MINISTRY OF HIGHER EDUCATION AND SIENTIFIC RESEARCH - SAWA UNIVERSITY - ENGINEERING COLLEGE -PHYSICS DEPT. SECOND STAGE 2.nd COURSE

جامعة ساوة الاهلية

كلية التقنيات الهندسية

القسم: الفيزياء الطبية والعلاج الاشعاعي

المرحلة الثانية /الفصل الثاني

عنوان المحا ضرة:

Zener Diode

رقم المحا ضرة (6)

the Sixth lecture

elecventh week

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بسم الله الرحمن الرحيم

IN THE NAME OF GOD, THE MOST GRACIOUS, THE MOST MERCIFUL

Department of Physics and Radiotherapy

Zener Diode

Zener Diode Definition

A Zener diode is a highly doped semiconductor device specifically designed to function in the reverse direction. It is engineered with a wide range of Zener voltages (Vz), and certain types are even adjustable to achieve variable voltage regulation.

Zener Diode Symbol

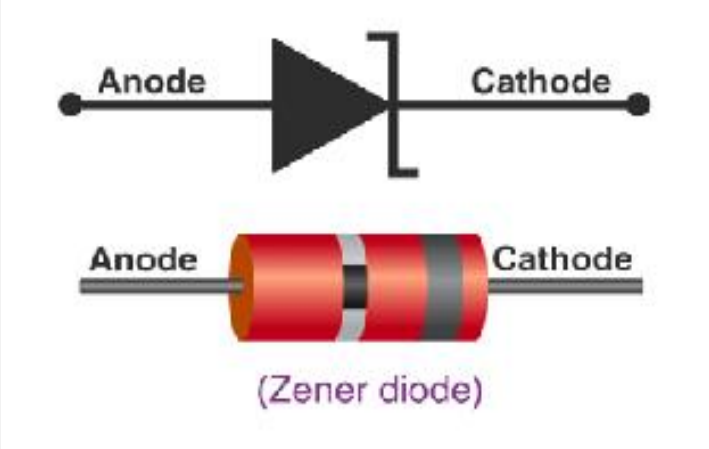


Fig. (29) zener diode symbol

(I) Zener Characteristic curves:

Zener diodes operate similarly to conventional diodes when in the forward-bias mode. They have a bias turn-on voltage of between 0.3 and 0.7V. When connected in the reverse mode, there is a small leakage current flow in most applications

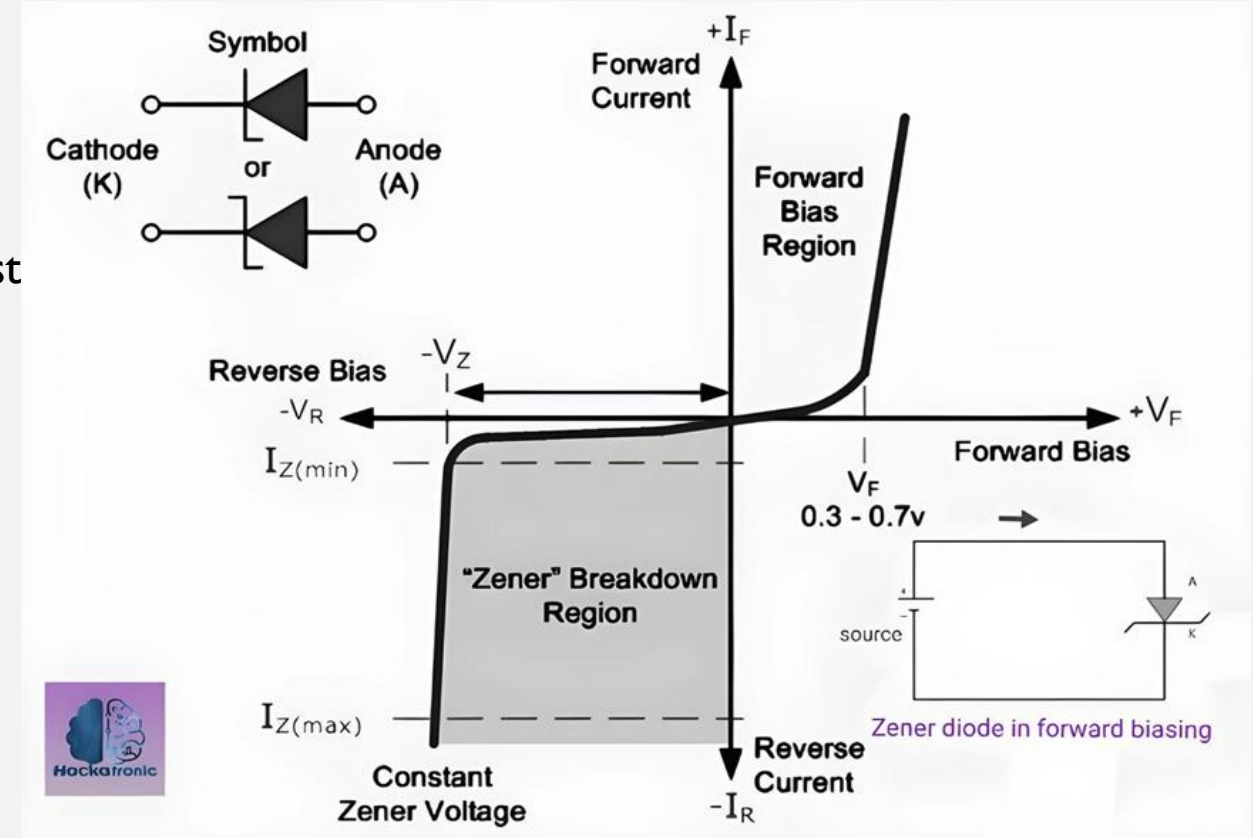
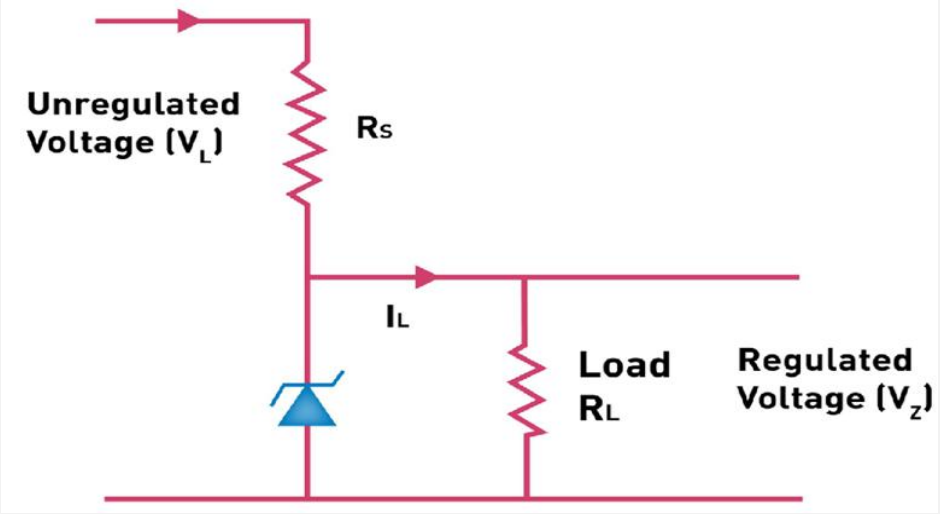


Fig. (30) Zener Characterist curves

Zener diode as a voltage regulator:

The zener diode is used as a Shunt voltage regulator for regulating voltage across small loads. The Zener diode is connected parallel to the load to make it reverse bias, and once the Zener diode exceeds knee voltage, the voltage across the load will become constant. The breakdown voltage of Zener diodes will be constant for a wide range of currents.

Fig.(31) Zener regulation



Essensial relationships

The series current (Is) is culculated by :

$$I_s = \frac{V_{in-} V_{out}}{Rs} \quad \text{----------} \quad (1)$$

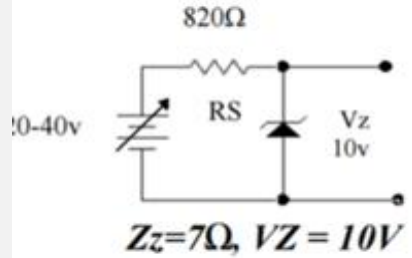
And also Is may be find by:

$$I_s = I_Z + I_L \quad \text{----------} \quad (2)$$

$$V_z \approx V_{out} \text{----------(3)}$$

$$I_L = \frac{V_{out}}{R_L} \quad \text{----------(4)}$$

Exa.(13) in the following figure :



1- By ideal approximation find the output voltage and (the maximum minimum Zener current

2- By second approximation find :

(a Vout(max)

(b Vout(min)

1)

A. Vout = VZ = 10V

B. $IZ(\max) = \frac{Vin(max) - ZV}{R} = \frac{40-10}{820} = 36.6\ mA$

C. $IZ(\min) = \frac{Vin(min) - ZV}{R} = \frac{20-10}{820} = 12.2\ mA$

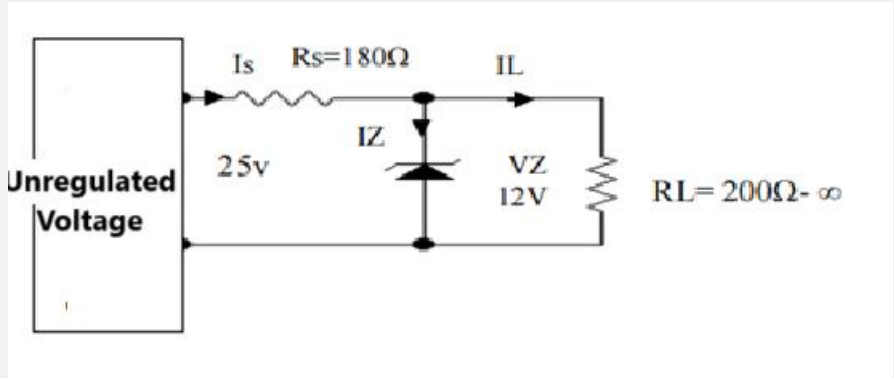
A. Vout (max) = VZ + IZ(max) * Zz

$= 10 + 36.6 * 10^{-3} * 7 = 10.25$ V

B. Vout (min) = VZ + IZ (min) *Zz

$= 10 + 12.2 * 10^{-3} * 7 = 10.09$ V

Example (12) Find the series current (Is) and (maximum and minimum value of zener) current , and also find (maximum and minimum value of Load) current



$$IS = \frac{Vin-Vout}{Rs} = \frac{Vin}{Rs} = \frac{25-12}{180} = 72mA$$

$$IL(\max) = \frac{Vout}{RL\ (min)} = \frac{VZ}{RL(min)} = \frac{12}{200} = 60mA$$

$$IL(\min) = \frac{Vout}{RL\ (mix)} = \frac{VZ}{RL(max)} = \frac{10}{\infty} = 0$$

Is = IZ+IL

IZ= IS- IL

IZ(max) = IS – IL (min) = 72-0=72mA

IZ(min) = IS – IL (max) = 72-60=12mA

Example 13:

in preceding Example find calculate the poutput voltage in ideal and normal zener diode

$$\text{Vout (min)} = VZ + IZ\ (\text{min})\ *Zz$$

$$= 12 + 12*10^{-3}*7 = 12.1\ \text{V}$$

$$\text{Vout (max)} = VZ + IZ(\text{max})\ *\ Zz$$

$$= 12 + 72\ *\ 10^{-3}*7 = 12.5\ \text{V}$$

انتهى .... شكرا لاستماعكم