PSpice Simulation Assignment #1

In this PSpice project you will become familiar with the software by creating two simulations of two DC Power Supply circuits. The first simulation is shown in Figure 1. This circuit is an "unregulated" DC power supply. By "unregulated" we mean that the DC output voltage will fluctuate if the peak AC input voltage changes (for example, if the voltage in a house suddenly drops as a refrigerator starts). In order to reduce these unwanted variations in the output voltage, a shunt regulator can be added to the circuit as shown in Figure 2. You will find that the shunt regulator has the advantage that it also reduces the "ripple voltage" at the output.

(Note: the 5 kΩ resistor simulates the load that would be attached to the power supply. In reality, an entire circuit would be powered in the place of the 5kΩ, but this would unnecessarily complicate the analysis.)

Part I

a) Enter the schematic for the unregulated power supply into the PSpice Schematics editor. Set the AC power supply to have a peak voltage of 20 v and a frequency of 60 Hz. We are not interested in DC offset voltages for this sine wave input, so let VOFF=0.

b) Ask PSpice to perform a "transient" analysis of the circuit so that you can view the output voltages as a function of time. You will want to examine at least a few cycles of the input voltage, so simulate from 0<t<3T, where T is the period for the input voltage.

c) In a brief write-up, show your schematic (use "copy to clipboard" to capture the schematic and paste it into Word). Include another figure that shows Vout vs. time. Discuss the following issues: (i) What is the average DC voltage at the output? (ii) What is the peak-to-peak ripple voltage at the output? (iii) What happens to the output voltage if the AC power supply voltage changes ±20%?

Figure 1. An unregulated DC power supply consists of a full wave bridge rectifier and a filter capacitor.
Part II
In this section you will modify the power supply from Part I to include a Shunt Regulator. This addition to the power supply should clamp the output voltage near the breakdown voltage of the zener diode (D6).

a) Repeat parts (a) and (b) from Part I with the shunt regulator in place as shown in Figure 2.

b) In the same *brief* write-up, show your new schematic. Include another figure that shows $V_{out}$ vs. time. Discuss the following issues: (i) What is the average DC voltage at the output? (ii) What is the peak-to-peak ripple voltage at the output? (iii) What happens to the output if the AC power supply voltage changes ±20%?

c) In one paragraph, summarize the advantages and disadvantages of the two DC power supply designs.

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**Figure 2.** A regulated power supply consisting of a full wave bridge rectifier, a filter capacitor, and a shunt regulator.