Course Name:	**EEEE**	**Semester:**	**I/II**
Date of Performance:	**17/05/22**	**Batch No:**	**E1**
Faculty Name:		**Roll No:**	**16010321005**
Faculty Sign & Date:		**Grade/Marks:**	

Experiment No: 6
Title: Zener diode voltage regulator

Aim and Objective of the Experiment:

- To understand the working of Zener diode as voltage regulator
- To calculate line and load regulation of Zener diode based shunt regulator

Requirements:

Zener diode, resistor, potentiometer, voltmeter, ammeter, DC source and bread board.

Theory:

A zener diode functions as an ordinary diode when it is forward biased. It is a specially designed device to operate in the reverse bias. When it is in the reverse breakdown region, the voltage (V_z) across Zener diode remains almost constant irrespective of the current (I_z) flowing through it. A series resistor A series resistor *Rs* is used to limit the zener current below its maximum current rating. The current through *Rs* is given by the expression is $I_S = I_Z + I_L$, where I_L is the current through the load resistor . The value of *Rs* must be properly selected to ensure break down of the Zener diode and also to keep *Iz* in limited in specified current limit.

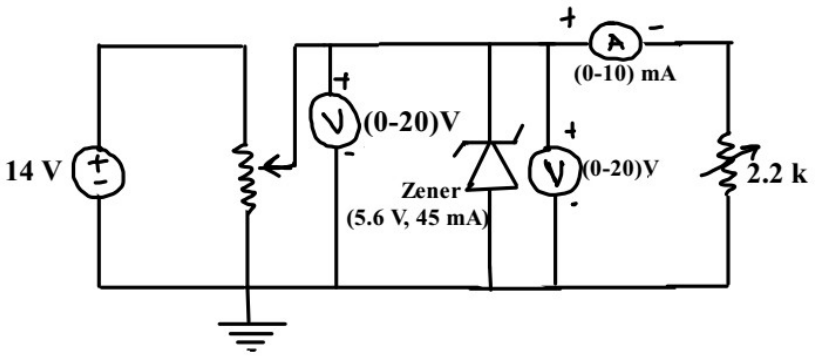
$$Rs_{min} = (V_{in} - V_z)/Iz_{max} \quad (1)$$

$$Rs_{max} = (V_{in} - V_z)/(Iz_{min} + I_L) \quad (2)$$

Design steps:

1. If for regulator
   Desired output parameters Vo=5.6 V, I_{Lmax}= 5mA
   Input voltage in the range V_{IN} = 8 V- 14 V
2. Choose Zener diode (5.6 V, 45 mA)
3. Choose potentiometer of value 4.7 kΩ so that I_L can be varied from 5.6/4.7 kΩ ≈ 1.2 mA.
4. I_{Zmax} = 45 mA so I_{Zmin} = 10% of I_{Zmax} = 4.5 mA
5. $R_{Smax} = (V_{INmin} - V_Z) / (I_{Zmin} + I_{Lmax})$ =(8-5.6) V/(4.5+ 5.0) mA ≈ 253 Ω
   $R_{Smin} = (V_{INmax} - V_Z) / I_{Zmax}$ = (14-5.6)V/(45 mA) ≈ 186 Ω
   Choose $R_{Smin} < Rs < R_{Smax}$ so Rs = 220 Ω and Power rating $(I_{max})^2 \times R_S$
   $I_{max} = (V_{IN} - V_Z) / Rs$ = (14-5.6) / 220 = 38 mA
   Power rating = $(38 \text{ mA})^2$ x220 = 0.32 watt ≈ 0.5 watts.

Circuit Diagram/ Block Diagram:



Stepwise-Procedure:

1. Design circuit and connect it as shown in the circuit diagram using Proteus simulator.
2. Keep V_{IN} more than 8V and adjust Potentiometer R_L such that I_L= 5 mA. Vary V_{IN} and Note V_O for finding line regulation.
3. Keep V_{IN} = 10 V and vary Potentiometer R_L such that I_L changed from 0 to 5 mA and not V_O for finding load regulation.
4. Plot the graph V_o Vs V_{IN} for line regulation and V_o Vs I_L for load regulation.

Proteus Screen shots

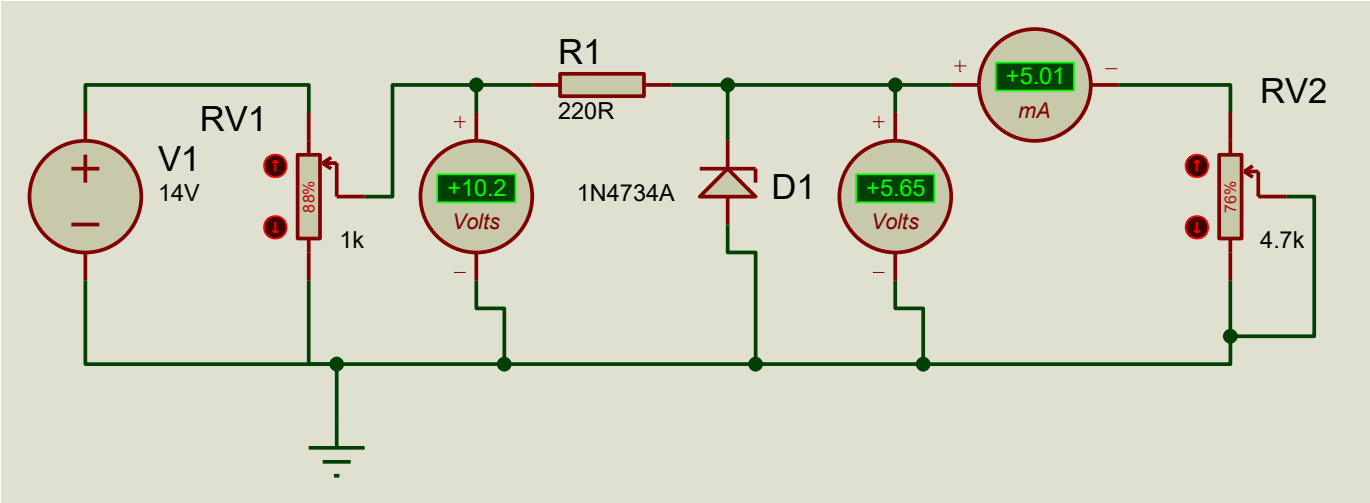


Figure 1

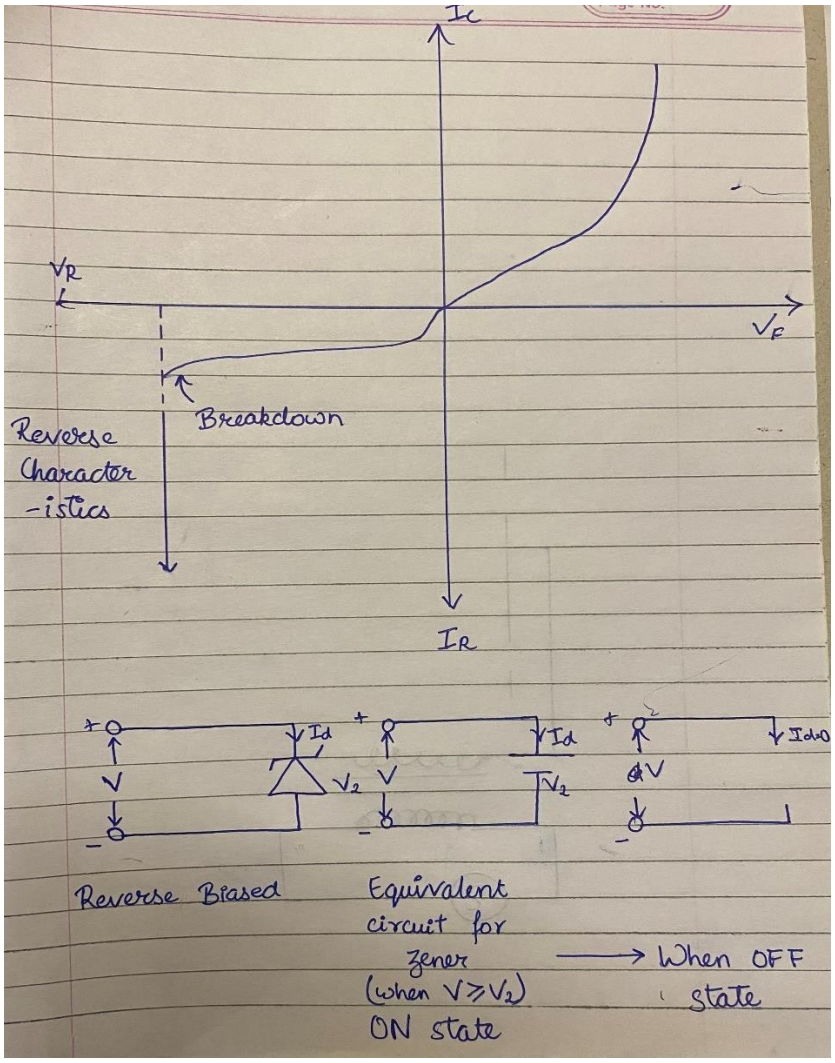
Observation Table:

Line Regulation: Set I_L= 5 mA **Load Regulations: Set V_{IN}= 10 V**

V_{IN} (V)	Vo (V)		I_L (mA)	Vo (V)
2	**0.7**		**0**	5.4
4	**2.8**		**2**	5.4
6	**4.7**		4	5.4
8	**5.3**		6	5.4
10	**5.4**		**8**	5.4
12	**5.4**		**10**	5.4

Post Lab Subjective/Objective type Questions:

1.Draw and explain I-V characteristics of Zener diode.



1. Zener diode is properly doped to have sharp breakdown voltage.
2. The Zener diode is always reverse connected
3. Zener diode has sharp breakdown voltage called Zener voltage
4. Reverse voltage across a Zener diode is more or less equal to the breakdown voltage

2. What is difference between PN junction diode and Zener diode?

A diode needs to be biased ini order to work. Biasing can be done by two ways, forward bias and reverse bias. A normal PN junction diode only works in forward bias conditions. But a zener diode is properly doped so that it has sharp breakdown voltage and therefore works in reverse bias conditions

Conclusion:

We are able to understand the concept of a Zener diode and its working as a voltage regulator.

Signature of faculty in-charge with Date: