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Basic Electronics Laboratory

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EXPERIMENT-20

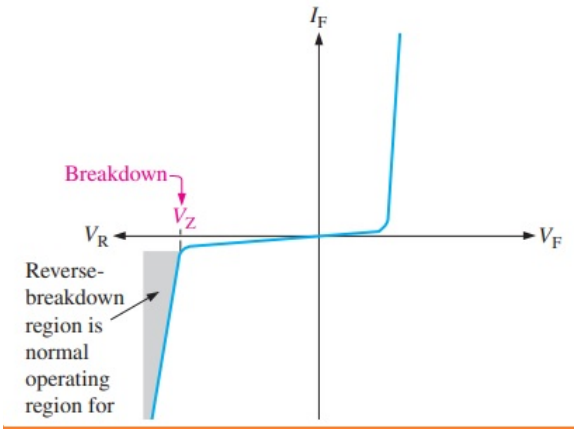
Lab Exam Report

Title: Zener Diode Load Regulation

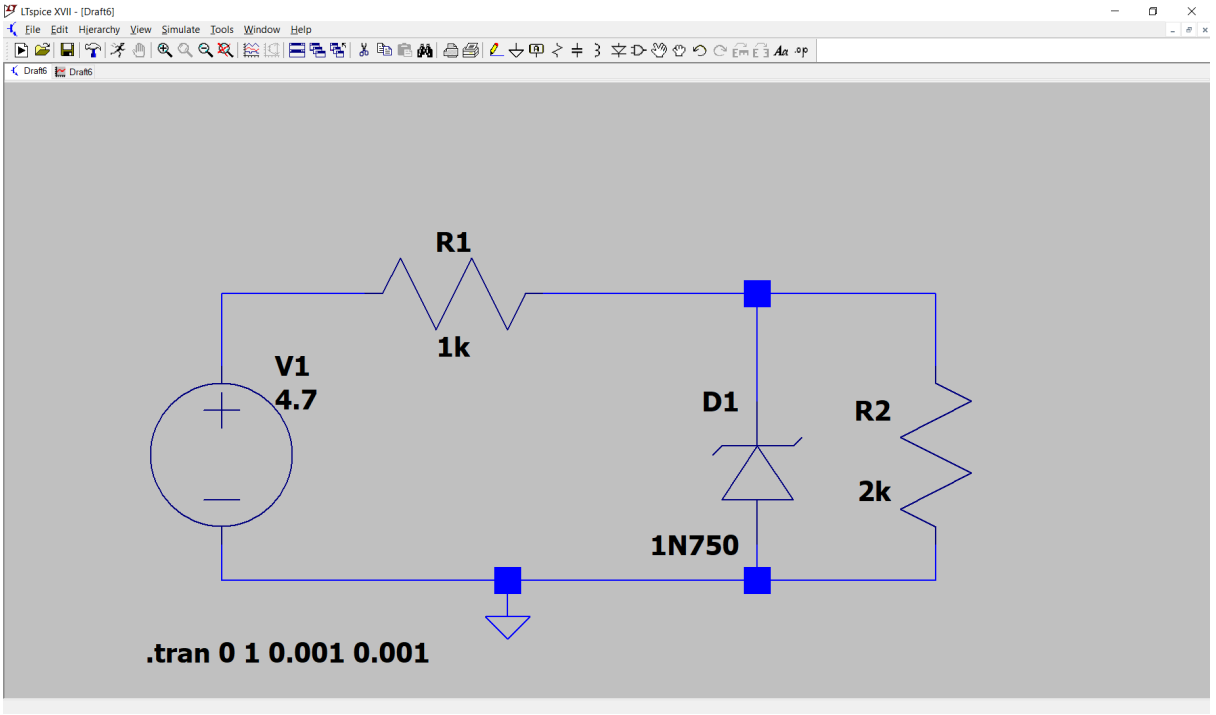
Tools Used: LTSpice XVII

Theory-

- A zener diode is a p-n junction semiconductor device designed to operate in the reverse breakdown region.
- The Zener diode is like a general-purpose signal diode. When biased in the forward direction it behaves just like a normal signal diode, but when a reverse voltage is applied to it, the voltage remains constant for a wide range of currents.
- Avalanche Breakdown: There is a limit for the reverse voltage. Reverse voltage can increase until the diode breakdown voltage reaches. This point is called the Avalanche Breakdown region. At this stage maximum current will flow through the zener diode. This breakdown point is referred to as “Zener voltage”.



Circuit Diagram:



$V_Z = 4.7\ V \approx \mathbf{5V}$

Observation Table:

Vs (V)	i_L (mA)	i_Z (mA)	V_o (With Load Resistance) (V)	V_o (Without Load Resistance) (V)	Voltage Regulation
1	333.316*10^-3	51.78633*10^-6	666.63212*10^-3	999.866*10^-3	0.4998773686
2	666.5579*10^-3	326.25493*10^-6	1.3331158	1.9981542	0.498860189
3	999.3837*10^-3	1.8488255*10^-3	1.998767	2.9769151	0.4893757501
6	1.92642	220.73998*10^-3	3.8528399	4.5122638	0.1711526866
8	2.242249	1.2732528	4.484498	4.5969019	0.02506499055
10	2.2951406	3.1145783	4.590281	4.6272435	0.008052339279
12	2.3117946	5.064616	4.6235892	4.6457825	0.004800015538
14	2.3216195	7.0351418	4.643239	4.6591802	0.003433206863
16	2.3286075	9.0141771	4.6572151	4.6697059	0.002682032015
18	2.3340476	10.997857	4.668095	4.6783996	0.002207452933
20	2.338514	12.984456	4.6770291	4.6858249	0.001880638288

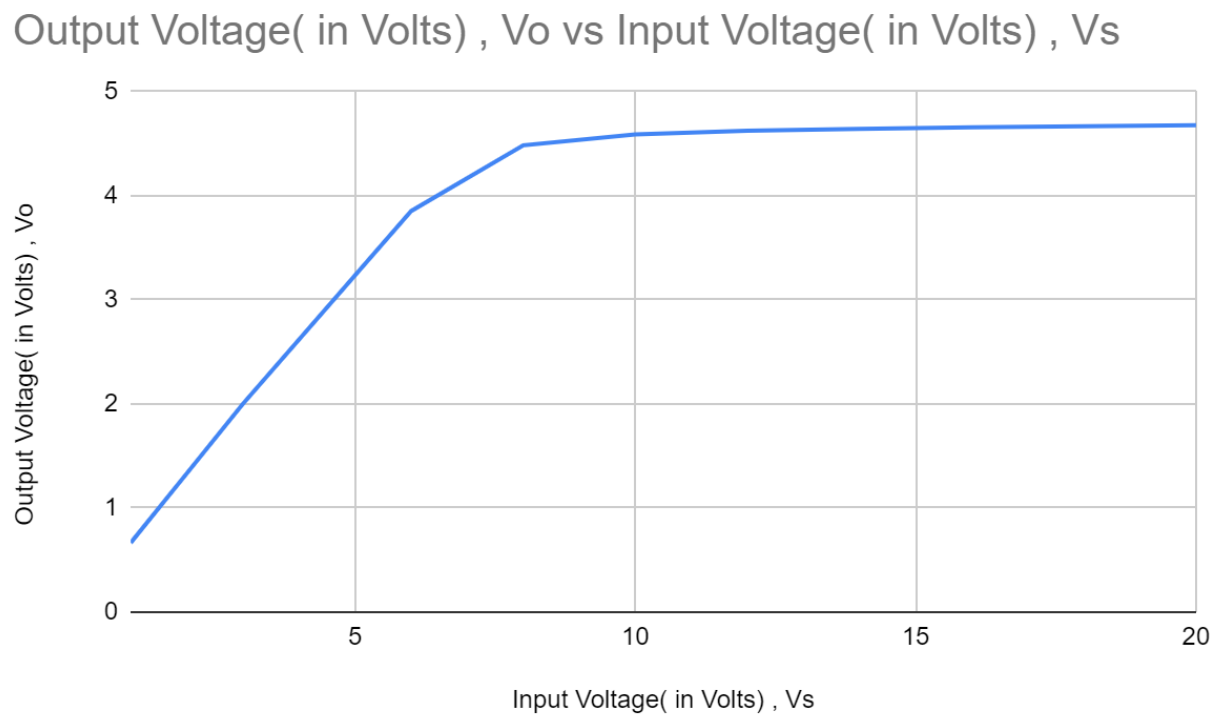
Formula for Voltage Regulation = $(V_{NL} - V_{FL})/(V_{FL})$

Where -

V_{NL} = Voltage (without load)

V_{FL} = Voltage (with load)

Graph (V_o v/s V_s):



Discussion and Notable observations:

- Zener diodes work in reverse bias mode in the breakdown region.
- A zener diode is a p-n junction semiconductor device designed to operate in the reverse breakdown region.
- Voltage regulation steadily increases as Load Resistance decreases.
- On plotting the graph of Output Voltage(in Volts) , Vo vs Input Voltage(in Volts) , Vs, we can clearly see that, -
    1. Initially, the output voltage increases with increase in the input voltage.
    2. After a certain point, the increase in output voltage with increase in input voltage is gradual
- Breakdown voltage for commonly available Zener diodes can vary widely from 1.2 V to 200 V.
- When the input voltage is 4.7V, the voltage across the load resistance is 3.111557V.
- Small Errors in data measurement are inevitable and can be attributed to small approximations in the simulation software.

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