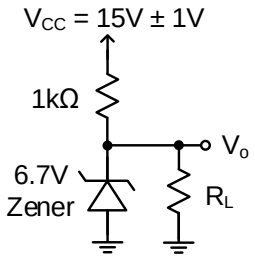
EECE 2412 – Homework 4 – Fall 2018

Due: Wednesday, October 10, 2018

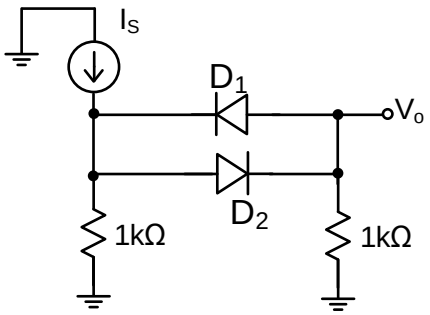
1) Problem D3.28 on page 192 in the textbook (Allan R. Hambley, Electronics, 2nd edition).

2) Problem 3.60 on page 195 in the textbook.

3) Read Section 3.7 of the textbook and check your understanding by completing the exercises at the end of this section before solving the following problem. The 6.7V Zener diode in the circuit below is specified to have $V_{zo} = 6.7V$, and $r_z = 50\Omega$. The supply voltage V_{CC} is nominally 15V, but can vary by ±1V. To analyze this circuit, use the model for a Zener diode in the breakdown region that is provided in the lecture slides. Another specification for this Zener diode is that $I_{ZK} = -I_D \geqslant 0.5mA$ is required to ensure that the diode remains in the breakdown region (instead of the idealized case in the lecture notes, where the edge of the breakdown region is defined as $I_Z = -I_D > 0$).
   a. Find V_o without load and the nominal V_{CC} value (of 15V).
   b. Find the change in V_o (±Δvolts) resulting from the ±1V supply voltage variation.
   c. Find the change in V_o resulting from connecting a load resistance $R_L = 2k\Omega$ (for the case with nominal supply voltage of $V_{CC} = 15V$).
   d. Find the value of V_o when R_L is changed to $0.85k\Omega$ (with nominal supply voltage of $V_{CC} = 15V$).
   e. For the complete supply voltage range ($14V < V_{CC} < 16V$), what is the minimum R_L for which the diode still operates in the breakdown region?



4) Use the constant voltage drop model (with $V_{do} = 0.7V$ in the forward bias region) to plot the transfer characteristic from the input I_S to the output V_O in the circuit shown below. On the x-axis, use a range for I_S from -2mA to +2mA. Clearly label the voltages at which the diodes switch on/off, and label the slopes of the curve in all regions around the switching points in the plot (V_O vs. I_S). Show the analysis steps that you used to plot the transfer characteristic.



5) Use PSPICE to plot the transfer characteristic (V_o vs. V_{in}) for the circuit in Fig. P3.16(a) on page 145

in the textbook with the D1N4002 diode model for the standard diode, the D1N750 for the Zener diode, and a 1KΩ resistor. Use a sweep range of -15V $\leqslant V_{in} \leqslant$ 15V, and label the voltage values of key transition points in the plot. Simulate the transient output voltage with an input of $V_{in}(t) = 3V \cdot \sin(30\pi \cdot t)$, and repeat the transient simulation with an input of $V_{in}(t) = 12V \cdot \sin(30\pi \cdot t)$. Chose a run time that ensures we can see at least 3 cycles of the input and output waveforms. Label the peak voltage values in the plots. Submit the schematic of the circuit and the relevant plots.