

Experiment 10

Aim:

Draw I-V characteristics graph for PN Junction diode and Zener Diode

Tools and Apparatus:

LTSpice, PN junction diode, Zener diode, Resistor, Voltmeter, Ammeter, Voltage Source

Theory and Design:

* PN Junction Theory :

- Ability to conduct in one direction.
- Very high resistance in opposite direction.

(Forward)
bias

(Backward)
bias

Short circuit $R \approx 0$ Open circuit $R = \infty$

* PN Junction with no external voltage :

- Even when there is no voltage connected as soon as pn junction is formed :

- ① Holes from p-region diffuses into N-region
- ② Electron from N-region diffuses into P-region
- ③ Movement happens because of thermal energy
- ④ This phenomenon happens for very short time.

P-type n-type

- Free electron (-ve charge)
- Hole (+ve charge)
- ⊕ immobile ion
- ⊖ immobile ion

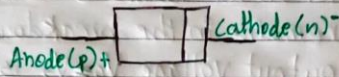
Electric Field

Creates certain Potential barrier → We have to break it to get current flow

(0.3
0.7)

• Zener Diode:

- A Zener diode is a special kind of diode which permits current to flow in the forward direction like a standard diode, but it will also allow it to flow in the reverse direction when the voltage is above the breakdown voltage or "Zener voltage".
- Zener diodes are designed so that their breakdown voltage is much lower.



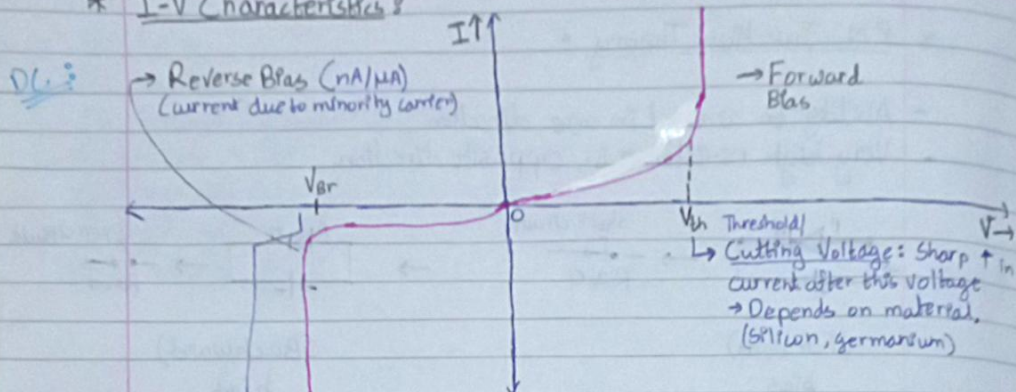
Zener Diode



Symbol

- In a standard diode, the Zener voltage is high, and the diode is permanently ^{damaged} if a reverse current above that value is allowed to pass through it.
- In the reverse bias direction, there is practically no reverse current flow until the breakdown voltage is reached.
- When this occurs there is a sharp increase in reverse current.
- Varying amount of reverse current can pass through the Zener diode without damaging it.
- The breakdown voltage or Zener Voltage (V_Z) across the diode remains relatively constant.

* I-V Characteristics:



→ V_{br} → Reverse Breakdown (Sharp ↑ in current)

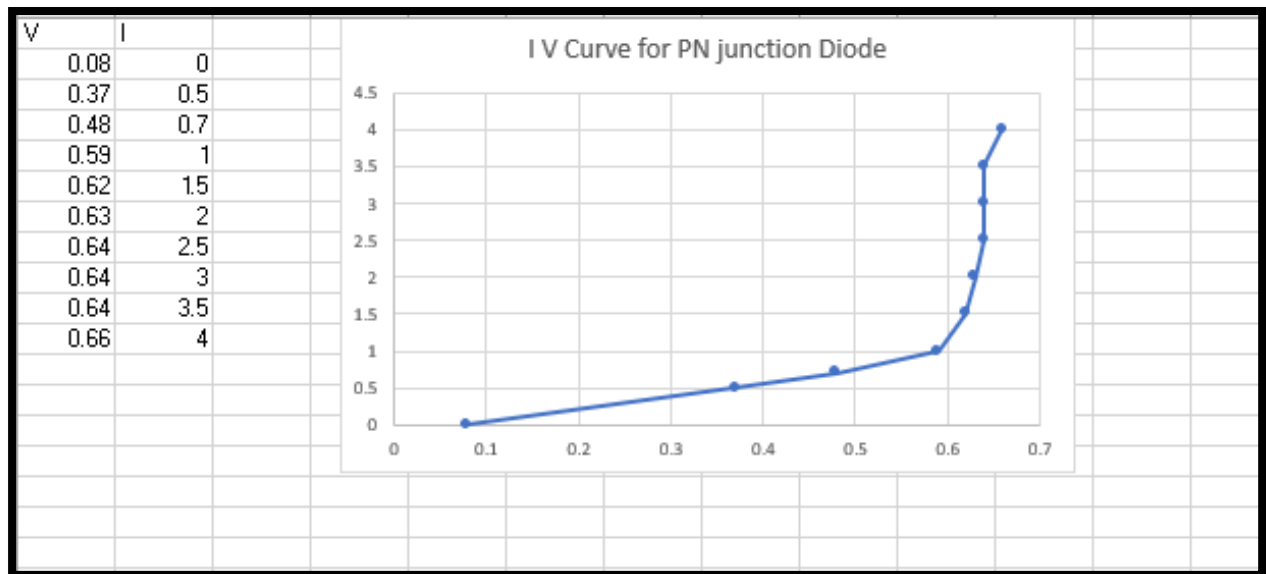
↳ ① Avalanche Breakdown → Due to high potential applied

↳ ② Zener Breakdown → Due to increased electric field

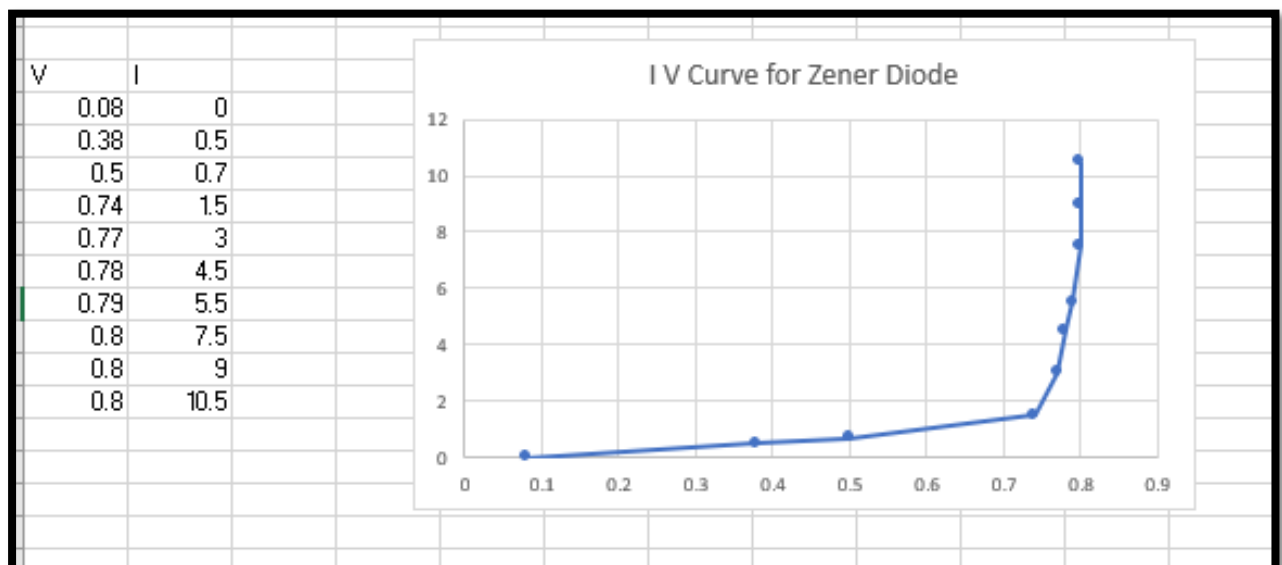
* → Zener diode has both but normal diode has only avalanche

Hardware Simulation Results:

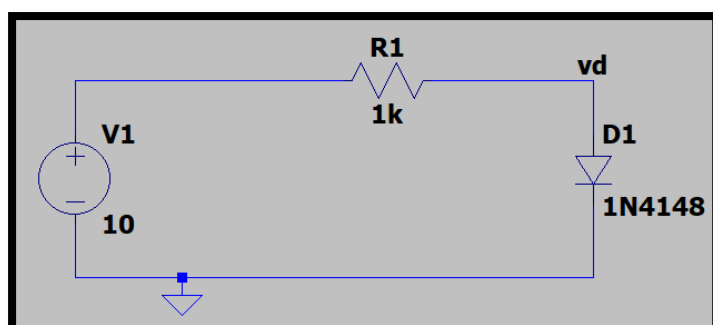
1) PN Junction



2) Zener Diode

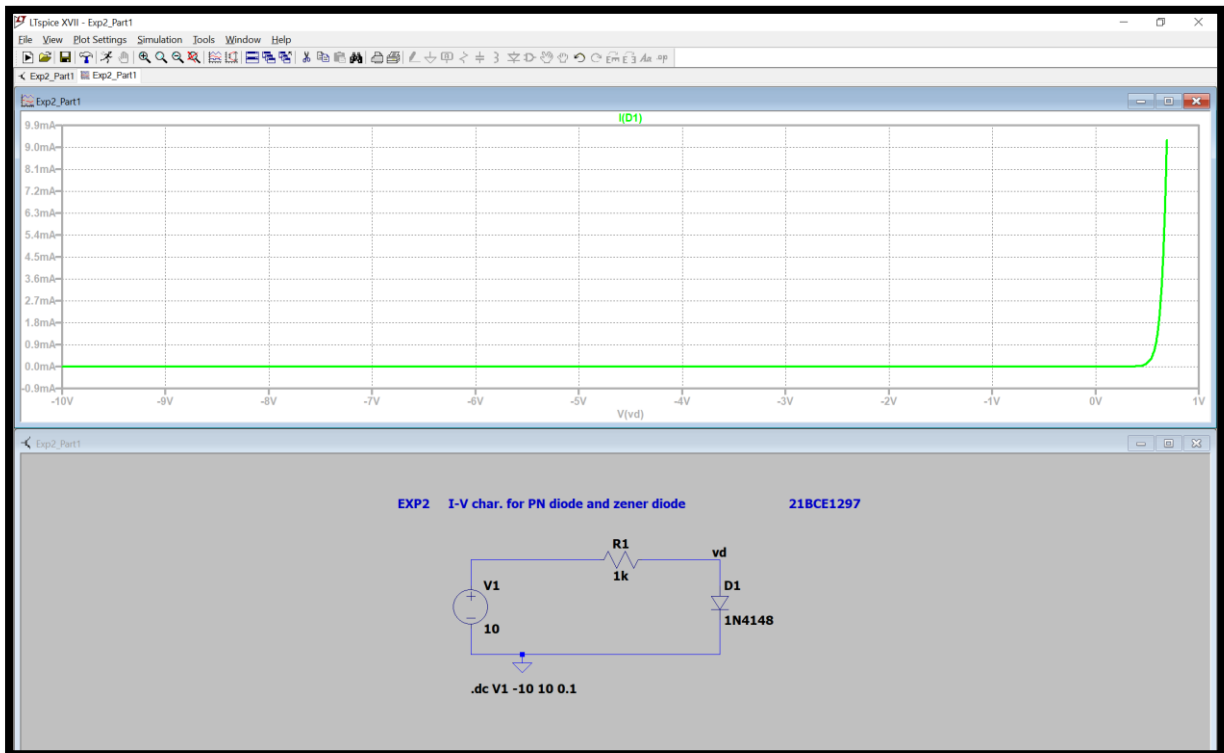


Circuit Diagram:

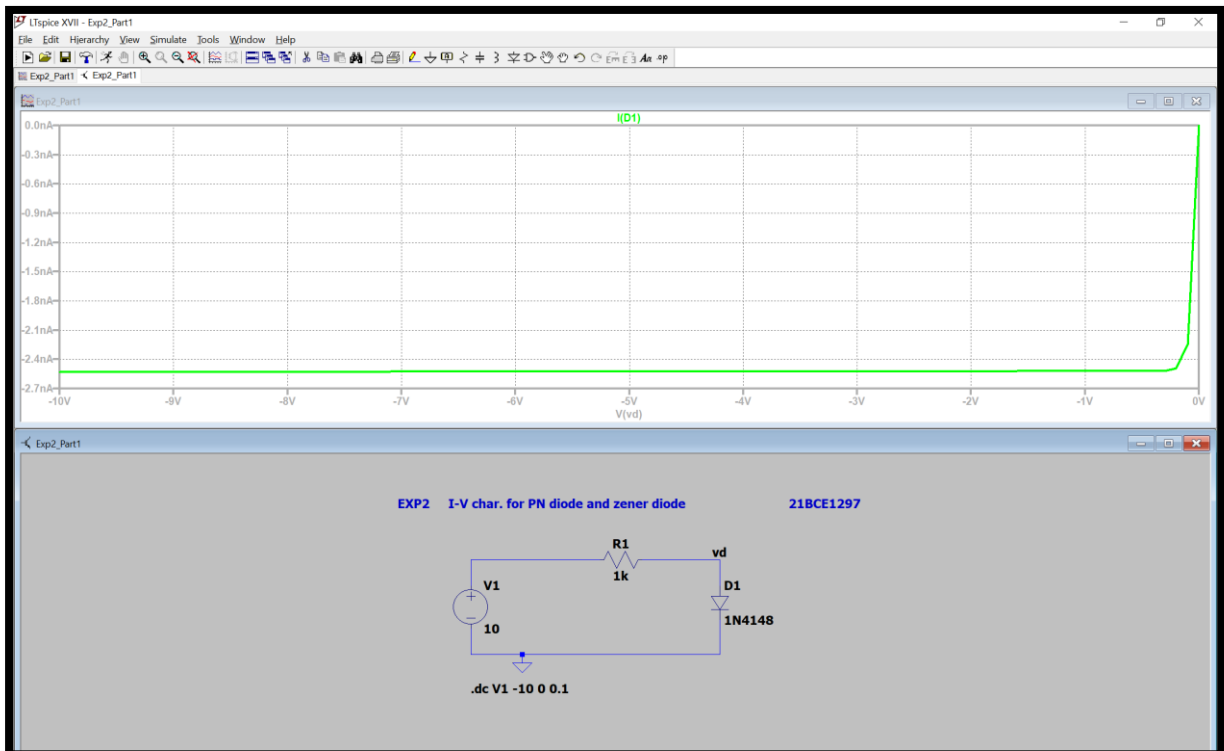


Software Simulation Results:

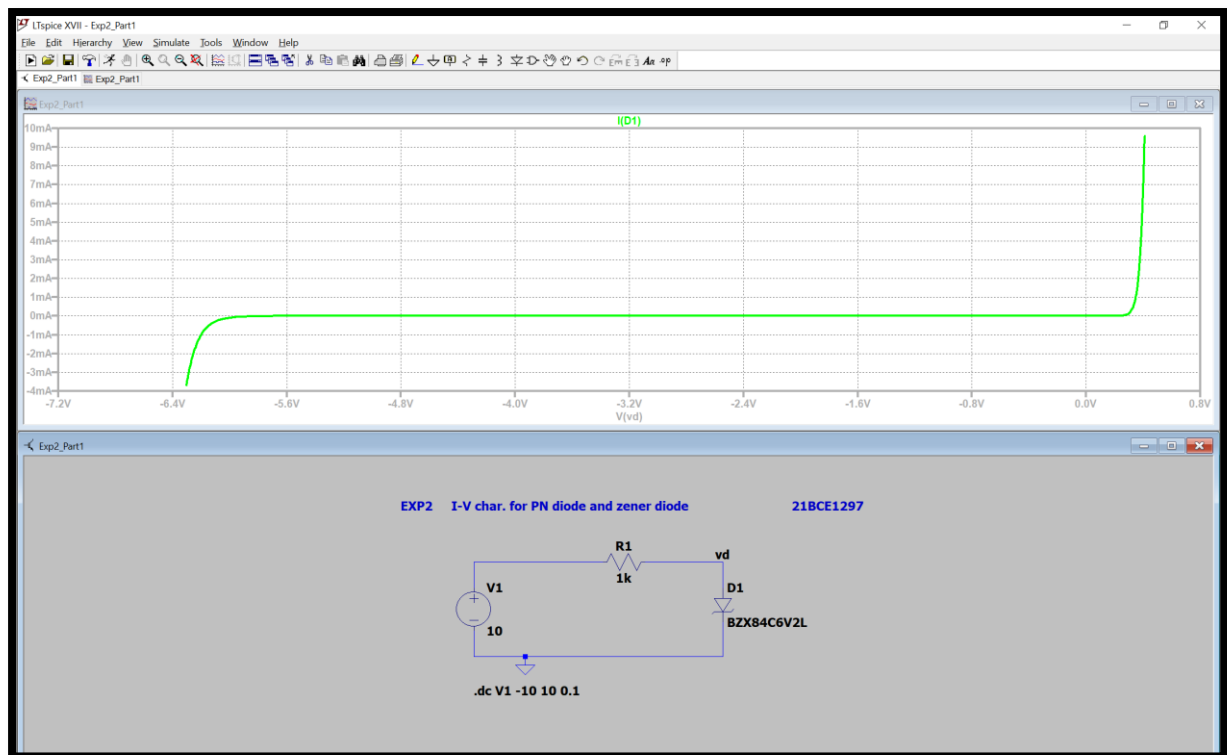
1) Forward Bias



2) Reverse Bias



3) Zener Diode



Conclusion:

I-V Characteristics curve of PN Junction diode and Zener diode is verified.

Inferences:

1. Threshold voltage and breakdown voltage for Zener diode and PN junction diode is clearly visible.
2. Connect all wires properly and tightly.
3. Label vd properly