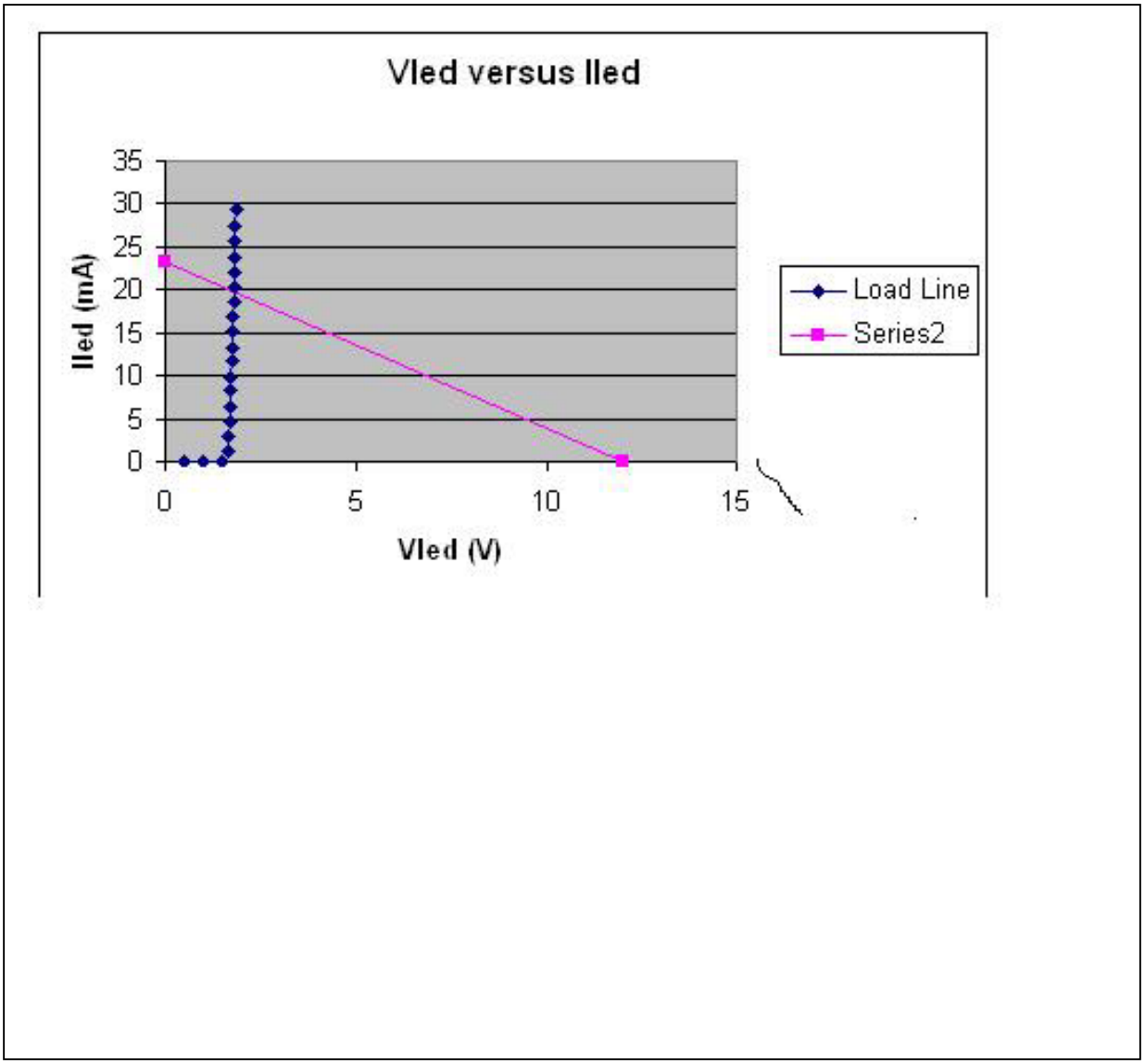
Experiment 6:

LEDs and Zener Diodes

Post-Lab Report

A.

- If V_S = 12 V DC, choose the series resistor to give 20 mA through the red LED. Draw the load line.

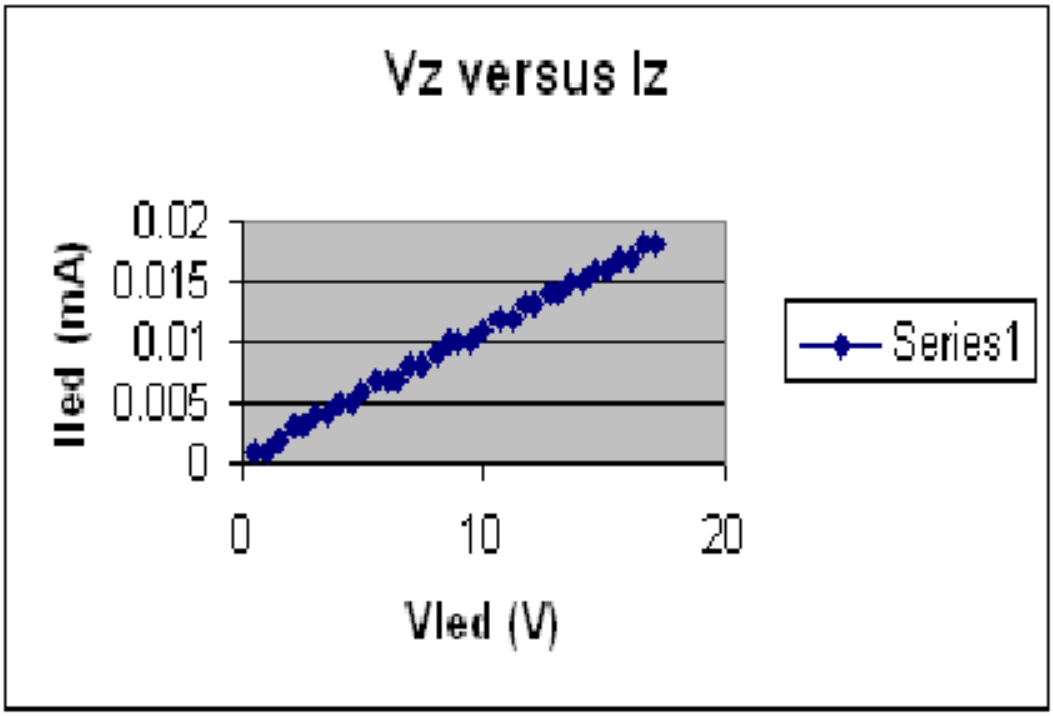


- In the circuit of Fig. 2, does the power dissipated in the reverse direction serve any useful purpose? How can it be eliminated?

NOTE:
(for question A1 the
using KVL
-12+0.02R+1.7=0 then
R=515 ohms)
The power dissipated in the reverse direction doesnt have any useful purpose. It can be eliminated by putting the diode or LED in the forward direction, so this will rectify the input voltage to only positive cycle and would eliminate the reverse direction power dissipation. We can also eliminate by superimposing the DC component of the voltage source to the AC source.

B.

- Plot a curve of IZ versus VZ.



- Calculate the value of the Zener resistance rZ.

Vz=rz*Iz;
rz=Vz/Iz=(4.56-4.97)/(0.005-0.006)=410kohms

- What is the minimum value of VS required to get Zener diode breakdown?

at (Vs=5.7,Iz=0.256) the minimum value for breakdown region is attained at 5.58 VOltage

- What is the value of the knee Zener voltage, VZK? ; What is the value of knee Zener current, IZK?

Vzk=5.56
Izk=0.42mA

- Find the line regulation of the Zener diode.

By definition the line regulation is the ratio of the change in VZ to the change in VS, provided that the diode is in the Zener region.

Line regulation=deltaVz/deltaVs

- For what range of load resistors does the Zener diode regulate the load voltage? What is the load regulation of the Zener diode?

The Zener diode regulates the load voltage for the range of load resistance where the Zener voltage is constant.
The lo ad regulation is the ratio of the change in VZ to the change in lLoad, provided that the diode is in the Zener region.
Load Regulation=delta Vz/delta I load

- How is the maximum current in a Zener diode determined?

The maximum current in a Zener diode is determined by taking the maximum value of the input voltage at no load. So the maximum current in a Zener diode is determined using:

Izmax=Pmax/Rz

- How is the minimum current in a Zener diode determined?

The minimum current in the Zener diode is determined by taking the minimum value of the input voltage with a very small resistance connected to the load. Therefore, the current in the load is at its maximum value thus the minimum Zener current in the diode can be calculated by the equation:
Iz min = I total – I loadmax

Thus, operating in the region close to the knee region allows us to determine the minimum value of the Zener current.

- Show that for a Zener voltage regulator, the value of the resistor R should be chosen using the equation:

$$R = \frac{V_{Smin} - V_{ZK} - r_Z I_{ZK}}{I_{ZK} + I_{LOADmax}}$$

For the Zener diode to conduct VZK, IZK, and VS must be at a certain minimum value. Thus, the load current is at its maximum value. From the Zener voltage regulator circuit we get:
VS = RIS + VL
VS = R (IZK + IL) + (VZK + rZ IZK)
Due to the above discussed minimum current limit for the Zener diode we replace VS by its minimum value and IL by its maximum value and solving for R we obtain the equation:

R=(Vsmin-Vzk-rz*Izk)/(Izk+Iloadmax)