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18/ENG06/007
MECHANICAL ENGINEERING
ENG 222

Assignment

1) Describe a Zener diode regulator and
a) Sketch the symbol and I-V characteristic curve
b) Sketch and label the circuit diagram

Answer

A zener diode is a special type of rectifying diode that can handle breakdown due to reverse breakdown voltage without failing completely. It allows current to flow in either a forward or reverse direction. A semiconductor diode will suffer from premature breakdown or damage if the reverse voltage applied across becomes too high. But zener diodes are designed to have a low and specified Reverse Breakdown Voltage which takes advantage of any reverse voltage applied to it.

Zener diode as a voltage regulator consists of a Current limiting resistor R_S, Connected to in series with the Input voltage V_S with the zener diode ~~R_L in this reversed biased Condition. The S~~ Connected in parallel with the load R_L in this reversed biased Condition. The stabilized output voltage is always selected to be the same as the breakdown voltage V_Z of the diode. The function of the regulator is to provide a constant output voltage to a load connected in parallel with it. Despite ~~of~~ the ripples in the Supply voltage or the variation in the load Current I_L, the Zener diode will continue to regulate the voltage until the diode current I_Z falls below the minimum value in the reverse breakdown region.

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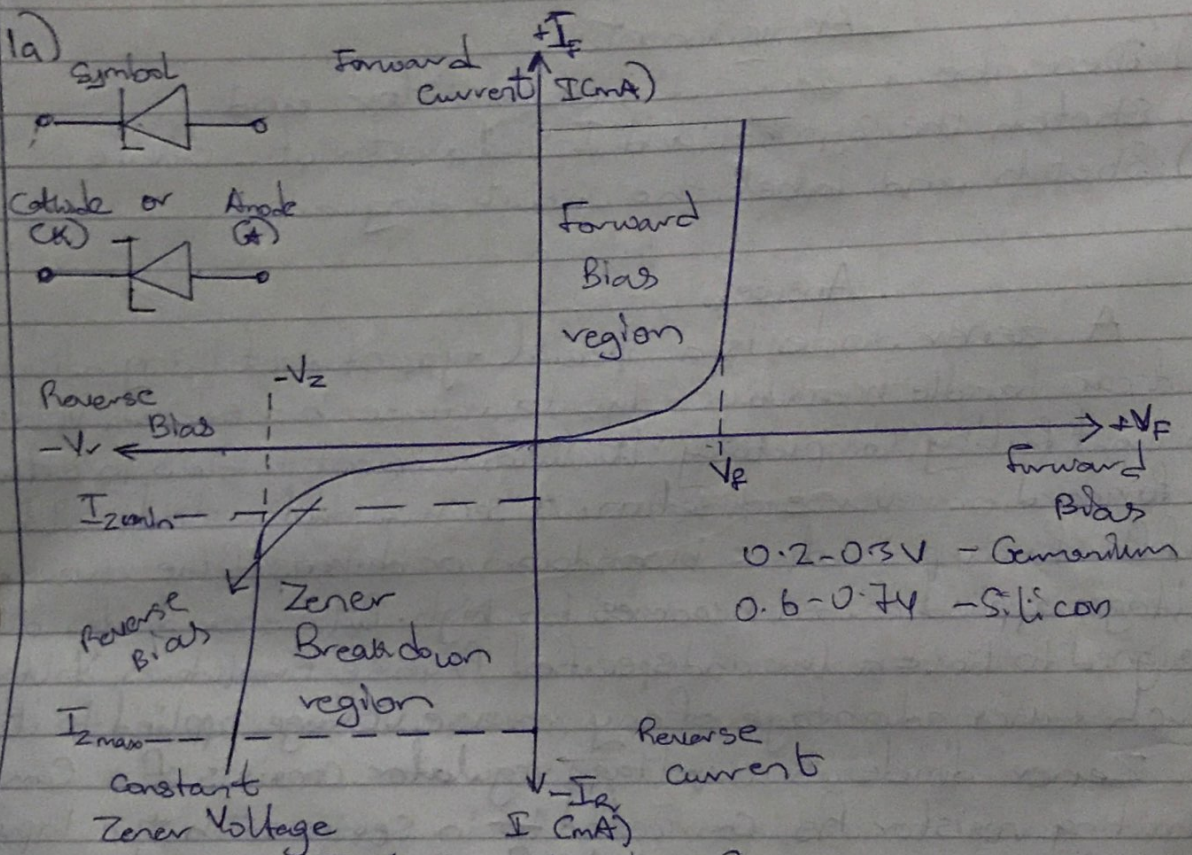
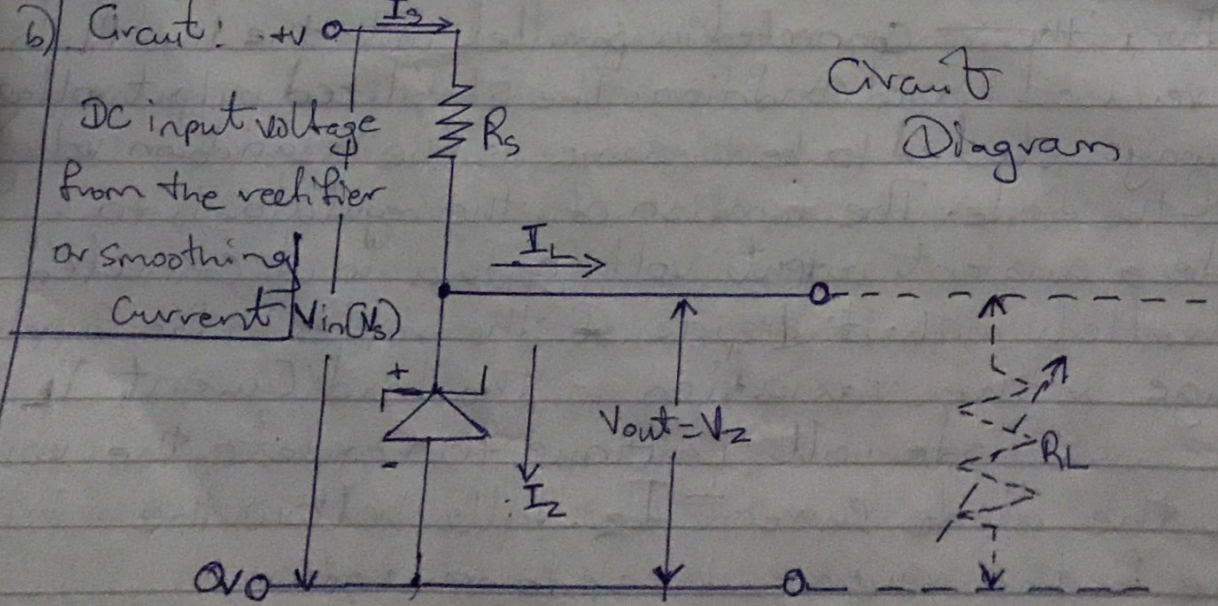
Then to summarise a little, a zener diode is always operated in its reverse biased condition. As such a simple voltage regular circuit can be designed using a zener diode to maintain a constant DC output voltage across the load in spite of variations in the input voltage or changes in the load current.

1a)



I-V characteristic Curve

b) Circuit:



Circuit Diagram

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2) $P = 5W$

$I_A = 500mA = 500 \times 10^{-3}$

$= 0.5A$

$V_{max} = 20V_{max}$

$V_{dc} = \frac{2 \times V_{max}}{\pi} = \frac{2 \times 20}{\pi}$

$= \frac{40}{3.142}$

$= 12.73V_{dc}$

i) The minimum value of the series resistor of the zener diode; $R_S = \frac{V_S - V_Z}{I_Z}$, $V_Z = ??$

$P = IV$ $\quad P_Z = 5W$

$P_Z = I_Z V_Z$ $\quad I_Z = 0.5A$

$V_Z = \frac{P_Z}{I_Z} = \left(\frac{5}{0.5}\right)V$

$= 10V$

$R_S = \frac{12.73 - 10}{0.5}$

$= \frac{2.73}{0.5}$

$\therefore = 5.46\Omega$

ii) The current across the diode at full load of 500Ω

$I_L = \frac{V_Z}{R_L}$ $\quad V_Z = 10V$

$R_L = 500\Omega$

$= \frac{10}{500}$

$= 0.02A$

$\therefore I_L = 20mA$

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