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| **Course Name:** | **EEEE** | **Semester:** | **I/II** |
| **Date of Performance:** | **14/12/21** | **Batch No:** | **A2** |
| **Faculty Name:** | **Maruti Zalte** | **Roll No:** | **16010121045** |
| **Faculty Sign & Date:** |  | **Grade/Marks:** |  |

**Experiment No: 6**

**Title: Zener diode voltage regulator**

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| **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 |

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| **Requirements:** |
| Zener diode, resistor, potentiometer, voltmeter, ammeter, DC source and bread board. |

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| **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 (Vz) across Zener diode remains almost constant irrespective of the current (*Iz)* 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 *IS=IZ+IL* , where *IL* 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.  Rsmin= (Vin-Vz)/Izmax (1)  Rsmax= (Vin-Vz)/(Izmin + IL) (2)  Design steps:  1. If for regulator  Desired output parameters Vo=5.6 V, ILmax= 5mA  Input voltage in the range VIN = 8 V- 14 V  2. Choose Zener diode (5.6 V, 45 mA)  3. Choose potentiometer of value 4.7 kΩ so that IL can be varied from 5.6/4.7 kΩ ≈ 1.2 mA.  4. IZmax = 45 mA so IZmin = 10% of IZmax = 4.5 mA  5. RSmax = (VINmin - VZ) /(IZmin +ILmax) =(8-5.6) V/(4.5+ 5.0) mA ≈ 253 Ω  RSmin = (VINmax - VZ) / IZmax = (14-5.6)V/(45 mA) ≈ 186 Ω  Choose RSmin < Rs <RSmax  so Rs = 220 Ω and Power rating (Imax)2 x RS  Imax = (VIN - VZ )/ Rs = (14-5.6) / 220 = 38 mA  Power rating = (38 mA)2 x220 = 0.32 watt ≈ 0.5 watts. |

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| **Circuit Diagram/ Block Diagram:** |
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| **Stepwise-Procedure:** |
| 1. Design circuit and connect it as shown in the circuit diagram using Proteus simulator. 2. Keep VIN more than 8V and adjust Potentiometer RL such that IL= 5 mA. Vary VIN and Note VO for finding line regulation. 3. Keep VIN = 10 V and vary Potentiometer RL such that IL changed from 0 to 5 mA and not VO for finding load regulation. 4. Plot the graph Vo Vs VIN for line regulation and Vo Vs IL for load regulation. |

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| **Proteus Screen shots** |
| Pargat Singh  Figure 1 |

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| **Observation Table:** |
| **Line Regulation: Set IL= 5 mA Load Regulations: Set VIN= 10 V**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **VIN (V)** | **Vo (V)** |  | **IL (mA)** | **Vo (V)** | | **4** | **3.37** | **1.21** | 5.67 | | **5** | **4.21** | **2** | 5.67 | | **6** | **5.08** | **3** | 5.66 | | **7** | **5.53** | **4** | 5.66 | | **8** | **5.58** | **5** | 5.65 | | **9** | **5.62** | **6** | 5.64 | | **10** | **5.65** | **8** | 5.63 | | **11** | **5.67** | **10** | 5.62 | | **12** | **5.70** | **12** | 5.6 | | **13** | **5.73** | **14** | 5.58 | | **14** | **5.75** | **20** | 5.52 |     VIN  VO    VO  IL  **Line regulation**= (Δ Vout / Δ Vin ) x 100  =(5.75-5.53)/(14-7) x 100  =0.22/7 x 100  =3.14 %    **Load Regulation**=(( VNL-VFL)/VFL) x 100’  =(5.67-5.56)/5.56 x 100  =1.98 % |
| **Post Lab Subjective/Objective type Questions:** |
| **1. Draw and explain I-V characteristics of Zener diode.**    **Forward Characteristics**  The forward characteristics of a Zener diode is shown in figure. It is almost identical to the forward characteristics of a P-N junction diode.  **Reverse Characteristics**  As we increase the reverse voltage, initially a small reverse saturation current Io. This current  flows due to the thermally generated minority carriers. At a certain value of reverse voltage, the reverse current will increase suddenly and sharply . This is an indication that the breakdown has occurred. This breakdown voltage is called as Zener breakdown voltage or Zener voltage and it is denoted by Vbr.  **2. What is difference between PN junction diode and Zener diode?**  The diffrences are as follows:   1. The PN junction diode allows the flow of electron in one direction only, whereas the Zener diode allows the flow of electron in both directions. 2. The voltage of the PN junction diode at which it starts working is comparatively higher, and the voltage of the Zener diode at which it starts working is lower, and it is known as Zener voltage. 3. The PN junction diode is not highly doped. On the other hand, the Zener diode has highly doped junctions. 4. On applying a large reverse bias voltage, the PN junction diode has chances of getting damaged, but the Zener diode is specialized for this case. 5. PN junction diode is used as voltage rectifiers, switchers, waveshapes, etc., whereas Zener diode is used as voltage stabilizers. |

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| **Conclusion:** |
| By performing this experiment and by the graphs plotted we can conclude that when the diode is in the reverse breakdown region, the voltage across Zener diode remains almost constant irrespective of the current flowing through it. |

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| **Signature of faculty in-charge with Date:** |