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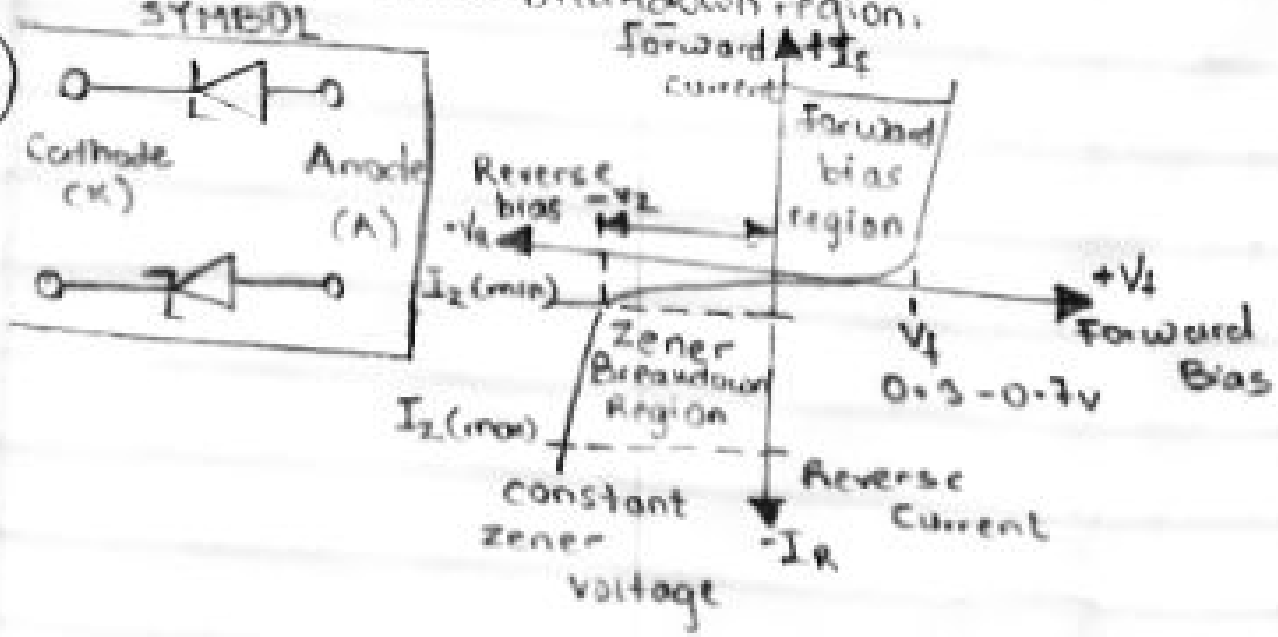
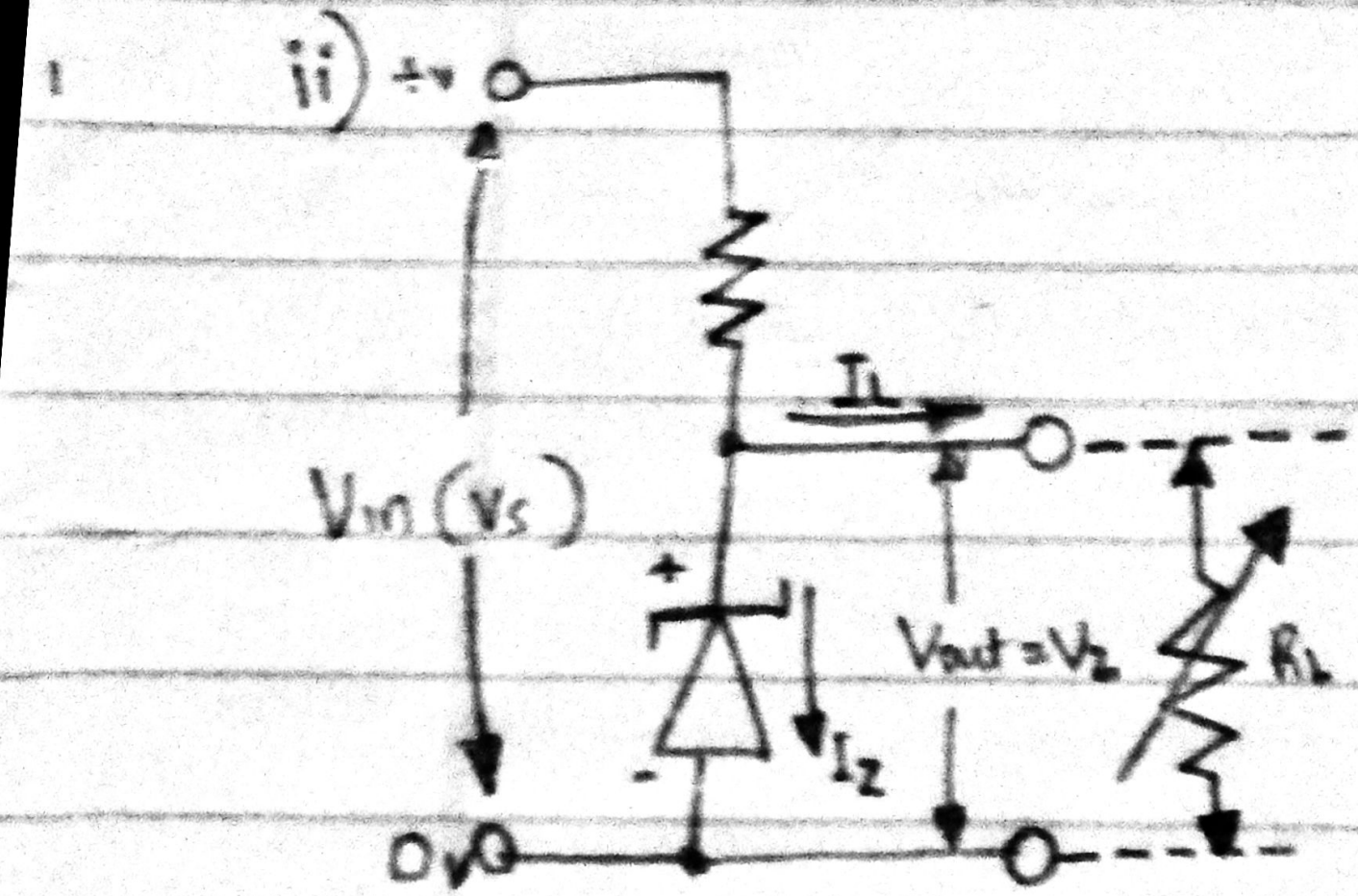
(1) The zener diode regulator simply put is a regulator that uses zener diode to regulate voltage. The zener diode has the ability to control itself and can be used to stabilize voltage source and for this reason, the zener diode regulator provides a constant output voltage to a load connected in parallel with it regardless of changes in both voltage and current as the zener diode regulates the voltage until the diode's current falls below the minimum value in the reverse breakdown region.

i)



Zener Diode I-V characteristics

Circuit Diagram



R_L = Load Resistor R_S = Series Resistor

V_{in} = Input Voltage V_{out} = Output Voltage

I_L = Load Current I_Z = Zener Current

V_Z = Zener Voltage

ii)

R_L = Load Resistor R_s = Series Resistor
V_{in} = Input Voltage V_{out} = Output Voltage
I_L = Load Current I_z = Zener Current
V_z = Zener Voltage

i) when load = 500Ω

$I_z = I_{Lmax} - I_L$

$I_L = \frac{V_z}{R_L} = \frac{10}{500} = 0.02A$

$0.02A = 20mA \ (*10^{-3})$

$I = 500 - 20 = 480mA$

(2) $P = 5W$, $I_{Lmax} = 500mA = 0.5A$
$V_{max} = 20$ $R = ?$, $P = IV$

$R_s = \frac{V_{in} - V_z}{I_{Lmax}}$,

$V_{in} = \frac{2V_m}{\pi} = \frac{2 \cdot 20}{\pi} = 12.732V$

$V_z = \frac{P}{I_{Lmax}} = \frac{5}{0.5} = 10V$

$\therefore R = \frac{12.732 - 10}{0.5}$

$= 5.46479$

$\approx 5.46\Omega$