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Experiments of analog electronics laboratory

Lab(2)

Characteristics of Zener diode

1. **Aim of the experiment :**

Displaying the characteristics of the Zener diode and studying the relationship between the current and voltage in the biasing state (forward and reverse).

2. Theory:

A Zener Diode, also known as a breakdown diode, is a heavily doped semiconductor device that is designed to operate in the reverse direction. When the voltage across the terminals of a Zener diode is reversed and the potential reaches the Zener Voltage (knee voltage), the junction breaks down, and the current flows in the reverse direction. This effect is known as the Zener Effect.

A Zener diode operates just like a normal diode when it is forward-biased. However, when connected in reverse-biased mode, a small leakage current flows through the diode. As the reverse voltage increases to the predetermined breakdown voltage (Vz), current starts flowing through the diode. The current increases to a maximum, which is determined by the series resistor, after which it stabilizes and remains constant over a wide range of applied voltage.

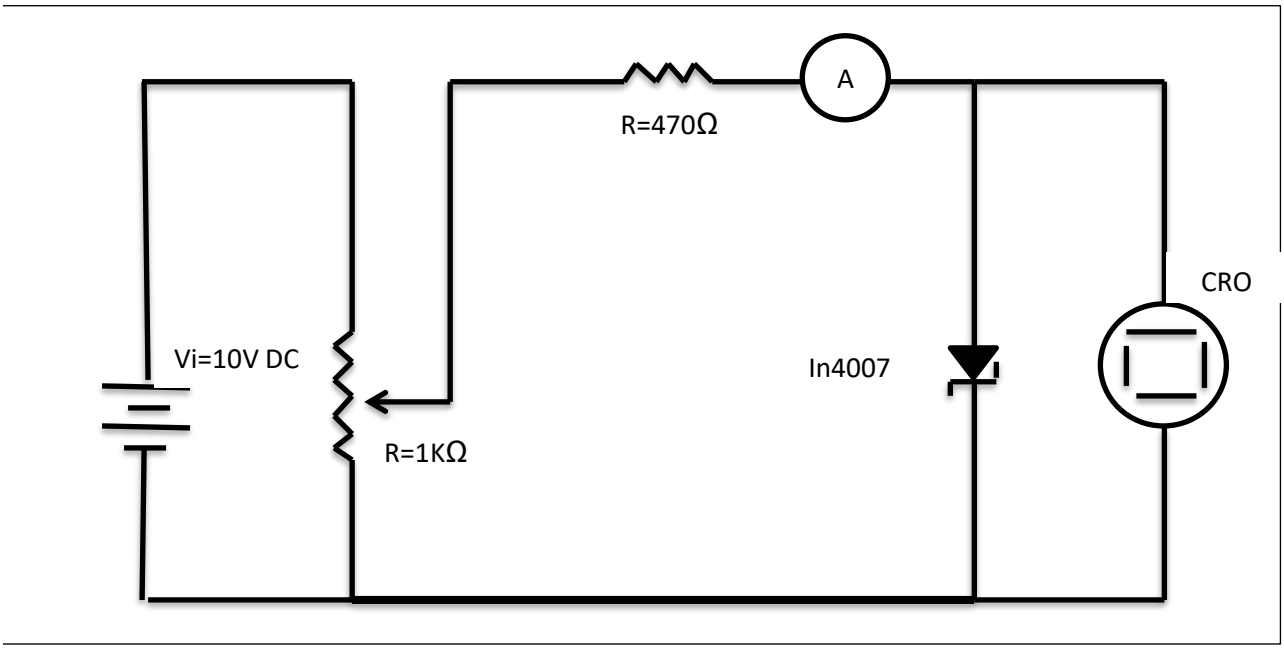
Avalanche breakdown occurs both in the normal diode and Zener Diode at high reverse voltage. When a high value of reverse voltage is applied to the PN junction, the free electrons gain sufficient energy and accelerate at high velocities. These free electrons moving at high velocity collides other atoms and knocks off more electrons. Due to this continuous collision, a large number of free electrons are generated as a result of electric current in the diode rapidly increases. This sudden increase in electric current may permanently destroy the normal diode, however, a Zener diode is designed to operate under avalanche breakdown and can sustain the sudden spike of current. Avalanche breakdown occurs in Zener diodes with Zener voltage (Vz) greater than 6V.

Zener Breakdown in Zener Diode

When the applied reverse bias voltage reaches closer to the Zener voltage, the electric field in the depletion region gets strong enough to pull electrons from their valence band. The valence electrons that gain sufficient energy from the strong electric field of the depletion region break free from the parent atom. At the Zener breakdown region, a small increase in the voltage results in the rapid increase of the electric current.

3. practical part:

a. Assemble the circuit as follow:



b. Set the voltage on the power supply unit to 0 volt.

c. Switch on and slowly increase the voltage using variable resistance(1kΩ) and record the current values as follow:

V(volt)	0	0.1	0.2	0.4	0.5	0.55	0.6	0.65	0.7
I(mAmp)									

d. Reverse the diode or the power supply voltage and record the current as the table below:

V(volt)	0	1	2	3	4	5	6	7	8
I(mAmp)									

e. Draw the relationship between current and voltage in the state (forward and reverse) biasing.

4. Discuss the difference in the current in the state of forward and reverse biasing.