

EE 236 Electronic Devices Lab
Lab - 01

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**Diode I/V characterization and Band Gap of
Semiconductors**

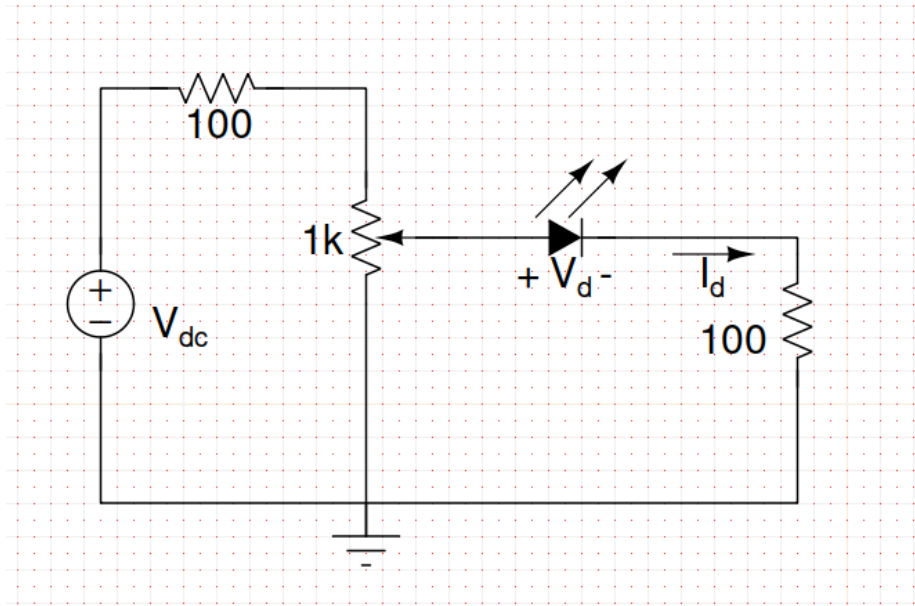


Figure 1: Circuit Diagram

1 Plot I_D v/s V_D for all five diodes

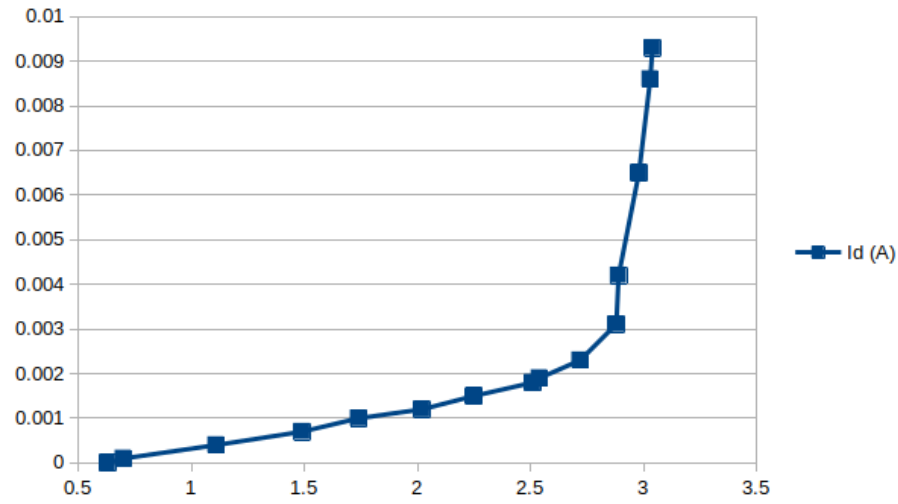


Figure 2: Blue diode characteristics

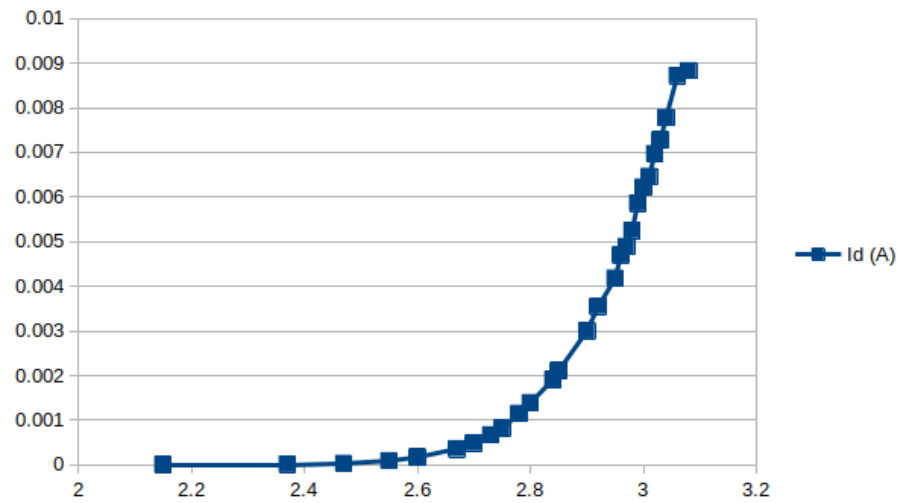


Figure 3: Green diode characteristics

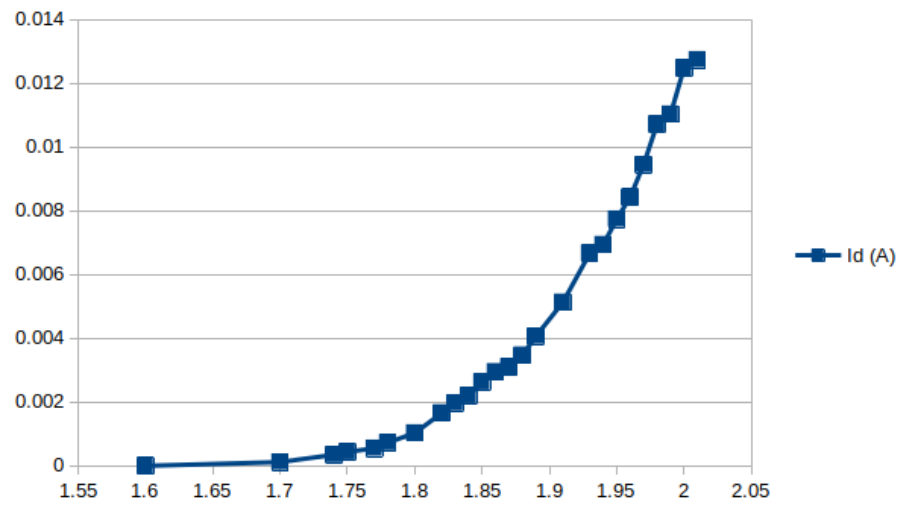


Figure 4: Red diode characteristics

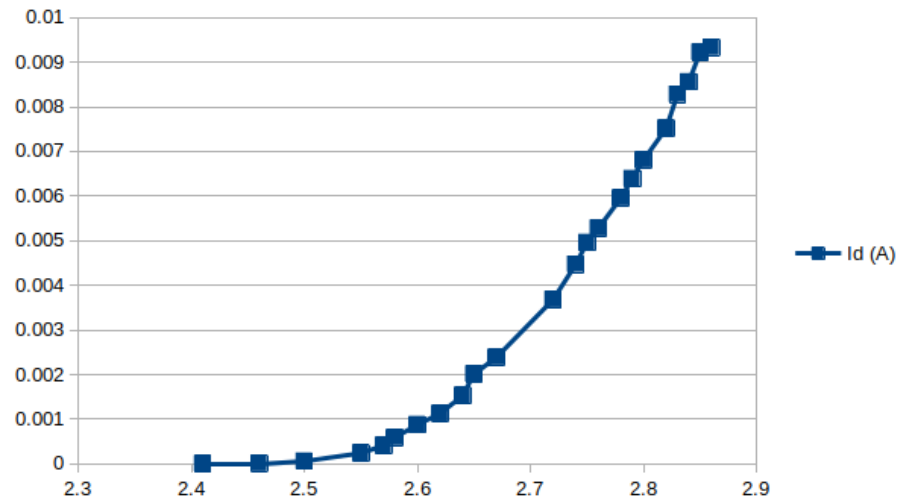


Figure 5: White diode characteristics

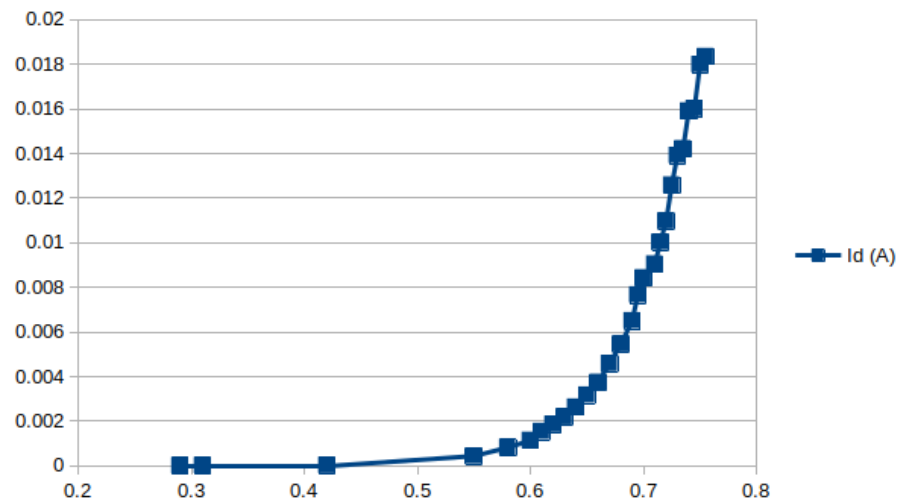
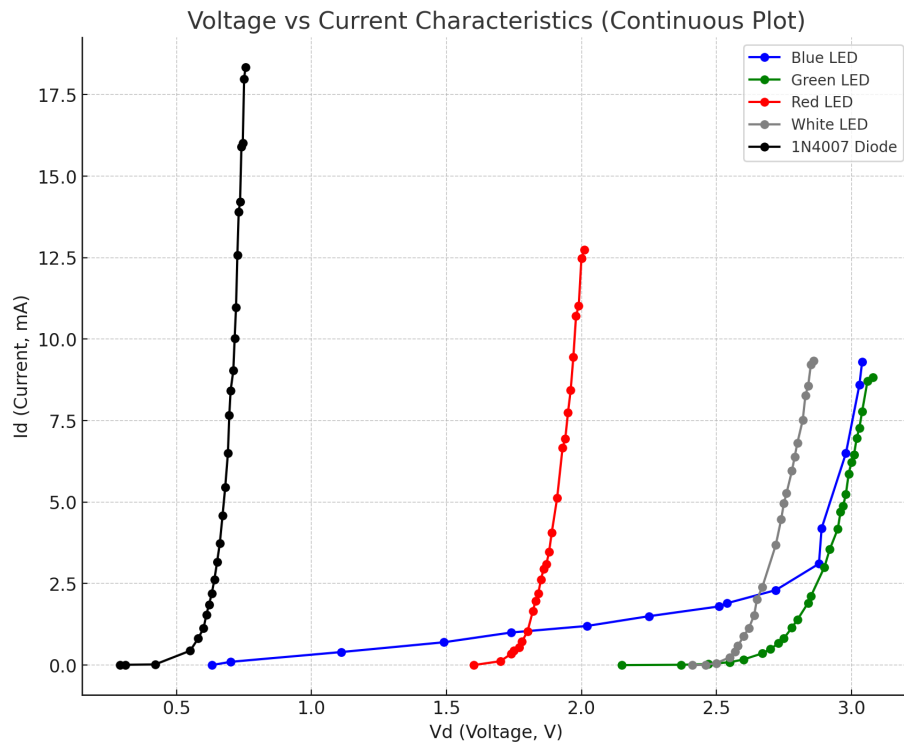


Figure 6: IN4007 diode characteristics



2 Plot $\log(I_D)$ v/s V_D for all the five diodes

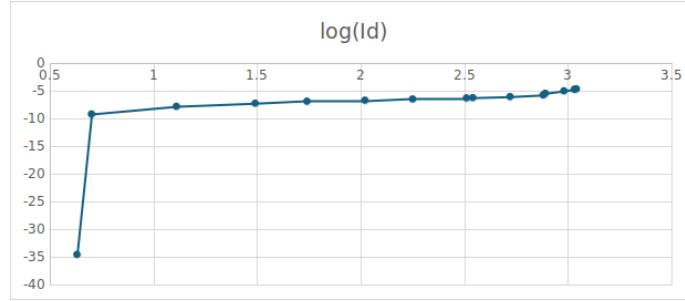


Figure 7: Blue diode $\log(I_D)$ v/s V_D characteristics

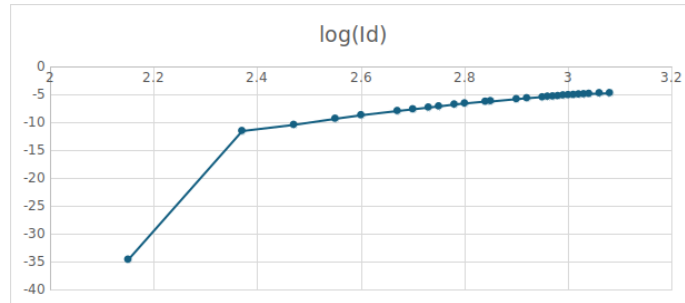


Figure 8: Green diode $\log(I_D)$ v/s V_D characteristics

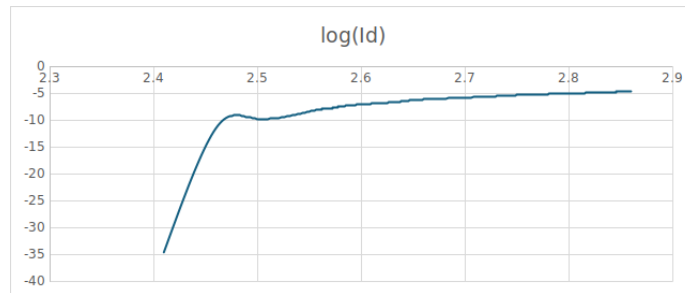


Figure 9: White diode $\log(I_D)$ v/s V_D characteristics

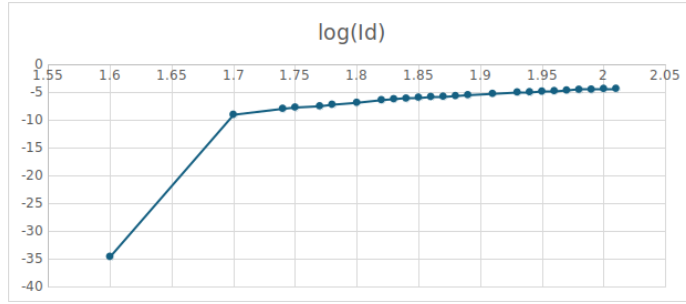


Figure 10: Red diode $\log(I_D)$
v/s V_D characteristics

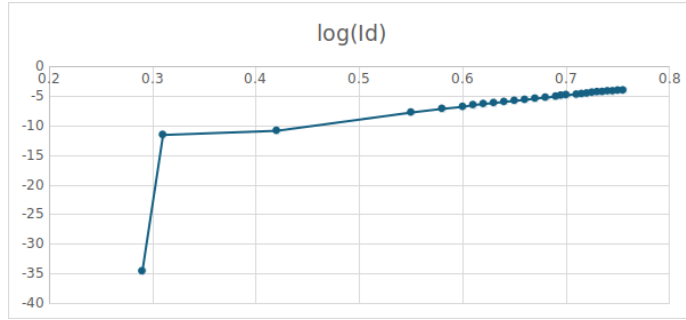
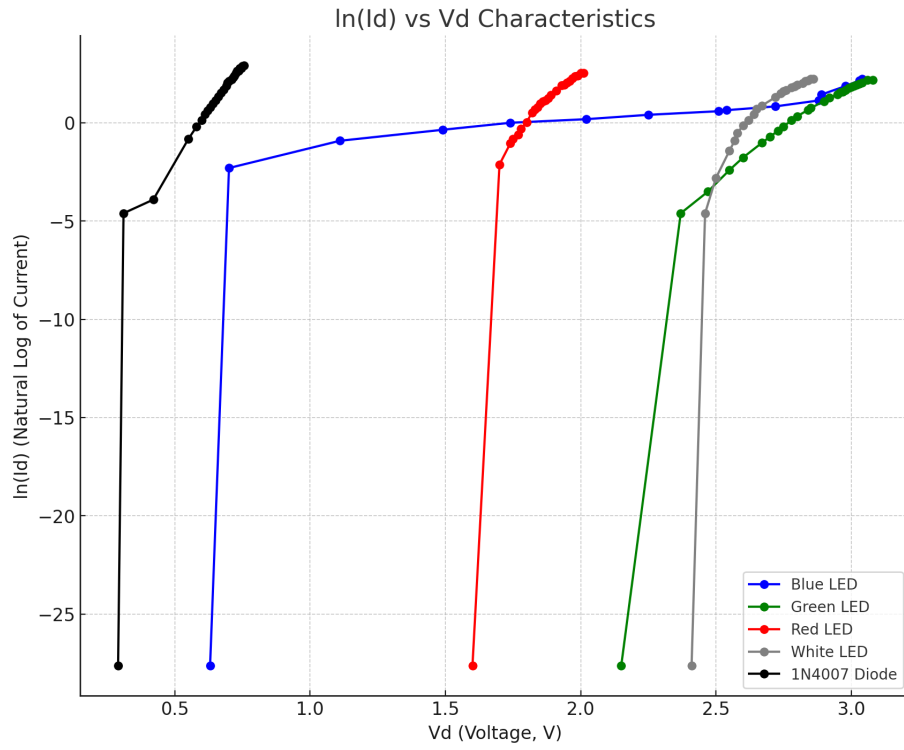


Figure 11: IN4007 diode $\log(I_D)$
v/s V_D characteristics

Diode Name	n (ideality)	Is (sat curr, A)	Intercept
Blue	8.4692	8.57 nA	-18.5742
Green	5.7439	11.165 pA	-25.2182
White	4.5878	0.421 pA	-28.4955
Red	3.7236	13.45 pA	-25.0317
IN4007	2.2164	41.06 nA	-17.0081

Table 1: Diode Characteristics: Ideality Factor, Saturation Current, and Intercept



3 Calculate band gap E_g from emission wavelengths

Material	Lambda (nm)	E _g (eV)
Blue	455	2.7253
Green	530	2.3396
White	450	2.7556
Red	631.25	1.9644
IN4007	1127.28	1.0999

Table 2: Material, Wavelength, and Energy Gap

4 Plot V_γ v/s E_g

Material	V_γ (cut-in) 1mA	V_γ (cut-in) 5mA	V_γ (cut-in) 0.05mA
Blue	1.74	2.93	0.63
Green	2.76	2.98	2.50
White	2.61	2.75	2.49
Red	1.80	1.91	1.60
IN4007	0.59	0.675	0.45

Table 3: Material and Cut-in Voltage (V_γ) at Different Current Levels

V_γ (cut-in) at Current	Correlation
1mA	0.801
5mA	0.952
0.05mA	0.511

Table 4: Correlation with V_γ at Different Current Levels

5 Tabulate E_g , I_s , $V_T H$, n_i and $N_{A,D}$

Material	Λ (nm)	E_g (eV)	η	Is (sat curr, A)	V_γ (1mA)	n_i	$N_{a,d}$
Blue	455	2.7253	8.4692	8.57e-9A	1.74	3.99E-4	1.36e11
Green	530	2.3396	5.7439	1.1165e-11A	2.76	6.65E-1	7.48e22
White	450	2.7556	4.5878	4.21e-13A	2.61	2.23E-4	1.40e18
Red	631.25	1.9644	3.7236	1.345e-11A	1.80	9.05E+2	9.78e17
IN4007	1127.28	1.0999	2.2164	4.106e-10A	0.59	1.50E+10	1.27e15

Table 5: Diode Characteristics Including V_γ (cut-in) Voltage at 1mA, Intrinsic Carrier Concentration, Acceptor Concentration, and Thickness

6 Applications of Diodes

6.1 Blue Diode (e.g., GaN-based Blue LED)

6.1.1 Applications:

- *Display Technology*: Used in RGB displays of TVs, Monitors, and Phones.
- *Lighting*: Used for high-intensity and energy-efficient light sources.
- *Data Storage*: Used in Blu-ray players for reading and writing data.

6.2 Green Diode (e.g., GaP-based Green LED)

6.2.1 Applications:

- *Signage*: Used in outdoor displays, traffic lights, and digital billboards.
- *Biomedical Devices*: Used in certain medical devices for signaling or optical sensing.

6.3 White Diode (e.g., Phosphor-converted White LED)

6.3.1 Applications:

- *General Lighting*: Widely used in residential and commercial lighting due to their energy efficiency and long lifespan.
- *Automotive Lighting*: Common in headlights, taillights, and interior lighting in vehicles.
- *Consumer Electronics*: Used in device backlighting, such as in phones, tablets, and laptop screens.

6.4 Red Diode (e.g., GaAs-based Red LED)

6.4.1 Applications:

- *Signal Indicators*: Red LEDs are used in electronic devices to indicate power, alarms, or status.
- *Remote Controls*: Common in infrared (IR) emitters for remote controls of TVs, air conditioners, etc.
- *Low-Level Laser Therapy*: Red laser diodes are used in therapeutic applications for pain relief and tissue healing.

6.5 IN4007 Diode (General-Purpose Rectifier Diode)

6.5.1 Applications:

- *Power Supplies*: Used in rectification circuits to convert AC to DC in power supplies for electronics.
- *Reverse Voltage Protection*: Protects circuits by blocking reverse voltage in electronic devices.
- *Voltage Clamping*: Used to clamp voltage spikes and protect sensitive components in circuits.

6.6 Conclusion:

Each diode type is chosen based on its specific electrical characteristics, such as forward voltage, current capacity, and switching speed, to suit the particular application.

7 Completion status

All experiments including readings and tabulation was completed in the lab.