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| **Course Name:** | **EEEE** | **Semester:** | **II** |
| **Date of Performance:** | **27 / 03 / 23** | **Batch No:** | **P1 - 2** |
| **Faculty Name:** | **Annu Abraham** | **Roll No:** | **16014022050** |
| **Faculty Sign & Date:** |  | **Grade/Marks:** | **/ 25** |

**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. |
| **Link for virtual lab:**  <https://portal.coepvlab.ac.in/vlab/auth/home?dept=2&lab=10> |

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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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| **Output snap:** |
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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)** | | **2** | **1.24** | **2** | - | | **3** | **2.18** | **3** | 5.62 | | **4** | **3.47** | **4** | 5.62 | | **5** | **4.22** | **5** | 5.61 | | **6** | **5.12** | **6** | 5.60 | | **7** | **5.51** | **7** | 5.60 | | **8** | **5.55** | **8** | 5.60 | | **9** | **5.58** | **9** | 5.59 | | **10** | **5.61** | **10** | 5.58 | | **11** | **5.64** | **11** | 5.58 | | **12** | **5.67** | **12** | 5.57 | | **13** | **5.70** | **13** | 5.57 | | **14** | **5.73** | **14** | 5.57 | |

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| **Graphs:** |
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| **Post Lab Subjective/Objective type Questions:** |
| 1. **Draw and explain I-V characteristics of Zener diode.**   Diagram  Description automatically generated  The VI characteristics of a zener diode is shown in the below above.  When forward biased voltage is applied to the zener diode, it works like a normal diode. However, when reverse biased voltage is applied to the zener diode, it works in a different manner.  When reverse biased voltage is applied to a zener diode, it allows only a small amount of leakage current until the voltage is less than zener voltage. When reverse biased voltage applied to the zener diode reaches zener voltage, it starts allowing a large amount of electric current.  At this point, a small increase in reverse voltage will rapidly increase the electric current. Because of this sudden rise in electric current, breakdown occurs called zener breakdown.  However, zener diodes exhibit a controlled breakdown that does damage the device. The zener breakdown voltage of the zener diode depends on the amount of doping applied. If the diode is heavily doped, zener breakdown occurs at low reverse voltages. On the other hand, if the diode is lightly doped, the zener breakdown occurs at high reverse voltages.   1. **What is difference between PN junction diode and Zener diode?**   The major difference between PN junction and the Zener diode is that the PN junction diode allows current to pass only in the forward direction, whereas the Zener diode allows the current to flow both in the forward and the reversed direction.  The other differences between the PN-junction and Zener diode are shown in the comparison chart. The PN junction diode is used for rectification purposes because it allows the current to flow only in one direction. It is a type of switch which only allows the forward current to pass through it. On the other hand, the Zener diode allows both the forward and reverse current to pass through it. The Zener diode is used as a voltage regulator in the electronic circuit because it provides the constant voltage from the supply to the load whose voltage varies over sufficient range. |

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| **Conclusion:** |
| With the help of this experiment, we are able to understand the use of a Zener diode as a voltage regulator and how it can be regulated with changes in voltage and current. |

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