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BASIC ELECTRICAL ENGINEERING II
ENG 222
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1.) Zener diodes can be used to produce a stabilised voltage output with low ripple under varying load current conditions. By passing a small current through the diode from a voltage source, via a suitable current limiting resistor (R_S), the zener diode will conduct sufficient current to maintain a voltage drop of V_{out}.

Resistor, Rs is connected in series with the zener diode to limit the current flow through the diode with the voltage source, V_S being connected across the combination. The stabilized output voltage V_{out} is taken from across the zener diode. The zener diode is connected with its cathode terminal connected to the positive rail of the DC supply so it is reversed bias and will be operating in its breakdown condition. Resitor Rs is selected so to limit the maximum current flowing in the circuit.

With no load connected to the circuit, the load current will be zero, ($I_L = 0$), and all the current passes through the zener diode which in turn dissipates its maximum power, also a small value of the series resistor Rs will result in a greater diode current when the load resistance R_L is connected and large as this will increase the power dissipation requirement of the diode so care must be taken when selecting the appropriate value of series resistance so that the zener's maximum power rating is not exceeded under this no-load or high impedance condition.

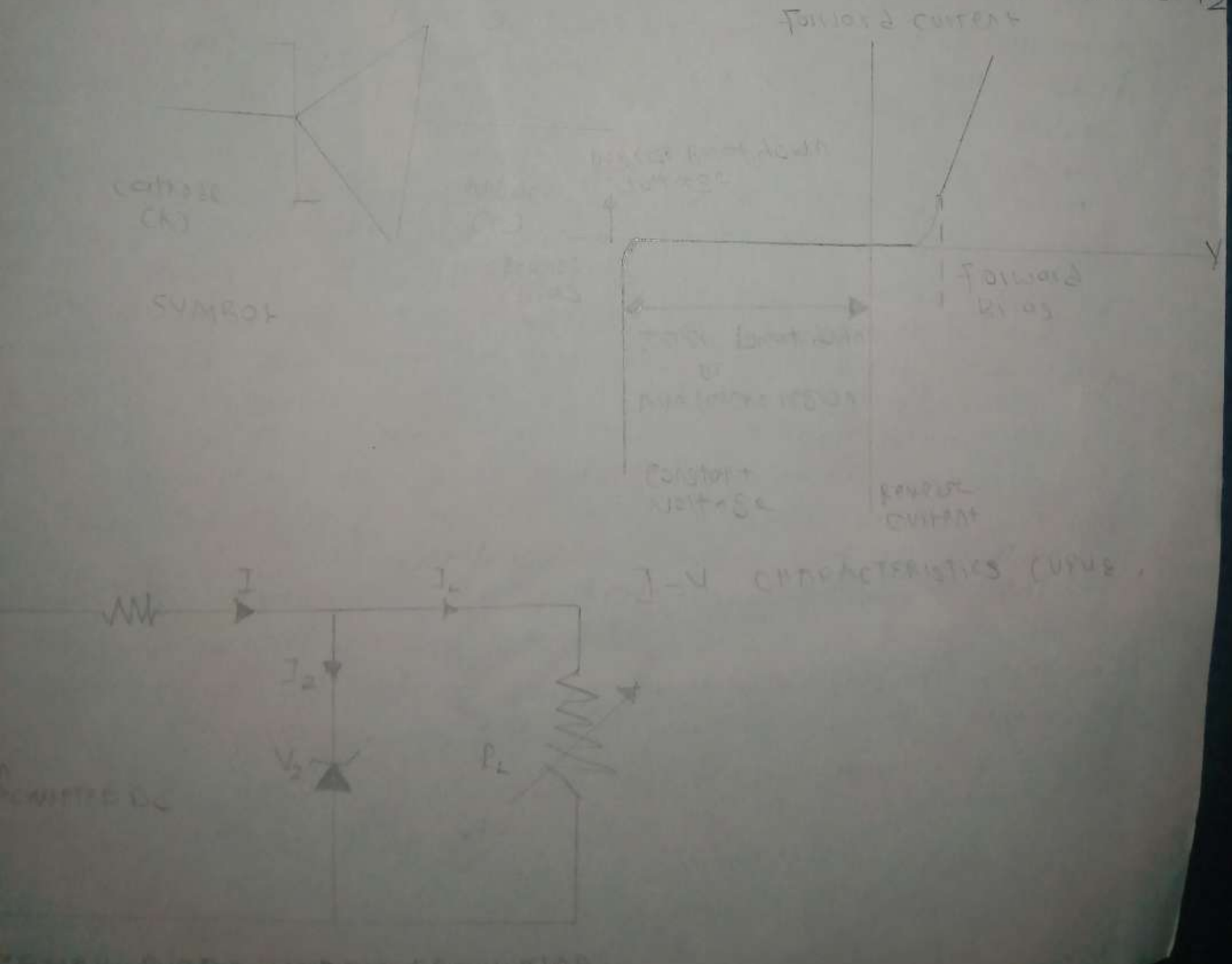
The load is connected in parallel with the zener diode, so the voltage across R_L is always the same as the zener voltage, ($V_R = V_Z$). There is a minimum zener current for which the regulation of the voltage is effective and the zener current must stay value operating under load within its breakdown region at all times. The upper limit of current is of course dependant upon the power rating of the device. The supply voltage V_S must be greater than V_Z.

P.T.O

One small problem with zener diode regulator circuit is that the diode can sometime generate electrical noise on top of the DC supply as it tries to regulate the voltage. Normally this is not a problem for most applications but the addition of a large value decoupling capacitor across the zener output may be required to give additional smoothing.

TO summarise a little. A zener diode is always operated in its reverse bias condition. As such a simple voltage regulator circuit can be designed using a zener diode to maintain a constant DC output voltage across the load in spite of variations in the input voltage or changes in the load current.

The zener voltage regulator consist of a current limiting resistor R_S connected in series with the input voltage V_S with the zener diode connected in parrallel with the load R_L in this reveised biased condition. The Resulated output voltage is always selected to be the same as the breakdown voltage V_Z of the diode.



Voltage across ... (VR = Vz). There is a minimum zener ... regulation of the voltage is effective and ... must stay ... value operating ... load ... ... at all times. The upper limit of ... ... the power rating of ... greater

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2) Max Power = 5W, I_z = 500mA = 0.5A, &

$20V_{max} = V_s$

Maximum current = $\frac{\text{Max Power}}{\text{Voltage}} = \frac{5W}{V} = 0.5A$

V_z = 10 Volt.

Minimum resistance $\frac{V_s - V_z}{I_z}$

$V_{DC} = 0.637 V_{max}$

$= 0.637 \times 20$

$= 12.74 V_{DC}$

Minimum resistance = $\frac{12.74 - 10}{0.5} = 5.48\Omega$

Load current $I_L = \frac{V_z}{R_L} = \frac{10}{500} = 0.02A$ or 20mA