| **Course Name:** | **EEEE** | **Semester:** | **I** |
| --- | --- | --- | --- |
| **Date of Performance:** | **6/12/2022** | **Batch No:** | **C2-2** |
| **Faculty Name:** | **Jyoti Varavedkar** | **Roll No:** | **16010122109** |
| **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. |
| **Link for virtual lab:**  <https://portal.coepvlab.ac.in/vlab/auth/home?dept=2&lab=10> |

| **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. |

| **Circuit Diagram/ Block Diagram:**  **Note: Perform this experiment either on virtual Lab or Proteus simulator** |
| --- |
|  |

| **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. |

| **V-Lab/Proteus Screen shots** |
| --- |
| Line Regulation:  DC volt = variable  Zener diode = 5.6v  Resistance (Rs) = 200 ohm  Resistance (Rl) = 1100 ohm    Load Regulation:  DC volt = 10v (Fixed)  Zener diode = 5.6v  Resistance (Rs) = 200 ohm  Resistance (Rl) = variable |

| **Observation Table:** |
| --- |
| **Line Regulation: Set IL= 5 mA Load Regulations: Set VIN= 10 V**   | **VIN (V)** | **Vo (V)** |  | **IL (mA)** | **Vo (V)** | | --- | --- | --- | --- | --- | | 2 | 2 | 4.48 | 5.6 | | 3 | 3 | 5 | 5.6 | | 4 | 4 | 5.6 | 5.6 | | 5 | 5 | 6 | 5.6 | | 5.6 | 5.6 | 8 | 5.6 | | 6 | 5.6 | 10 | 5.6 | | 6.6 | 5.6 | 12 | 5.6 | | 7 | 5.6 | 14 | 5.6 | | 7.6 | 5.6 | 16 | 5.6 | | 8 | 5.6 | 18 | 5.6 | | 8.6 | 5.6 | 20 | 5.6 | | 9 | 5.6 |  | 24 | 10 | | 9.6 | 5.6 |  | 26 | 10 | | 10 | 5.6 |  | 28 | 10 | |  |  |  | 30 | 10 | |
| **Post Lab Subjective/Objective type Questions:** |
| 1. Draw and explain I-V characteristics of Zener diode.  2. What is difference between PN junction diode and Zener diode?  1] Zener diode is p–n junction diode which is manufactured to operate in breakdown region.Its forward bias characteristic is same as that of ordinary junction diode. This means current does not flow until bias is less than barrier potential. Current increases rapidly beyond it with increase in forward voltage. In reverse bias, initially a small reverse saturated current flows and at particular value of reverse voltage, increases suddenly. This voltage is zener breakdown voltage (Vz).    2] The differences between pn junction and zener diode are:     | sr. no. | PN Junction | Zener Diode | | --- | --- | --- | | 1 | The electricity flows in one direction. | The electricity flows in both direction. | | 2 | The reverse bias permanently damages the depletion layer. | The reverse bias makes the electricity flow in both direction. | | 3 | Used for rectification. | Used for regulation. | | 4 | The width of depletion layer is larger because the p and n junction region is lightly doped. | The width of depletion layer is narrow because the p and n junction region is heavily doped. | | 5 | Symbol: | Symbol: | |

| **Conclusion:** |
| --- |
| Thus, we learnt the working of Zener diode as voltage regulator and how to calculate line and load regulation of Zener diode . |

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