American University of Beirut

Department of Electrical and Computer Engineering

EECE 310 – Electronics Fall 2011 – 2012

*Due Wednesday October 26, 2011 at 9:00 am*

**Homework 4**

**1.** **[50 points]** Design a Zener voltage regulator to provide a regulated voltage of around 9 V. The available 9 V, 0.5 W Zener is specified to have a drop of 9 V at a test current of
10 mA. At this value of current *r*Z is specified to be 25 . The value of *I*ZK for the diode is 2 mA. The unregulated supply varies between 10.5 V and 14 V. The regulator is required to supply a load that draws a current of 5 to 20 mA.

1. **[5 points]** Find *V*Z0 for the Zener diode.
2. **[5 points]** Find *IZmax*. **[5 points]** Find the Zener voltage when the Zener current is at *IZmax*.
3. **[5 points]** Calculate the range of values for the resistor *R* in the circuit.
4. Using a value of *R* that is close, to the nearest **[5 points]** *standard* 5% *tolerance resistor value*, to the upper range:
	* 1. **[5 points]** Find the change in load voltage that corresponds to the 10.5-to-14 V variation in the unregulated supply voltage. Assume that the load current is constant.
		2. **[5 points]** Find the change in load voltage that corresponds to the full change in load current. Assume that the supply voltage is fixed.
		3. **[5 points]** What is the maximum current that the Zener diode should be able to conduct? **[5 points]** What is the Zener power dissipation under this condition? **[5 points]** What is the worst-case power dissipation in the resistor *R*?

**2. [25 points]** Consider the waveform shown in Figure 1.



Figure 1

Assume that *T* = 1/50 sec. This voltage is the input to a half-wave rectifier with a capacitor filter. The diode drops 0.75 V when conducting, and the load draws a constant current of 15 mA.

1. **[5 points]** Calculate the value of the capacitor if the ripple voltage
is at most 0.5 V.
2. **[5 points]** For what fraction of the cycle does the diode conduct?
3. **[5 points]** Find the average diode current.
4. **[5 points]** Find the peak diode current.
5. **[5 points]** Find the PIV for the diode.

**3. [25 points]** Repeat Problem 2 for the case in which the rectifier is a full-wave rectifier using a 4-diode bridge.