OBI-OBUOHA ABIAMAMELA

18/EN05/040

MECHATRONICS ENGINEERING.

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Question

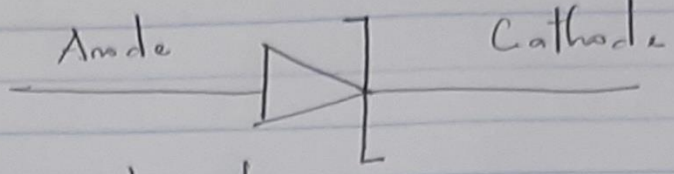
1. It is important to understand what a zener diode is. It is an electronic component which acts like the signal diode when forward biased. It helps to achieve a steady voltage at a varying level of current. This occurs after its breakdown reverse voltage is reached. It allows current flow in the reverse bias after the breakdown reverse voltage is reached. That is the significant difference.

Zener diode is also similar to PN junction diode. The doping concentration being different compared to PN junction diode. They are both similar in forward bias conditions but the zener diode acts as a "REGULATOR" in reverse bias.

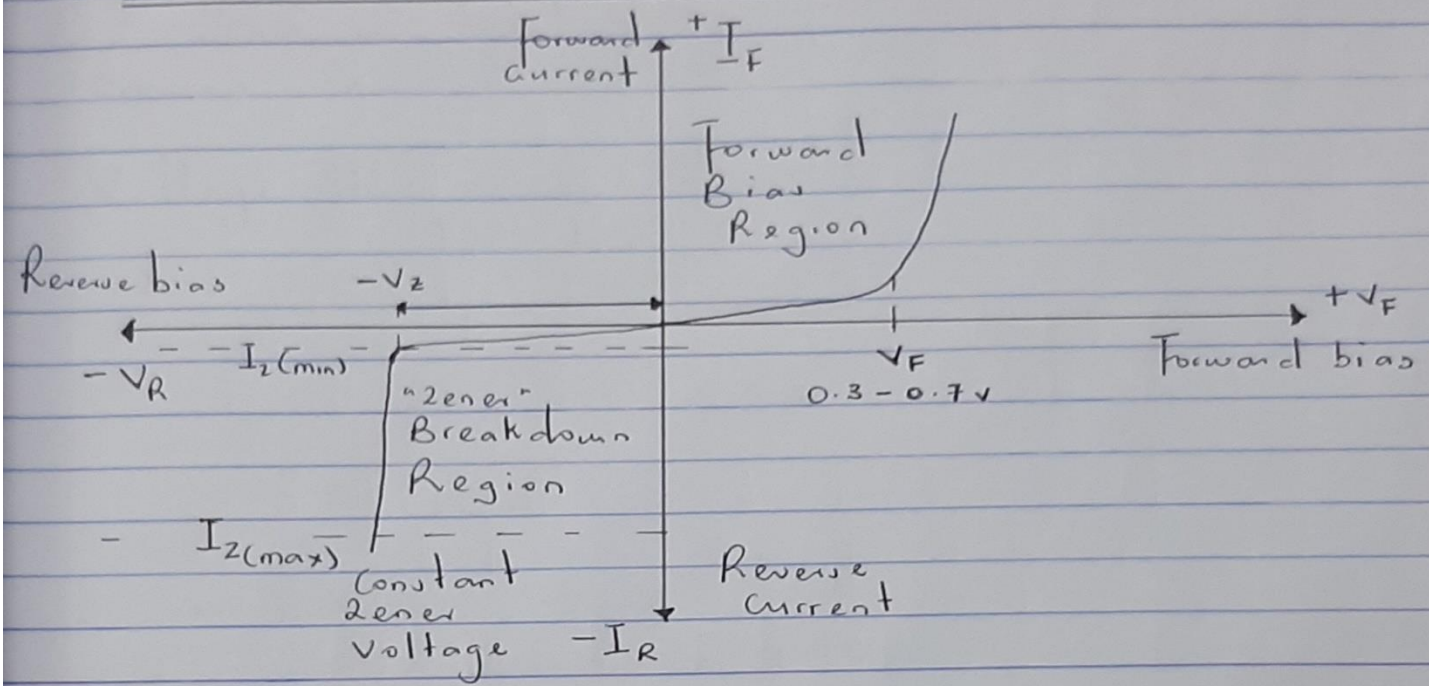
Therefore a voltage regulator is a circuit consisting of a zener diode implemented in its reverse bias condition.

A ~~vot~~ zener voltage regulator consists of a voltage source V_s, connected to a series connection of a resistor R_s and a zener diode. The zener diode can be connected in parallel to a load, R_L. This depends on the power intended to be dissipated by the diode. The R_s regulates the amount of current flowing through the circuit. V_{out} is connected across the zener diode.

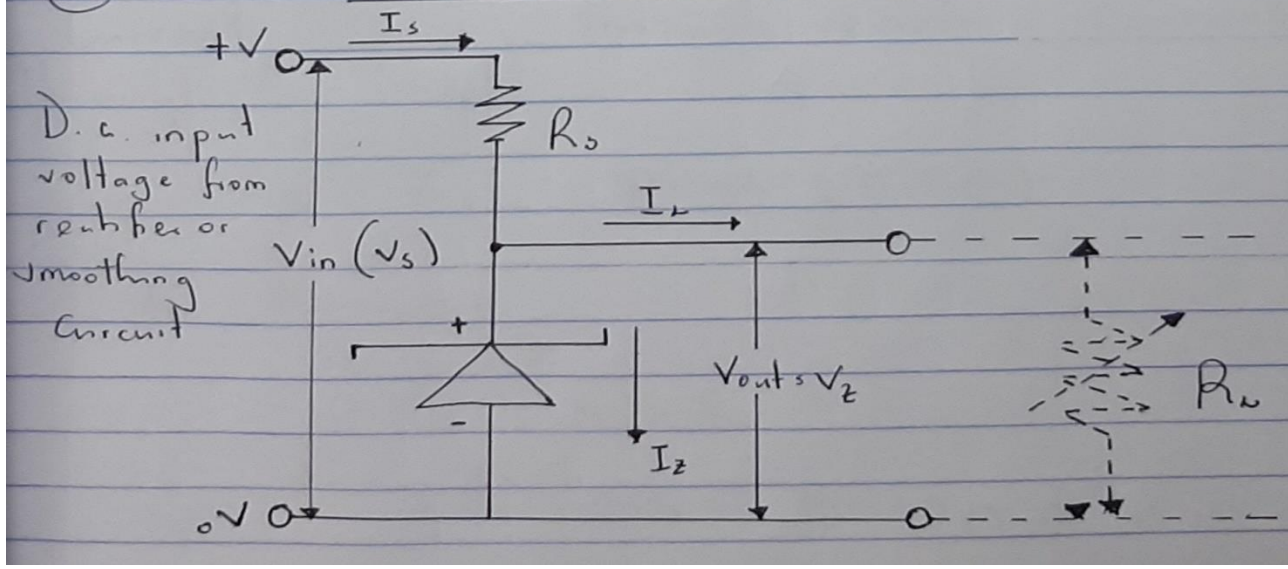
1 (I) Symbol



I-V characteristic curve.



(II) CIRCUIT DIAGRAM.



Question 2

Zener diode

max power (1W) = 5mW

$I_z \times V_z = 5mW$

where $I_z = 500mA \Rightarrow 0.5\,A$

$\therefore V_z = 5mW \,|\, I_z$

$V_z = 5mW \,|\, 0.5\,A$

$V_z = 10V$

Connection in series

$\therefore V_R + V_z = V_{d.c}$

$V_{d.c} = \frac{2\,V_{max}}{\pi} = 0.637\,V_{max}$ (For a bridge rectifier)

$\therefore V_{d.c} = 0.637 \times 20V$

$= 12.74V$

$\therefore V_{in} = V_{d.c} = 12.74V$

Also,

$V_R + V_z = 12.74V$

$V_R + 10V = 12.74V$

$V_R = 12.74V - 10V$

$V_R = 2.74V.$

for the resistor, $I_R \times R = V_R$

$R = V_R \,|\, I_R$

$R = 2.74 \,|\, 0.5 = 5.48\Omega$

∴ The minimum value of the series resistor to the Zener diode

$\Rightarrow$ 5.48 Ω

(II) $V_Z = V_L$

∴ $V_L = 10\,V$

A||B $V_L = I_L \times R_L$

$10\,V = I_L \times 500\,\Omega$

$I_L = 10 / 500$

$I_L = 0.02\,A$

∴ $I_L + I_Z = 0.5A$

$0.02A + I_Z = 0.5A$

$I_Z = 0.5A - 0.02A$

$I_Z = 0.48\,A$

$\Rightarrow$ 480 mA

∴ The current across the diode at full load of 500Ω

$\Rightarrow$ 480 mA $\Rightarrow$ 0.48 A