AKA PEACE OTAOGHENE
18/ENG01/002
CHEMICAL ENGINEERING

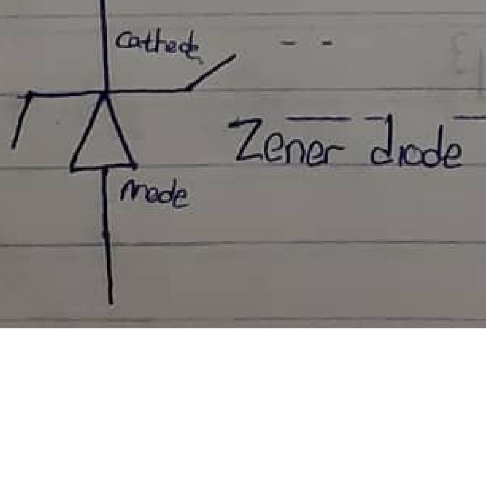
1. Describe a Zener diode regulator

A Zener-diode regulator is a general purpose diode which behaves like a normal diode when in forward biased, but when in reversed bias above a certain voltage [high reverse voltage] known as AVALANCHE point or Zener break down Voltage.

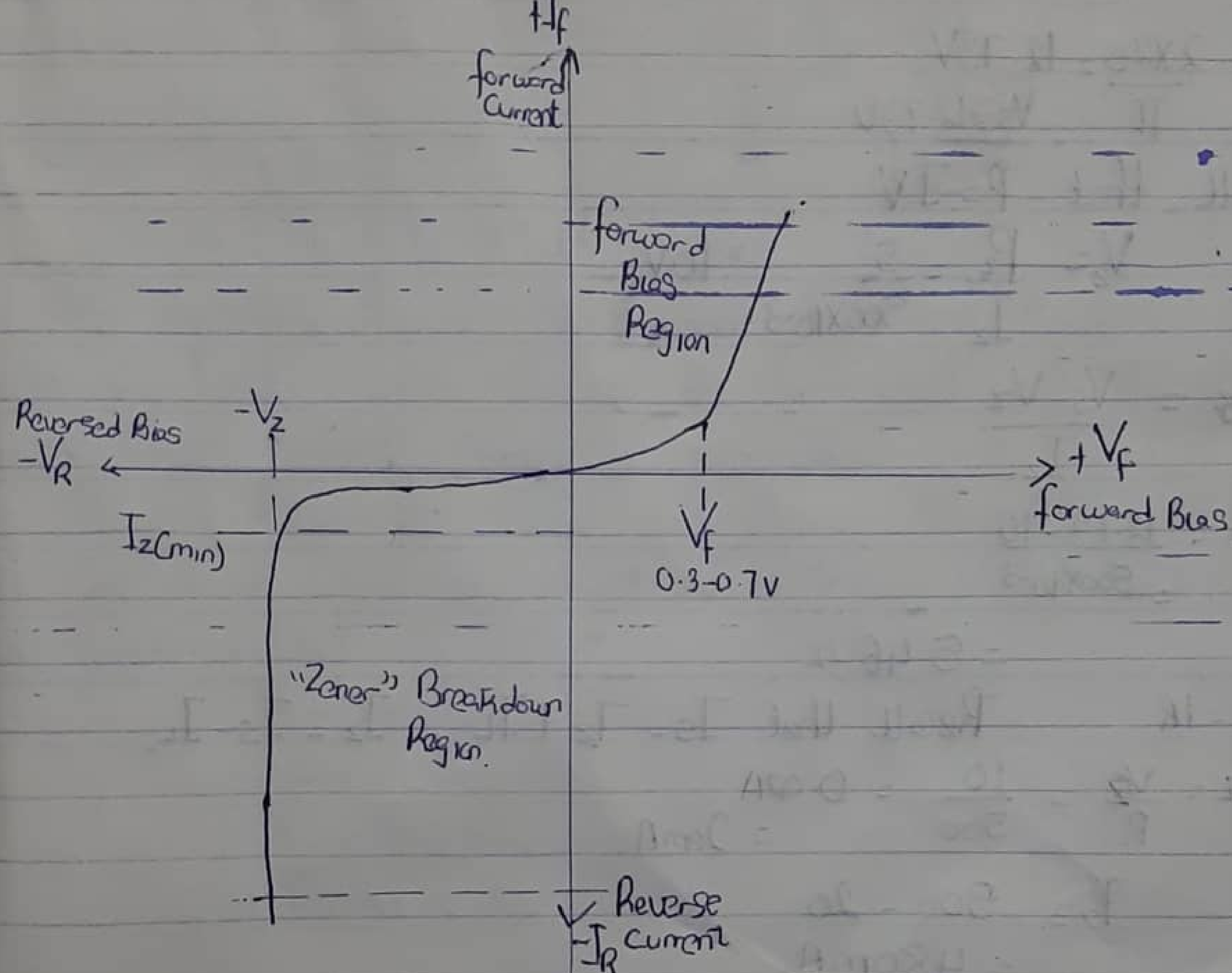
The Zener diode also called the break-down Voltage is specially designed to have a low predetermined Reverse Breakdown Voltage.

Breakdown occurs in the semi conductor depletion layer and a current starts to flow through the diode to limit the increase in voltage.

The Zener diode Symbol

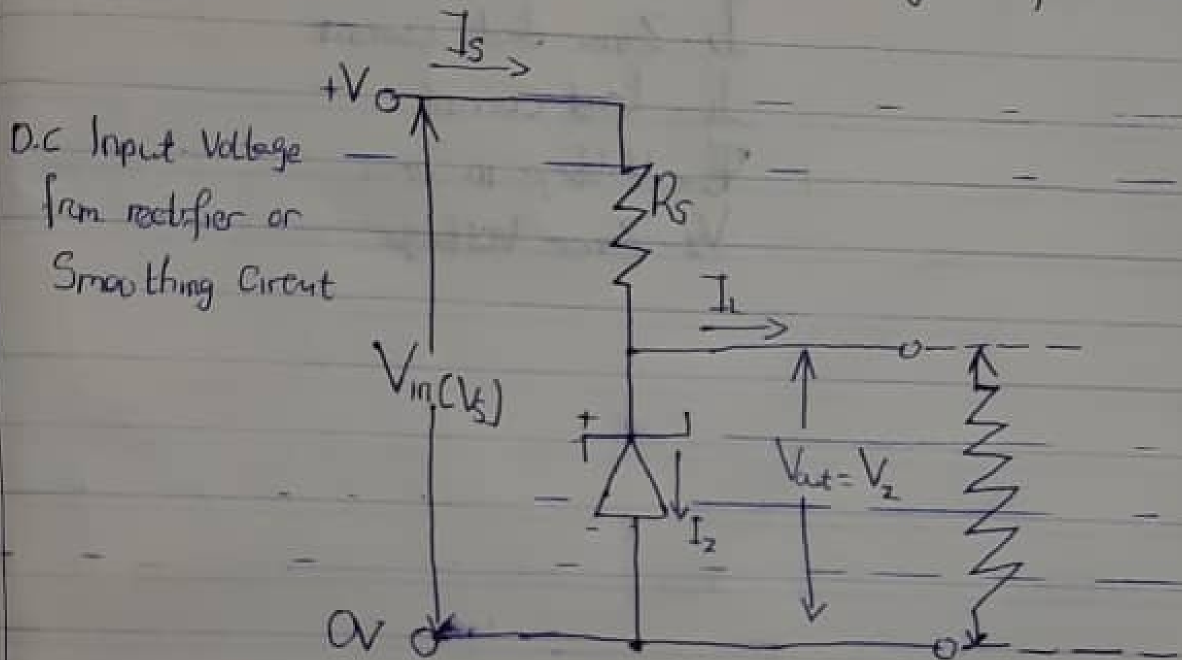


The Zener diode characteristics Curve.



The Zener diode is used in its reversed state i.e the diode connects to the negative supply. from the IV characteristics curve above its seen that the Zener diode has a complete breakdown region of almost a constant negative and remains nearly constant between breakdown current (Iz(min) and the maximum rating Iz(max))

The Sketch and labelled circuit diagram of a Zener diode



The resistor Rs and the Zener diode are connected in series to limit current through the diode (I_Z) with the voltage source being connected across the combination.

To find Rs min and Rs max. for Rs min, the extreme condition is considered which is when Vin is minimum and load current is maximum (I_L)

$$I_S = I_{Z\,min} + I_{L\,max}$$

$$I_{Z\,min} = P_{min} / V_Z$$

$$V_S = V_{in\,min} - V_Z$$

$$R_{S\,min} = V_S / I_S$$

Then for $R_{s max}$ the extreme Condition States that V_{in} is maximum and load current is minimum [i.e no Load Connected]

$$I_S = I_{z max} + I_{L min}$$

$$I_{z max} = P_{max} / V_z$$

$$V_S = V_{in\,max} - V_z$$

$$R_{s max} = V_S / I_S$$

2. $P_z = 5W$ $I_z = 500mA$ $V_s = 20V_{max}$

$I_z = 0.5A$

V_{max} to V_{dc}.

$V_{dc} = \frac{2V_{max}}{\pi}$ [for bridge Rectifier]

$V_{dc} = \frac{2 \times 20}{\pi} = 12.73V$

$V_s = 12.73V$

Recall that $P = IV$

$V_z = \frac{P_z}{I_z} = \frac{5}{500 \times 10^{-3}} = 10V$

$R_s = \frac{V_s - V_z}{I_z}$

$R_s = \frac{12.73 - 10}{500 \times 10^{-3}}$

$= 5.46\Omega$

ii) $V = IR$ Recall that $I_s = I_z + I_L$, $I_z = I_s - I_L$

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

$= 20mA$.

$I_z = 500 - 20$

$= 480mA$.