ECE 3040 Microelectronic Circuits Quiz 3

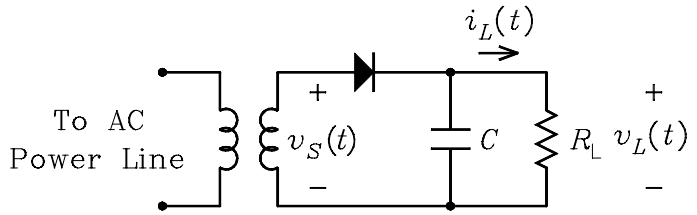
June 2, 2004

Professor Leach Name_____

Instructions. Print your name in the space above. The quiz is closed-book and closed-notes. The quiz consists of 2 problems. **Honor Code Statement:** *I have neither given nor received help on this quiz.* Initials _____

1. (a) What are the two diode reverse breakdown mechanisms called? *Answer:* Zener and avalanche.
   (b) Draw the symbol for a Zener diode. (See the notes or book)
   (c) What are the two charge storage mechanisms in a diode called? Which dominates for a forward biased diode and is it determined by a voltage or a current? Which dominates for a reverse biased diode and is it determined by a voltage or a current? *Answer:* Junction (or depletion) charge and diffusion charge. The diffusion charge dominates in a forward biased diode and is determined by the current. The junction (or depletion) charge dominates in a reverse biased diode and is determined by the voltage.
   (d) Describe the construction of a Schottky barrier diode and draw its symbol. *Answer:* It is a metal (aluminum) to semiconductor (n-type) junction. See notes or book for diagram.

2. A half-wave rectifier circuit is shown. It is given that $v_S(t)$ is a 60 Hz sinusoidal voltage with an rms value of 24 V. When the diode is forward biased, its voltage drop is $V_{D0} = 0.6\,\text{V}$. The circuit values are $R_L = 200\,\Omega$ and $C = 1000\,\mu\text{F}$.



   (a) Calculate the peak load voltage. *Answer:* $v_{L(peak)} = 24\sqrt{2} - 0.6 = 33.34\,\text{V}$
   (b) Calculate the maximum reverse bias voltage across the diode. *Answer:* $33.341 - \left(-24\sqrt{2}\right) = 67.282\,\text{V}$
   (c) The percent ripple is given by % ripple $= [1 - \exp(-T/R_L C)] \times 100\%$. When the diode is off, what is the lowest value that the load voltage can "droop" to before the diode conducts again? *Answer:*

$$\%\text{ ripple} = \left[1 - \exp\left(\frac{-1}{60 \times 200 \times 1000 \times 10^{-6}}\right)\right] \times 100\% = 7.996\%$$

$$v_{AC} = 33.341 \times \frac{7.996}{100} = 2.666\,\text{V}$$

$$v_{\text{droop}} = 33.341 - 2.666 = 30.675\,\text{V}$$