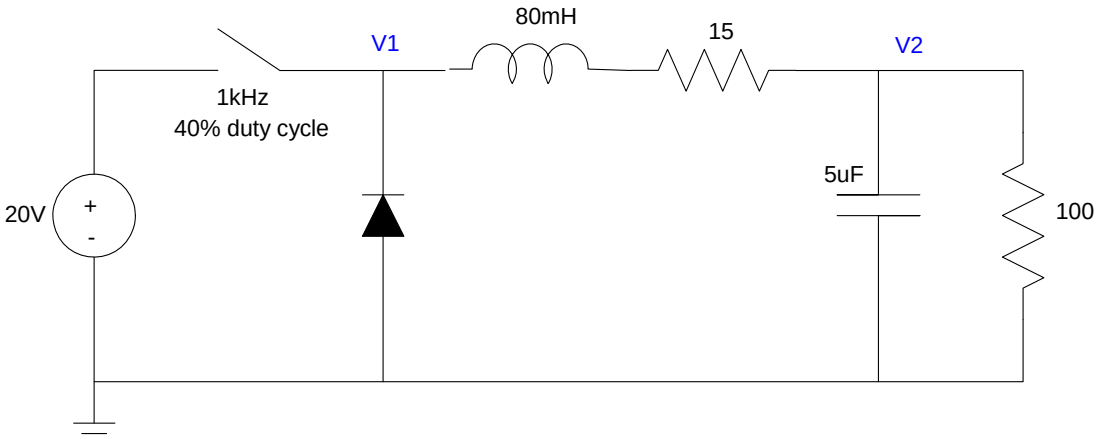
ECE 320 - Homework #6

DC to DC Converters, Schmitt Triggers, Fourier Transforms. Due Monday, February 24th

DC to DC Converters

1) Determine the voltages (both DC and AC) for V1 and V2.

2) Simulate this circuit in PartSim and determine the voltages at V1 and V2 (both DC and AC)



3) Change the duty cycle and C so that

- The DC voltage at V2 = 5.00V
- The ripple at V2 is 100mVpp

Schmitt Triggers

4) A thermistor has the following resistance vs. temperature relationship

$$R = 1000 \cdot \exp\left(\frac{3905}{T} - \frac{3905}{298}\right)\ \Omega$$

where T is the temperature in degrees Kelvin (Celsius + 273). Design a circuit which outputs

- +10V when T > 5C
- 0V when T < 0C
- No change for 0C < T < 5C

5) Design a circuit which turns on and off a DC motor based upon temperature

- The motor turns on when T > 5C
- The motor turns off when T < 0C
- No change for 0C < T < 5C

Assume the motor draws 400mA @ 10V when on.

6) (Lab): Build the circuit you designed for problem #5.

Fourier Transforms

The voltage V1 in problem #1 is a 40% duty cycle square wave

$$V_1(t) = V_1(t + 1ms) \qquad \textit{V1 is periodic in 1ms - i.e. it's a 1kHz square wave}$$

$$V_1(t) = \begin{cases} +20V & 0 < t < 400\mu s \\ -0.7V & 400\mu s < t < 1000\mu s \end{cases}$$

7) Determine the first five terms for the Fourier transform for V1(t)

$$V_1(t) = a_0 + a_1\cos(\omega_0 t) + b_1\sin(\omega_0 t) + a_2\cos(2\omega_0 t) + b_2\sin(2\omega_0 t)$$

8) Determine V2(t) at each frequency

- DC
- 1kHz
- 2kHz

9) How do your answers for problem #1 and problem #8 compare?

	Problem #1	Problem #8
V2(DC)		
V2 1kHz term		
V2 2kHz term		

note: The 1kHz term is V1pp for problem #1. This is related to problem #8 as

$$2\left|a_1 - jb_1\right| = V_{pp} \qquad \text{at 1kHz}$$

The 2kHz term is V1pp for problem #1 is 0Vpp (we ignored it). This is related to problem #8 as

$$2\left|a_2 - jb_2\right| = V_{pp} \qquad \text{at 2kHz}$$