King Fahd University of Petroleum & Minerals
Physics Department
PHYS 308 (Term 211)

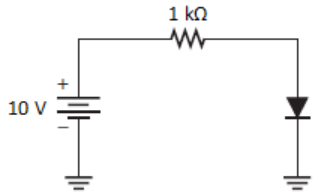
Homework 1

Monday, September 20, 2021

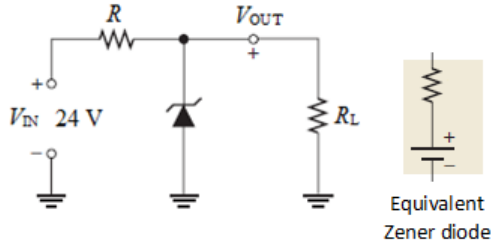
The solution must contain all the detailed steps and calculations.
Due date: Tuesday, September 28.

Important: Always take the value of 0.7 V for Silicon.

Problem 1.
Determine the forward voltage and forward current for the diode in the figure below for each of the diode models (ideal model, simplified model, approximate model). Also find the voltage across the limiting resistor in each case. Assume $r_F = 10\ \Omega$ at the determined value of forward current.



Problem 2.
For the circuit below:



(a) Determine V_{OUT} at I_{ZK} and at I_{ZM}.
(b) Calculate the value of R that should be used.
(c) Determine the minimum value of R_L that can be used.

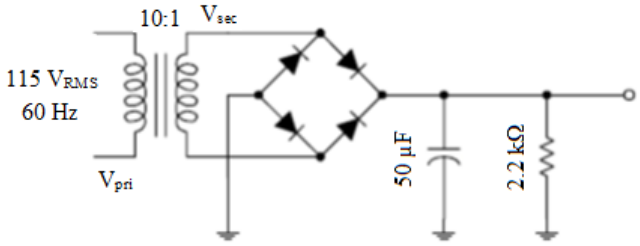
The datasheet of the Zener diode gives the following information:
$V_Z = 15$ V @ I_Z (Zener current or Zener test current) = 17 mA.
I_{ZK} (Zener knee current) = 0.25 mA.
Z_Z (Zener impedance) = 14 Ω.
P_{DM} (maximum power dissipation) = 1 W.

Important: Since the voltage curve is not ideally vertical, a change in Zener current (ΔI_Z) produces a small change in Zener voltage (ΔV_Z). By Ohm's law, the ratio of ΔV_Z to ΔI_Z is the impedance, and is expressed in the following equation:

$$Z_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

Problem 3.

For the circuit below:



(a) Find the output DC voltage.
(b) Determine the ripple factor in %.
(c) Does the 50 µF capacitance match the calculated ripple factor?
(d) Determine the load current.