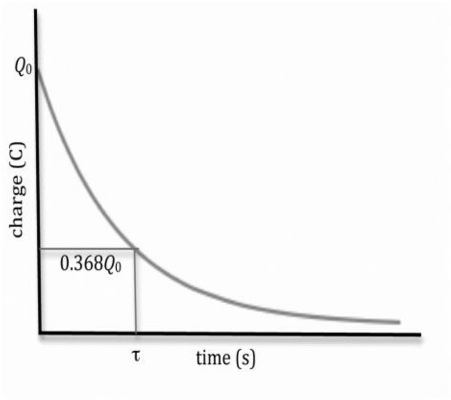


GRAPH:

CHARGING MODE **DISCHARGING MODE**



(a)



(b)

PROCEDURE:

This circuit is connected as shown in fig, taking one set of R and C values.

CHARGING:

When the terminal1 is connected to charging switch, the capacitor will change with time. This changing in charge is noted as a voltage across the capacitor with time. The change in charging voltage is noted for every 1 min with help of stop watch and recorded in the observation table. The graph is drawn between time on x-axis and voltage on y-axis. The time constant is calculated from the graph by calculating the time corresponding to 63% value of maximum value and comparing with theoretical value of time constant(RC) (from fig (a)).

DISCHARGING:

When the terminal 1 is connected to discharging, the charged capacitor will be discharged with time. The decayed voltage across the capacitor is noted with 10 time interval upto zero voltage. The graph is drawn between the voltage across the capacitor and time on x-axis. The time constant is calculated at 36% of maximum voltage across the capacitor and comparing with theoretical value of time constant (RC).This experiment is repeated with different set of R and C values(from fig (b)).

OBSERVATIONS:

R= **C=**

Charging mode		Discharging mode	
Time (sec)	Voltage (Volts)	Time (sec)	Voltage (Volts)

APPLICATIONS:

When a capacitor is charged by a DC Voltage, the accumulation of charge on its plates is a method of storing energy which may be released at different rates. An example of the energy storage application is the photoflash capacitor used in flashguns of photographic cameras.

1.The charging time and discharging time is calculated for a R.C circuit and is connected to series of decorative bulbs.

2.Capacitors are of two types; a) fixed and b) variable, both of which are used in a wide range of electronic devices. Fixed capacitors are further divided into electrolytic and non-electrolytic.

RESULT:

The theoretical value of time constant is ___________ sec.

The experimental value of time constant is ____________ sec in charging mode

The experimental value of time constant is ____________ sec in discharging mode

VIVA QUESTIONS:

1. Charge is defined as.
2. Write the SI and CGS units of charge.
3. Define time constant.
4. Convert the value of picofarads into micro farads.
5. What are the units of resistance?
6. What are the units of capacitance?
7. Define an electric circuit.
8. What are series and parallel connections in a circuit?
9. Define ohm’s law.
10. Write the relation between resistance and specific resistance.
11. State four types of capacitors.
12. Define capacitance and resistance.
13. What is meant by charging a capacitor?
14. What is meant by discharging a capacitor?
15. Write the formula to determine time constant of an RC circuit.
16. Give the symbolic representation of a resistor and capacitor.
17. Write the units of current.
18. Differentiate charging and discharging modes.
19. Write the equation for energy stored in a capacitor.
20. Define electro motive force.
21. Write the formula for charging of an RC circuit in terms of Voltage.
22. Write the formula for discharging of an RC circuit in terms of Voltage.
23. Write the units of current.
24. What does a series circuit specifies?
25. Write the equation for energy stored in a capacitor.
26. Write the difference between capacitor and Resistor.
27. List out types of semiconductors.
28. Classify types of solids based on band gap.
29. What are the types of impurities present in n-type semiconductors?
30. Define energy gap in solids.

9. STEWART AND GEES METHOD

AIM:

To determine the field of induction at several points on the axis of a circular coil carrying current using Stewart and Gee's type of tangent galvanometer.

APPRATUS:

Stewart and Gee's galvanometer, Battery eliminator, Ammeter, Commutator, Rheostat, Plug keys and connecting wires.

PRINCIPLE:

When a current of i-amperes flows through a circular coil of n-turns, each of radius a, the magnetic induction B at any point (P) on the axis of the coil is given by

$$\mathbf{B} = \frac{\mu_0 n i a^2}{2(x^2+a^2)^{\frac{3}{2}}} \text{Tesla} \_\_\_\_\_\_\_ \qquad (1)$$

Where B is the magnetic induction on the axial line of the coil

$\mu_0 = 4\pi \times 10^{-7}$ Henry/meter

n is number of turns in the coil =

i is the current through the coil =

a is the radius of the coil (in m) =

x is the distance from the centre of the coil (in m) =

When the coil is placed in the magnetic meridian, the direction of the magnetic field will be perpendicular to the magnetic meridian; i.e., perpendicular to the direction f the horizontal component of the earth's field, say B_e .When the deflection magnetometer is placed at any point on the axis of the coil such that the centre of the magnetic needle lies exactly on the axis of the coil, then the needle is acted upon by two fields B and B_e, which are at right angles to one another. Therefore, the needle deflects obeying the tangent law,

$$B = B_e \tan\theta \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (2)$$

Where B_e is the horizontal component of the earth's field is taken from standard tables. The intensity of the field at any point calculated from equation (2) and verified using equation(1).

PROCEDURE:

With the help of the deflection magnetometer and a chalk, a long line of about one meter is drawn on the working table, to represent the magnetic meridian. Another line perpendicular to this line is also drawn. The Stewart and Gee's galvanometer is set with its coil in the magnetic meridian, as shown in the figure. The external circuit is connected , keeping the ammeter, rheostat away from the deflection magnetometer. This precaution is very much required because, the magnetic field produced by the current passing through the rheostat and the permanent magnetic field due to the magnet inside the ammeter affect the magnetometer reading, if they are close to it.

The magnetometer is set at the centre of the coil and rotated to make the aluminum pointer read (0,0) in the magnetometer. The key, K, is closed and the rheostat is adjusted so as the deflection in the magnetometer is about 60^0. The current in the commutator is reversed and the deflection in the magnetometer is observed. The deflection in the magnetometer before and after reversal of current should not differ much. In case of sufficient difference say above 2^0 or 3^0, necessary adjustments are to be made.

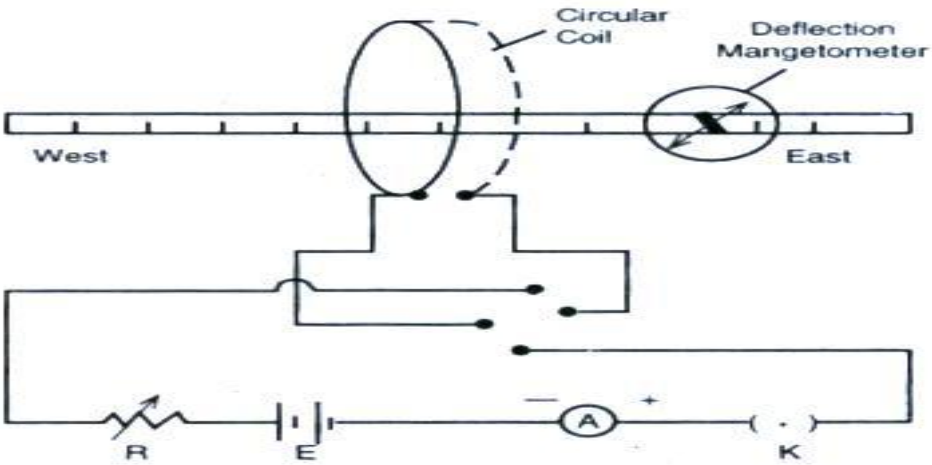


Figure 2 : *Arrangement for the measurement of magnetic field along the axis of a current carrying coil*

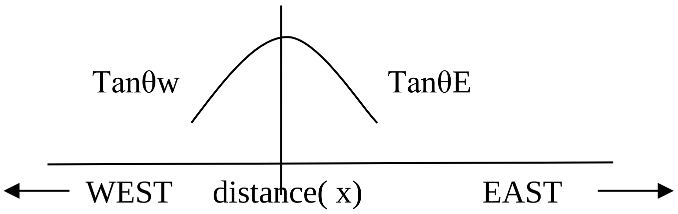
The deflections before and after reversal of current are noted when d = 0. The readings are noted in Table 1. The magnetometer is moved towards East along the axis of the coil in steps of 5 cm at a time. At each position, the key is closed and the deflections before and after reversal of current is noted. The mean deflection be denoted as $\boldsymbol{\theta}_E$. The magnetometer is further moved towards eastin steps of 5cm each time and the deflections before and after reversal of current are noted, until the deflection falls to 30^0.

The experiment is repeated by shifting the magnetometer towards west from the centre of the coil in steps of 5cm, each time and deflections are noted before and after reversal of current. The mean deflection is denoted as $\boldsymbol{\theta}_{\mathbf{W}}$.

It will be found that for each distance (X) the values in the last two columns are found to be equal verifying equation (1) and (2).

A graph is drawn between X on x-axis and the corresponding Tan$\boldsymbol{\theta}_{\mathbf{E}}$ and Tan$\boldsymbol{\theta}_{\mathbf{W}}$ along y-axis. The shape of the curve is shown in the figure. The points A and B marked on the curve lie at distance equal to half the radius of the coil (a/2) on either side of the coil.

MODEL GRAPH:



PRECAUTIONS:

1. The ammeter, voltmeter should keep away from the deflection magnetometer because these meters will affect the deflection in magnetometer.

2.The current passing through rheostat will produce magnetic field and magnetic field produced by the permanent magnet inside the ammeter will affect the deflection reading.

OBSERVATIONS:

Current through the coil i= __ amps. Number of the turns in the coil n = __________

Radius of the coil (in m) a = _______ m, $\mu_o = 4\pi x10^{-7}$ Henry/meter

$B_e = 0.39x10^{-4}$ Tesla

Table 1 :

	Distance of	Deflection in the magnetometer East side	Deflection in the magnetometer West side		Tanθ	B =	$B = \frac{\mu_0 n i a^2}{2(x^2+a^2)^{\frac{3}{2}}}$

S.No	deflection magnetometer from centre of the coil (x) in meters	θ_1	θ_2	θ_3	θ_4	Meanθe	Tanθe	θ_1	θ_2	θ_3	θ_4	Meanθw	Tanθw	$\boldsymbol{\theta = \frac{\theta_e + \theta_w}{2}}$				

TABLE 2 :

Sl. No.	Distance from the centre of the coil (x) (meters)	$B = B_E Tan\theta$ (Tesla)	$B = \frac{\mu_0 nia^2}{2(x^2 + a^2)^{3/2}}$ (Tesla)	Remarks
1. 2. 3. 4.				

RESULT: Magnetic field induction at several points have been determined with the help the circular current carrying coil and it is observed that the experimental and theoretical values are approximately same.

VIVA QUESTIONS:

1. Define electric field.
2. What is permeability?
3. Define magnetic meridian & magnetic field.
4. What is the use of an ammeter?
5. Define the magnetic field of induction and give its units.
6. State Biot-savarts law.
7. What is deflection magnetometer?
8. What is tangent law?
9. What is the difference between magnetic induction & earth's magnetic field?
10. What is a commutator?
11. What do you observe in this experiment?
12. What is tangent galvanometer?
13. What is the use of tangent galvanometer?
14. What is the value of permeability of free space?
15. Write the equation for Biot-savarts law.
16. Define flux density.
17. What are the units of permeability?
18. Define relative permeability.
19. Purpose of rheostat in the experiment.
20. State ampere law.
21. How to define a magnet.
22. Define dipole moment.
23. Units of Dipole moment.
24. Magnetic moment in magnetic material is due to.
25. Differentiate Soft and Hard magnetic materials.
26. What are ferrites?
27. Compare and contrast between Anti ferro magnetic and Ferri magnetic materials.
28. How many types of magnetic materials are there.
29. Write the relation between permeability and field induction.
30. Explain Magnetic levitation.

10. OPTICAL FIBER

AIM :

To determine the Numerical aperture (NA) and acceptance angle (θ_a) of a given optical fibre.

APPARATUS :

LED source, NA jig and optical fiber.

THEORY :

Numerical aperture of an optical fiber is a measure of how much light can be collected by the optical fiber. It is the product of refractive index of the incident medium and the Sine of the Θ_a.

$$NA = n_i . \sin\theta_a, \; n_i \text{ for air is } 1$$

$$NA = \sin\theta_a$$

$\theta_a = \sin^{-1}(NA)$

For a step index fiber, as in the present case, the numerical aperture is given by

$$NA = \sqrt{\frac{n_1^2 - n_2^2}{n_0}}$$

Where, n_1 = refractive index of core

n_2 = refractive index of cladding

n_0 = refractive index of the medium where optical fiber is installed

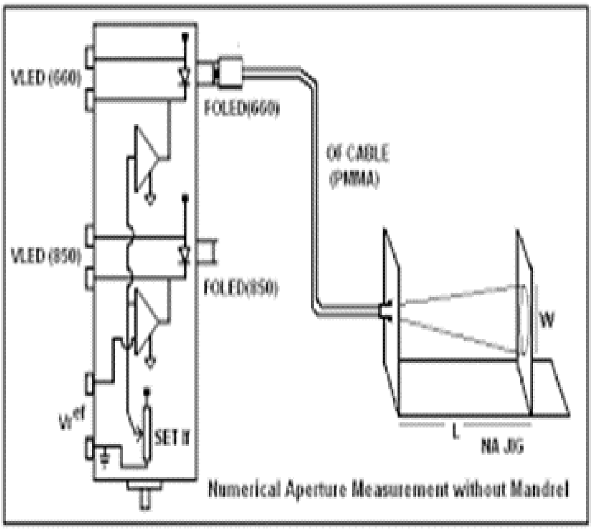
EXPERIMENTAL FORMULA : $NA = \frac{W}{\sqrt{4L^2 + W^2}}$

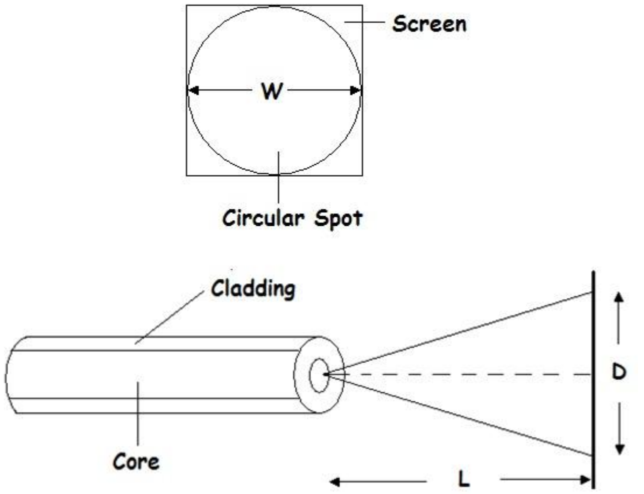
$$\theta_a = Sin^{-1}(NA)$$

Where, L= perpendicular distance between the fiber end and the screen.

W = diameter of the light falling on the screen.

NA MEASUREMENT SCHEME OF DIAGRAM :





PROCEDURE :

The schematic diagram of the numerical aperture measurement system is shown above and itself explanatory.

The step by step procedure is given below as follows:-

Step1:-Connect one end of the cable 1 (1-meter FI cable) to FO LED of TNS20A and the other end to the NA jig as shown.

Step2:- Plug the AC mains. Light should appear at the end of the fiber on the NA Jig. Turn the knob clockwise to set to maximum P_0.The light intensity should increase.

Step3:- Hold the white screen with the concentric circles (10, 15, 20 and 25 mm diameter) vertically at a suitable distance to make the red spot from the emitting fibre coincide with the 10 mm circle.

ANOTHER METHOD :

In this method the experiment set up for the NA Measurement is shown in the above figure.

First of all, one end of the optical fiber is connected to the power output LED. The other end of the fiber is connected to NA Jig through the connector.

The A.C main supply is switched on. The light emitted by LED passes through the optical fiber cable to the other end. The set knob is adjusted such that maximum intensity is observed on the screen and it should not be further disturbed.

A screen with concentric circles of known diameter is moved along the length of the NA jig to observe the circular spreading of light intensity on the screen.

The screen is adjusted such that the first circle from the centre of the screen is completely filled with the light. At this position, the distance (L) from the fiber end to the screen is noted on the NA jig.

The experiment is repeated of the subsequent circles by adjusting the length L along NA jig and the readings are noted in table. The diameter of the circles may be determined using a travelling microscope.

TABLE :

S.NO	Distance of the screen (L) mm	Diameter of the circle (W) mm	NA	Θ_a degrees

RESULT: Numerical aperture of the fiber cable NA ____________

Acceptance angle of the fiber cable is $\boldsymbol{\Theta_a}$ _____________

VIVA QUESTIONS:

1. Define Numerical aperture .
2. What are the parts of optical fiber?
3. On what principle does an optical fiber works.
4. What is meant by attenuation in optical fibers?
5. Mention the different types of optical fibers are.
6. Define step index optical fiber .
7. Define graded index optical fiber.
8. What are the types of losses in optical fiber?
9. What is total internal reflection?
10. What is critical angle?
11. Write the formula for Numerical aperature.
12. Define acceptance angle of an optical fiber.
13. Define snells law.
14. Write the formula for Numerical aperature in terms of fractional refractive index change.
15. Write the applications of optical fibers.
16. Write applications of optical fibers in medicine .
17. What is meant by scattering loss?
18. Write the unit for losses in fibers.
19. What is meant by intermodal dispersion?
20. What are the different components of fiber optic communication system?
21. Write the unit for losses in fibers.
22. What is meant by intermodal dispersion?
23. What are the different components of fiber optic communication system?
24. Explain single mode optical fiber.
25. What is the core diameter in multi mode optical fiber?
26. Determine critical angle from Snell's law.
27. List out reasons for attenuation in fibers.
28. Explain scattering losses in optical fibers.
29. Describe absorption losses in optical fibers.
30. What are the two important sections in optical fiber communication system?

11. PHOTO ELECTRIC EFFECT

-

AIM:

To determine the Work function (φ) of a given material and Planck's constant by using Photo cell.

APPARATUS:

0-10 V power supply, digital milliammeter, digital voltmeter, Filters with different colors(Wavelenghts), Light Source.

THEORY:

The phenomenon of emission of electrons from the surface of a material when light falls on it,is known as the photoelectric effect. The emitted electrons are called photoelectrons.

A typical experimental setup for observing the photoelectric effect is shown in Fig.1.Light falls on target metal plate T as a result electrons are ejected from the surface of the plate. When the ejected electrons reach the collector electrode C placed oppositeto T, an electric current, called photocurrent flows through the circuit. This photocurrent canbe measured by an ammeter connected to the circuit.

Stopping Potential: The minimum amount of volatage required to stop the photocurrent is known as stopping potential.

Work Function: The minimum amount of energy required to eject the electrons from metal surface is known as work function.

The energy of a photon is given by $E = hf$

where

h---is called Planck's constant

f--- is the frequency of radiation.

When the photons falls on metal surface, an electron can absorb the energy of a photon and acquire enough energy to escape the surface potential barrier.

φ(also called work function).

The maximum kinetic energy with which the electron can eject out,

According to the principle of energy conservation is given by

$$K_{Max} = hf - \varphi$$

the relationship can also be written as

$$eV_0 = hf - \varphi$$

The above equation shows that a graph of V_0 versus f will be a straight line with the slopebeing equal to *h/e*.

The work function can be written as

$$\varphi = hf - eV_0$$

EXPERIMENTAL SETUP:

The Planck's constant measurement unit is shown in Fig.1. It consists of a light source, a photo vacuum tube, DC voltmeter, DC ammeter and connecting ports. Also supplied along with the units are four filters of different colors.

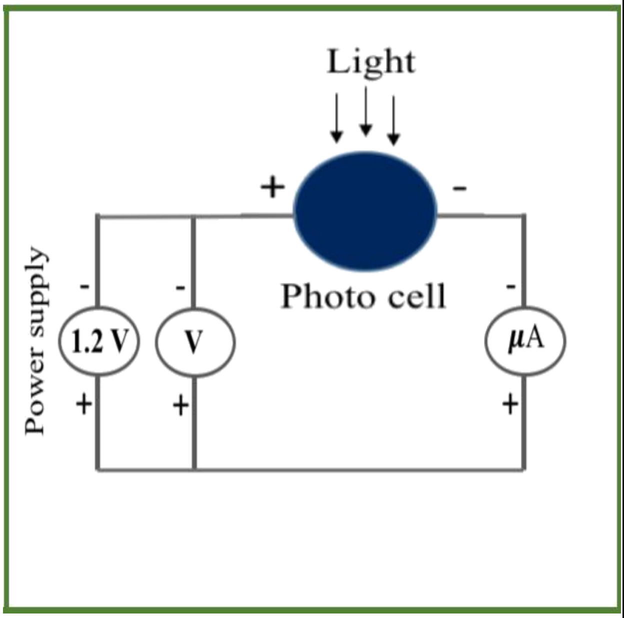


Fig 1: Experimental set up-photo electric effect

PROCEDURE:

1. Take the Planck's constant setup & fix the photo vacuum tube at particular position.

2. Connect the ammeter positive to Voltemeter Positive. Photo cell positive to Voltemeter negative, Photocell negative to ammeter negative.

3. Connect the mains cord and switch on the power supply and light source. Now you canobserve some value of current on ammeter.

4. First insert the 'red' color filter in front of photo vacuum tube.

5. If the observed current is too low, then slide the photo vacuum tube towards light source till you get some appreciable current. Fix the photo tube at this distance (position 1).

6. Now Increase the Voltage until the current becomes zero.

7. When the current becomes zero, note the value of applied voltage by DC voltmeter. This is the stopping potential, V_0 for the given color.

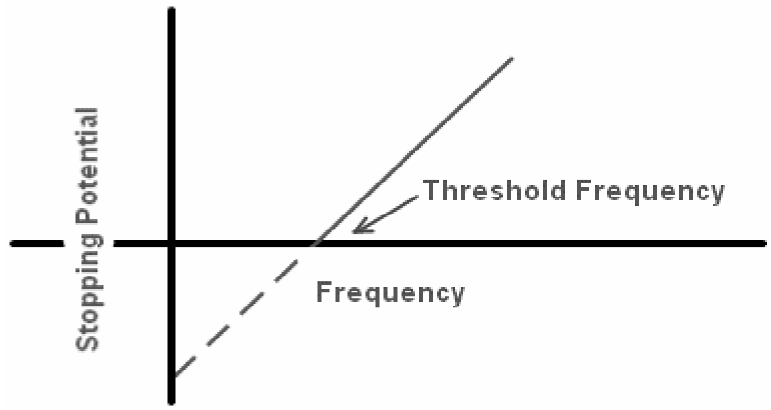
8. Repeat steps 7-10 for the other color filters, e.g. orange, yellow, green and blue respectively, keeping the position of the photo vacuum tube fixed.

12. Tabulate all the readings as indicated in Table 1.

13. Plot a graph of V_0 versus f (Hz).

OBSERVATIONS:

Velocity of light , $c= 3\times10^8 ms^{-1}$.



GRAPH: Variation in stopping potential with frequency.

TABLE: Determination of V_0 as a function of frequency f

S.no	Colours	Frequency (10^{14} Hz)	Wavelength (nm)	Stopping voltage (V)	Work function $\varphi = hf - eV_0$ joules

GRAPH:

Plot a graph of v_0 versus frequency from data in table 1.

The intercept of the graph gives the threshold frequency f_o

Planck's Constant h= f_o / φ JS(Joules Sec)

CALCULATION:

Value of $e = 1.6\times10^{-19}$C.

Slope of the V_0 -*f* graph

Frequency f = C/λ

PRECAUTIONS:

1. Fix the incident light source and filter postions exactly with suitable distance
2. Stopping potential shoudbe note down exactly at zero ammeter reading.
3. The negative potential must be applied very slowly until zero current value is reached.

RESULT:

Value of Work function from the experiment φ= joules

Plancks constant from the experiment h = jsec

VIVA QUESTIONS:

1. What is Photo electric effect?
2. Define threshold frequency.
3. What is work function and its significance?
4. What are the units for plank's constant?
5. What is the visible wavelength range?
6. What type of material we can use in the photo cell?
7. What are the applications of Photo electric effect?
8. Define wavelength.
9. Define semiconductor.
10. What are the types of semiconductors?
11. Explain the type of impurities present in p-type semiconductor.
12. What are extrinsic semiconductors?
13. Classify solids based on band theory.
14. Explain the formation of conduction band and valence band.
15. Define Energy gap in solids.
16. What are the majority charge carriers in n-type semiconductor?
17. What is the function of photo cell?
18. Define photon.
19. What is the value of Planck's constant?
20. According to Planck's theory energy of one photon.
21. Which instrument we are using to measure current.
22. What is the functionality of rheostat in circuit?
23. Define resistivity.
24. Differentiate conductors and semiconductors.
25. Explain biasing.

26. What are the types of biasing?

27. Mention any two applications for forward biased devices.

28. What is recombination?

29. What are the types of recombination?

30. What is the principle of Photoelectric effect?

12. DETERMINATION OF ENERGY GAP OF A SEMICONDUCTOR

AIM:

To determine the energy band gap of a given semiconductor using a diode in reverse bias.

APPARATUS:

P-N diode, power supply, microammeter, thermometer and heating arrangement for the diode.

FORMULA:

Energy band gap of semiconductor (E_g) = slope x 2 x 1.38 x 10^{-23} Joule

OR

(E_g) = slope x 1.983 x 10^{-4} eV

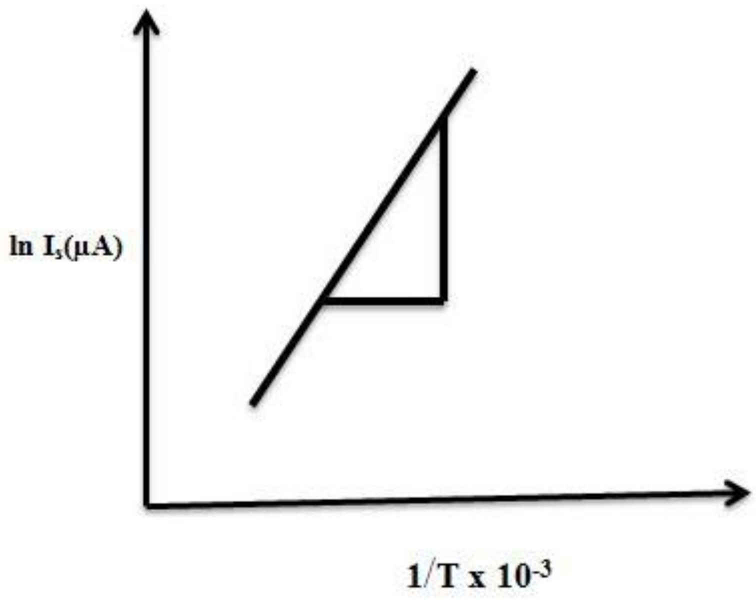
$$\left[\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\ln I_s}{1/T}\right]$$

where

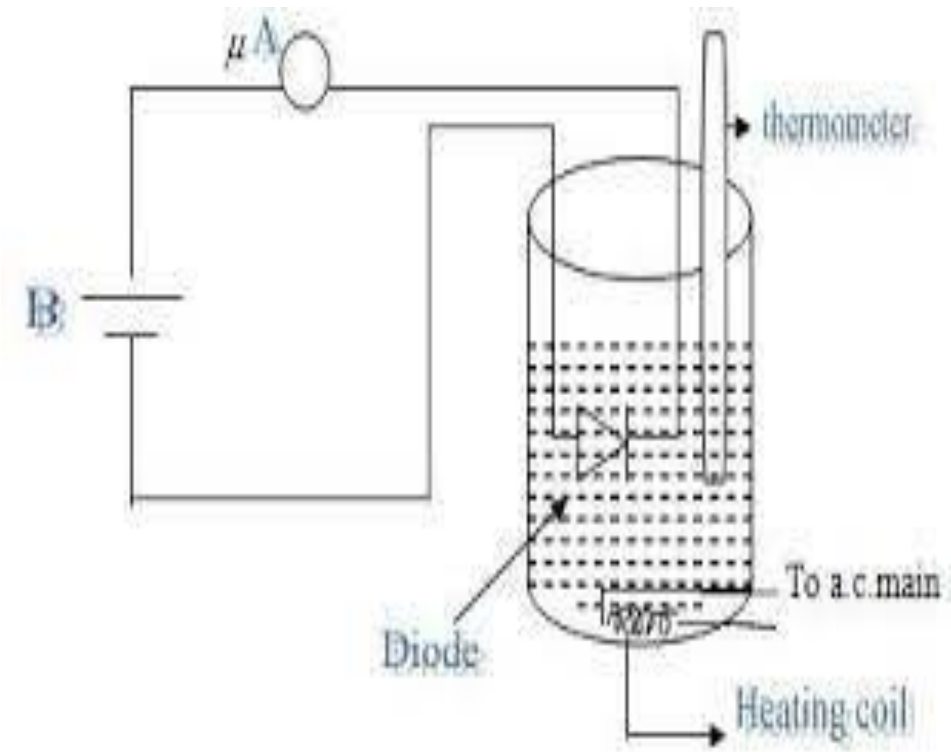
I_s is reverse saturation current

T is absolute temperature

MODEL GRAPH:



CIRCUIT DIAGRAM:



PROCEDURE:

The diode is connected in reverse bias as shown in the circuit diagram.The diode is placed in an oil bath. The temperature of the oil is noted. A constant potentialdifference (say 10 V) is applied and the current $I_s$is noted. The temperature is raised to 80^{o}C and the corresponding current is noted. The experiment is repeated by decreasing temperature in steps of 5^{o}C (upto 40^{o}C). A graph is plotted between ($\ln I_s$) and 1/T and astraight line graph is obtained with negative slope. We can also plot a graph by taking the numerical values of $\ln I_s$ on Y-axis and on 1/T the x-axis. Then we get a straight line graph with positive slope. The slope of the graph is found out. The band gap energy is calculated using formula.

OBSERVATION TABLE:

S.no	Temperature		1/T (x 10^{-3})(1/K)	Reverse bias current (I_s) µA	ln I_s µA
	t^0(C)	T(K)			

CALCULATIONS:

Taking 1/ T along X-axis and lnIs along Y-axis, plot a graph between ln Is and 1/T for three different voltages. The graph will be a straight line as shown in above fig. Determine the slope of straight line from this graph and then calculate band gap using formula,

Band gap (Eg) = slope x 1.983 x 10^{-4} --------eV

PRECAUTIONS:

The following precautions should be taken while performing the experiment:

1. The diode must be reverse biased.
2. Do not exceed the temperature of the oven above 100℃ to avoid over heating of the diode.
3. The voltmeter and ammeter reading should initially be at zero mark.
4. Bulb of the thermometer should be inserted well in the oven.
5. Readings of microammeter should be taken when the temperature is decreasing.
6. Readings of current and temperature must be taken simultaneously.

RESULT:

The energy band gap of a given semiconductor E_g = ----------- e V.

VIVA QUESTIONS:

1. Define an intrinsic semiconductor.
2. Distinguish between an N-type semiconductor and a P-type semiconductor
3. Explain the formation of P-N junction in a diode.
4. What is the depletion layer in P-N junction?
5. Explain conduction band and valence band in an intrinsic semiconductor.
6. Define energy gap in an intrinsic semiconductor.
7. On what factors energy gap depends.
8. What is forward bias and reverse bias?
9. Explain the formation of covalent bonds in an intrinsic semiconductor.
10. Write the applications of P-N junction diode.
11. Charge is defined as.
12. Write the SI and CGS units of charge.
13. Define time constant.
14. Convert the value of pico-farads into micro farads.
15. What are the units of resistance?
16. What are the units of capacitance?
17. Define an electric circuit.
18. What are series and parallel connections in a circuit?
19. Define ohms law.
20. Write the relation between resistance and specific resistance.
21. State four types of capacitors.
22. Define capacitance and resistance.
23. What is meant by charging a capacitor?
24. What is meant by discharging a capacitor?
25. Write the formula to determine time constant of an RC circuit.
26. Give the symbolic representation of a resistor and capacitor.
27. Write the units of current.
28. Differentiate between charging and discharging modes.
29. Write the equation for energy stored in a capacitor.
30. Define electro motive force.

APPLIED PHYSICS LAB INNOVATIVE EXPERIMENTS

S.NO. LIST OF EXPERIMENTS:

EXPERIMENT – 1

DETERMINATION OF THE WAVELENGTH OF LASER SOURCE USING A DIFFRACTION GRATING

AIM:
To determine the wavelength of the laser source using a plane diffraction grating

APPARATUS:
A laser source, a plane diffraction grating, meter scale.

FORMULA: $\lambda = \frac{Sin\theta}{N.n}$

Where λ = Wavelength of laser source of light
θ = Angle of diffraction
N = No. Of lines per cm on the grating = xxx lines/2.54 cm = xxxx lines/cm
n = Order of the spectrum

$$\text{Sin}\theta = \frac{Y_n}{\sqrt{(D^2+{Y_n}^2)}}$$

Where, y_n = linear separation of diffraction maxima from the central maxima
D = distance between the grating and the screen

THEORY:

The light emitted by conventional light source such as Na lamp, Hg vapor lamp is incoherent i.e., it spreads out more (or) less uniformly in all directions. But a laser beam is highly intense and directional than that of any ordinary source of light. However, the laser beam diverges slightly due to the diffraction effects. The optical frequencies of the diffraction effect the optical frequencies of lasers are exactly large (1.5 to 100 Hz)

PROCEDURE:

The laser source, whose wavelength is to be determined is mounted horizontally on an optical bench such that light emitted from the laser source is incident normally on the grating. The position of the bench s adjusted, so that a red spot observed on the screen. The central bright red spot corresponds to the central maxima and the other spots correspond to the 1^{st}, 2^{nd} ,3^{rd} …. on either side of central maxima. The grating s placed at a distance (D) from the screen, and then the laser separation 'Y_n' between the central maxima and 1^{st} order maxima on either – sides measured with a scale. The experiment is changing the distance between the grating and screen. For different values and in each case the linear separation is noted.

The Sine of the angle of the diffraction θ is calculated by using formula $\text{Sin}\theta = \frac{Y_n}{\sqrt{(D^2+{Y_n}^2)}}$

Finally the wavelength of given laser source is calculated by using the formula

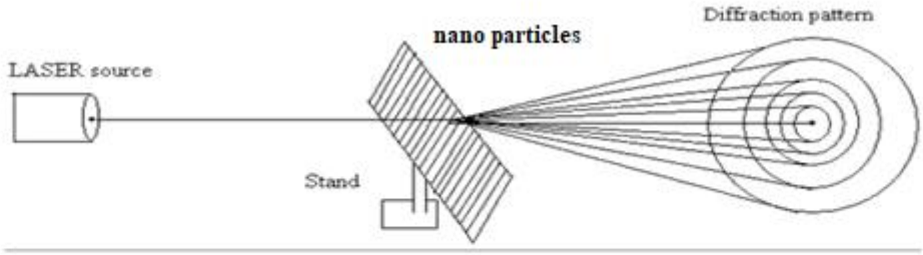
$$\lambda = \frac{Sin\theta}{N.n}$$

Where, N = No. of lines per cm on the grating

n = Order of the spectrum

PRECAUTIONS:

1. Laser light source should be switched off after taking observations
2. The grating should be placed on the optical bench, so the incident light emitted b the laser should be incident normally on it.
3. The grating and the screen should be at same light.
4. The separation between the central maxima and first, second, third order maxima should be measured accurately.



S.no	Distance between screen and glass plate (D), cm	Order of diffraction (n)	Distance between the central bright point and n^{th} fringe (X_n), Cm	Particle size $d = \frac{n\lambda}{x_n}$,cm
1		1		
		2		
2		1		
		2		

Mean d =

RESULT: Wavelength of given laser source = _____________A^0

VIVA QUESTIONS:

1.Expand LASER?

2.Define diffraction?

3.Define diffraction grating?

4.What are the properties of Laser

5.Compare constructive interference and destructive interference.

6.Why do the rings gets closer as the order of the rings is increased?

7.What is the purpose of glass plate incline at 45^0(beam splitter) in this experiment.

8.Why the centre of rings are dark?

9.Define monochromatic radiation.

10.Why are the rings are circular?

11.Define interference.

12.What will happen if few drops of transparent liquid is introduced between the

13.Plano convex lens and glass plate?

14.Why is a sodium lamp, rather than an incandescent or fluorescent lamp, used in the experiments?

15.On which principle Newton's Rings are formed.

16.What are the types of Interference?

17.What are the precautions to be taken while doing the experiment?

18.Define coherence.

19.Write the condition for Maximum intensity in thin films.

20.Write the condition for Minimum intensity in thin films.

21.Diameter of dark ring is proportional to.

22.Bright ring diameter is proportional to.

23.Write the equation for thickness of the film in Newton's Rings experiment.

24.Define dispersive power of material.

25.What is diffraction grating?

26.Define wavelength?

27.What are the units of wavelength?

28.What do you mean by LPI?

29.Write the maximum intensity condition in single slit diffraction.

30.Write the minimum intensity condition in single slit diffraction.

EXPERIMENT – 2

PARTICLE SIZE DETERMINATION USING LASER

AIM: To determine the size of the given micro particles (lycopodium powder) using laser.

APPARATUS: Diode laser, fine micro particles having nearly same size, glass plate, screen, metre scale

FORMULA: Particle size (diameter) d is given by

$$d = \frac{n\lambda}{x_n}, \text{ m}$$

Symbol	Explanation	Units
n	Order of diffraction	-
λ	Wavelength of laser light used 6700 x 10^{-10}m	metre
D	Distance between glass plate and the screen.	metre
x_n	Distance between central bright spot and the n^{th} ring	metre

PROCEDURE: A glass plate is taken and a fine powder of particle size in the range of micrometer is sprinkled on the glass plate. This glass plate is kept between laser light and screen. Now laser beam gets diffracted by the particles present in the glass plate. By adjusting the distance between the glass plate and the screen, (D) a circular fringe pattern is seen on the screen and the distance between the central bright point and n^{th} fringe x_n for various orders of diffraction is measured using the formula, the particle size is determined. The experiment is repeated for different D values.

RESULT: The size of the particle d =………….. m

VIVA QUESTIONS:

1.Give the phenomenon involved?

2.What are nanoparticles?

3.What are the applications of nanoparticles?

4. Define dispersive power.

5.Give any two examples for dispersion.

6.Define refractive index .

7.Does refractive index have units.

8.What does the word 'Direct reading' refers to?

9. Prism is made by using which material.

10.Write the formula to calculate least count of spectrometer.

11.Calculate the least count of the given Spectrometer.

12.For what purpose reading lenses are used .

13.Type of light source is used for this experiment.

14.Define Snell's law.

15.How many colours are present in a spectrum?

16.Define Wavelength .

17.Units for Wavelength.

18.Mention the applications of dispersion.

19.Armstrong is the unit for.

20.Define monochromatic radiation.

21. Why are the rings are circular?

22. Define interference.

23. What will happen if few drops of transparent liquid is introduced between the

24.Plano convex lens and glass plate?

25.Why is a sodium lamp, rather than an incandescent or fluorescent lamp, used in the Experiments?

26.On which principle Newton’s Rings are formed.

27.What are the types of Interference?

28.What are the precautions to be taken while doing the experiment?

29.Define coherence.

30.Write the condition for Maximum intensity in thin films.