| **Course Name:** | **EEEE** | **Semester:** | **I/II** |
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| **Date of Performance:** | **29/11/2021** | **Batch No:** | **A3** |
| **Faculty Name:** |  | **Roll No:** | **16010121051** |
| **Faculty Sign & Date:** |  | **Grade/Marks:** |  |

**Experiment No: 6**

**Title: Zener diode voltage regulator**

| **Aim and Objective of the Experiment:** |
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| * To understand the working of Zener diode as voltage regulator * To calculate line and load regulation of Zener diode based shunt regulator |

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

| **Theory:** |
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| 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. |

| **Circuit Diagram/ Block Diagram:** |
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| **Stepwise-Procedure:** |
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| 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. |

| **Proteus Screen shots** |
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| **Observation Table:** |
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| **Line Regulation: Set IL= 5 mA Load Regulations: Set VIN= 10 V**   | **VIN (V)** | **Vo (V)** |  | **IL (mA)** | **Vo (V)** | | --- | --- | --- | --- | --- | | **4** | **3.41** | **1.21** | **5.67** | | **5** | **4.26** | **2** | **5.67** | | **6** | **5.04** | **4** | **5.66** | | **7** | **5.53** | **6** | **5.64** | | **8** | **5.58** | **8** | **5.63** | | **9** | **5.62** | **10** | **5.62** | | **10** | **5.65** | **12** | **5.60** | | **11** | **5.68** | **14** | **5.58** | | **12** | **5.70** | **16** | **5.56** | | **13** | **5.73** | **18** | **5.52** | | **14** | **5.75** | **20** | **5.16** |             Line regulation = (ΔVo/ ΔVIN) x 100  =[(5.75-5.53) / (14-7)] x 100 = 3.14%  Load regulation =[ (VNL -VFL ) /VFL ] x 100  = [(5.67-5.56)/5.56] x 100 =1.97% |
| **Post Lab Subjective/Objective type Questions:** |
| 1. **Draw and explain I-V characteristics of Zener diode.**     The right half side of the characteristics curve is the part in which the zener diode receives forward voltage, which is positive voltage across its anode to cathode terminals. The diode in this region is in forward biased. During this period, the current is small for a while until it spikes exponentially up once the voltage reaches a certain point, called the threshold voltage.  The left half side of the characteristics curve is the more important part, when considering zener diodes. This is the part in which the zener diode receives positive voltage across its cathode to anode terminals. The diode in this region is reverse biased. At first, when receiving reverse voltage, the current is very small. There is only a small current, called the leakage current, flowing through the diode. Once it hits the breakdown voltage, the current drastically increases. This current is the called the avalanche current, because it spikes so drastically. The breakdown voltage point is also important, not just because of the avalanche current, but more importantly because once the voltage of the zener diode has reached this point, it remains constant at this voltage, even though the current across it may increase largely.   1. **What is difference between PN junction diode and Zener diode?**  | **Basis For Comparison** | **PN Junction Diode** | **Zener Diode** | | --- | --- | --- | | Definition | It is a semiconductor diode which conducts only in one direction, i.e., in forward direction. | The diode which allows the current to flow in both the direction i.e., forward and reverse, such type of diode is known as the Zener diode. | | Symbol | diode-symbol | zener-diode | | Reverse Current Effect | Damage the junction. | Do not damage the junction. | | Doping Level | Low | High | | Breakdown | Occurs in higher voltage. | Occur in lower voltage. | | Ohms Law | Obey | Do not obey. | | Applications | For rectification | Voltage stabilizer, motor protection and wave shaping. | |

| **Conclusion:** |
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| The experiment was performed successfully and the working of the Zener diode as voltage regulator was effectively understood. |

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