Parul University

FACULTY OF ENGINEERING AND TECHNOLOGY

BACHELOR OF TECHNOLOGY

LABORATORY MANUAL

ENGINEERING PHYSICS
(203192104)

B.Tech. 1^{st} year

Department of Applied Sciences and Humanities

Instructions to students

1. The main objective of the Engineering Physics laboratory is: ***Learning Engineering Physics through the Experimentation***. ***All the experiments are designed to illustrate various phenomena in different areas of*** **Engineering Physics** ***and also to expose the students to various instruments and their uses***.
2. Be prompt in arriving to the laboratory and always come well prepared for the experiment.
3. Be careful while working on the equipment's operated with high voltage power supply.
4. Work quietly and carefully. Give equal opportunity to all your fellow students to work on the instruments.
5. Every student should have his/her individual copy of the Engineering Physics *Practical Book*.
6. Every student has to prepare the notebooks specifically reserved for the Engineering Physics practical work:" *Engineering Physics Practical Book"*
7. Every student has to necessarily bring his/her *Engineering Physics Practical Book*, *Engineering Physics Practical Class Notebook* and *Engineering Physics Practical Final Notebook*, when he/she comes to the Practical to perform the experiment.
8. Record your observations honestly. Never makeup reading or doctor them either to get a better fit on the graph or to produce the correct result. Display all your observations on the graph (if applicable)
9. All the observations have to be neatly recorded in the *Engineering Physics Practical Class Notebook* (as explained in the *Engineering Physics Practical Book*) and verified by the instructor before leaving the laboratory.
10. If some of the readings appear to be wrong then repeat the set of observations carefully.
11. Do not share your readings with your fellow student. Every student has to produce his/her own set of readings by performing the experiment separately.
12. After verification of the recorded observations, do the calculation in the *Engineering Physics Practical Class Notebook* (as explained in the *Engineering Physics Practical Book*) and produce the desired results and get them verified by the instructor.
13. Never forget to mention the units of the observed quantities in the observation table. After calculations, represent the results with appropriate units.
14. Calculate the percentage error in the results obtained by you if the standard results are available and also try to point out the sources of errors in the experiment.
15. Find the answers of all the questions mentioned under the section '*Find the Answers*' at the end of each experiment in the *Engineering Physics Practical Book.*
16. Finally record the verified observations along with the calculation and results in the *Engineering Physics Practical Notebook.*
17. Do not forget to get the information of your next allotment (the experiment which is to be performed by you in the next laboratory session) before leaving the laboratory from the Technical Assistant.
18. The grades for the Engineering Physics practical course work will be awarded based on your performance in the laboratory, regularity, recording of experiments in the *Engineering Physics Practical Final Notebook*, lab quiz, regular viva-voce and end-term examination.

CERTIFICATE

This is to certify that

Mr./Ms.………………………………………………………

with enrolment no. …………………………has successfully

completed his/her laboratory experiments

In Engineering Physics laboratory during the academic

year…………

Date:

Signature of HOD: *Signature of lab teacher:*

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EXPERIMENT NO. 1

LIGHT EMITTING DIODE

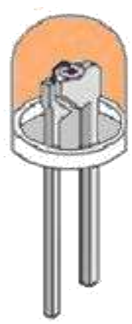
OBJECTIVE: To study the I-V characteristic of LED and determine Knee voltage and dynamic resistance of LED.

APPARATUS: Circuit board comprises 0-10 V D.C. at 10 mA, continuously variable regulated power supply, integral current limiting resistor, Digital voltmeter, digital current meter, LED, Patch chords.

THEORY: Light Emitting Diodes

Light Emitting Diodes or **LED´s** are among the most widely used of all the different types of semiconductor diodes available today. They are the most visible type of diode that emit a fairly narrow bandwidth of either visible light at different coloured wavelengths, invisible infra-red light for remote controls or laser type light when a forward current is passed through them. A "**Light Emitting Diode**" or **LED** as it is more commonly called, is basically just a specialized type of PN junction diode, made from a very thin layer of fairly heavily doped semiconductor material.

When the diode is forward biased, electrons from the semiconductors conduction band recombine with holes from the valence band releasing sufficient energy to produce photons which emit a monochromatic (single colour) of light. Because of this thin layer a reasonable number of these photons can leave the junction and radiate away producing a coloured light output. Then we can say that when operated in a forward biased direction **Light Emitting Diodes** are semiconductor devices that convert electrical energy into light energy.



LED Construction

The construction of a light emitting diode is very different from that of a normal signal diode. The PN junction of an LED is surrounded by a transparent, hard plastic epoxy resin hemispherical shaped shell or body which protects the LED from both vibration and shock.

By mixing together a variety of semiconductor, metal and gas compounds the following list of LEDs can be produced

• **Gallium Arsenide (GaAs)** - infra-red

• **Gallium Arsenide Phosphide (GaAs P)** - red to infra-red, orange

• **Aluminium Gallium Arsenide Phosphide (Al Ga As P)** – high-brightness red, orange-red, orange, and yellow

• **Gallium Phosphide (Ga P)** - red, yellow and green

• **Aluminium Gallium Phosphide (Al Ga P**) - green

• **Gallium Nitride (Ga N)** - green, emerald green

• **Gallium Indium Nitride (Ga In N)** – near ultraviolet, bluish-green and blue

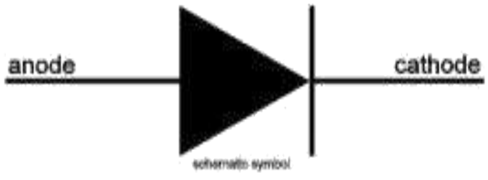
• **Silicon Carbide (Si C)** - blue as a substrate

• **Zinc Selenide (Zn Se)** - blue

• **Aluminium Gallium Nitride (Al Ga N)** – ultraviolet

SIMPLE DIODE:

A simple diode is a two terminal electrode device consisting of p – n junction, formed either from germanium (Ge) or silicon (Si) crystal. The circuit symbol of a p – n junction diode or semiconductor diode is shown in Fig.



LIGHT EMITTING DIODE:

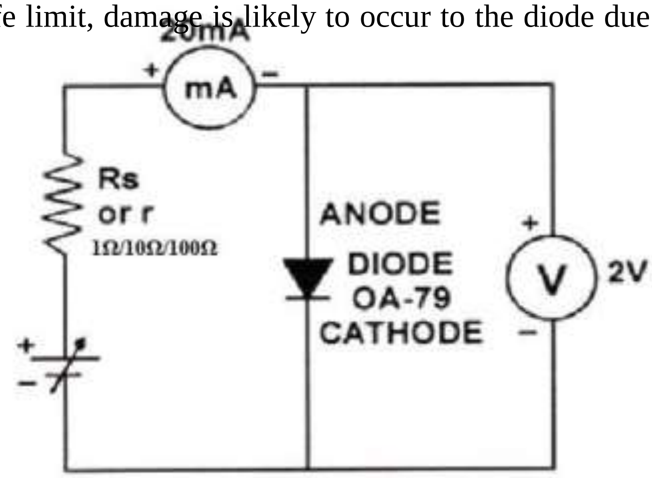
The operation of light emitting diode (LED) is based on the phenomenon of electroluminescence, which is the emission of light from a semiconductor material under the influence of an electric field. LEDs are the best known optoelectronic devices which emit a fairly narrow bandwidth of visible light; usually red, orange, yellow, blue or green. A light emitting diode is a simply a p – n junction diode. It is usually made from semiconductor materials such as aluminium gallium arsenide (Al Ga As) or gallium arsenide phosphide (Ga As P).

FORWARD BIASING:

When the positive end of the battery is connected to the anode of the diode and negative to cathode of the diode, the connection is called forward biasing.

When the p – n junction diode is forward biased and if the applied voltage is gradually increased in steps, at some forward voltage, 0.3 V for Ge and 0.7 V for Si, the potential barrier is altogether eliminated and current starts flowing. This voltage is known as threshold voltage (V_{th}) or knee voltage or cut in voltage. The mill ammeter readings are noted at various steps of applied voltage and a graph is plotted between voltage and current, as shown in Fig(ii). From the graph it is seen that practically no current flows until the barrier voltage (V_B) is overcome. When the external voltage exceeds the barrier potential or the threshold value, the current increases exponentially. This portion is known as linear operating region of the diode. If the forward voltage is increased beyond a safe limit, damage is likely to occur to the diode due to overheating.

CIRCUIT DIAGRAM:



PROCEDURE:

- Set – up the circuit as shown in figure.
- Set the current limiter suitably, e.g. 100 mA for rectifiers and 20 mA for LED, Zener diode and small signal diodes.
- Vary the voltage in small steps and measures the current in terms of the voltage drop across the resistance. The current in mA is obtained by dividing it by the value of resistance. Also, the actual voltage across the diode should be corrected for by taking into account the drop across the current measuring resistance, i.e., $V_D = V_M - V_R$ where V_D is the voltage across diode; V_M is the measured voltage; V_R is the voltage across current measuring resistance. Tabulate the readings.
- Sketch the V – I characteristics with voltage on X-axis and current on Y-axis and extend the linear portion of the curve downward to obtain the cut-in voltage V_c. The slope of the linear portion gives the dynamic resistance r_d of the diode.

OBSERATION TABLE:

(Value of series resistance R=_____________ ohm)

Sr. No.	Applied Voltage V_{in}(volt)	Diode Current I_d (mA)

CALCULATION:

PRECAUTIONS:

- Set the current limit switch properly. An incorrect setting may damage the device under test.
- To sketch the characteristics accurately near the sharp bends (around the cut-in and breakdown points) a larger number of readings may be necessary. Choose suitable resistances, as suggested, for current measurements in these portions

RESULT: The forward biased characteristics curve is plotted in the graph.

The knee voltage of given LED is found as________ volt.

The dynamic resistance of LED is found as ___________ ohm.

QUESTIONS: -

1] What do u mean by knee voltage?

Ans: -____
____
____

2] What is depletion region in PN junction?

Ans: -____
____
____

3] What is barrier potential?

Ans: -____
____
____

SIGNATURE OF FACULTY WITH DATE