ECE 320 - Homework #7

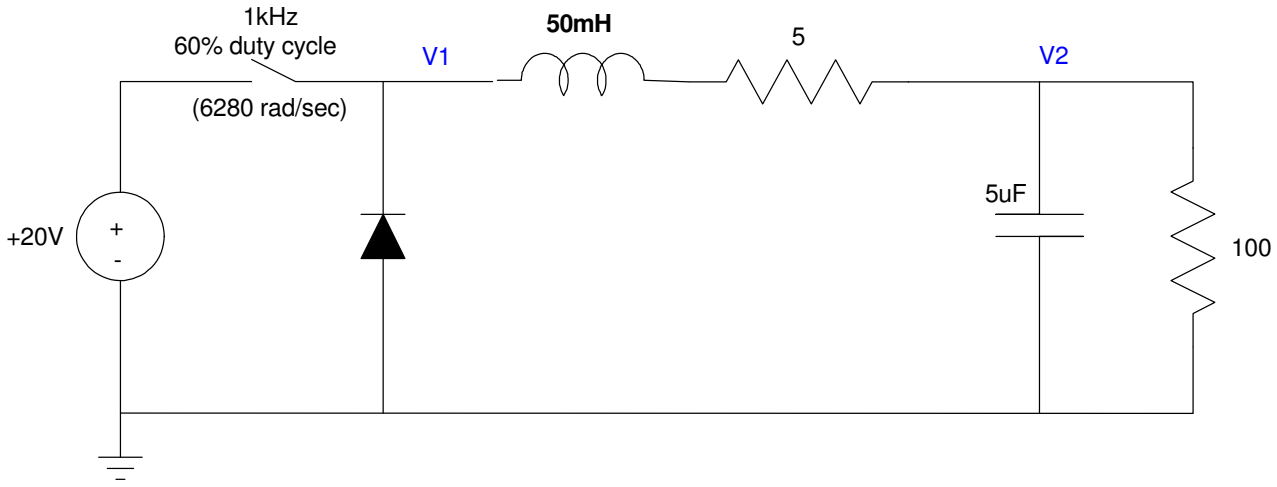
Fourier Transform, DC to AC, SCR. Due March 1st, 2021

Fourier Transform

The voltage V1 is a 60% duty cycle square wave

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

$$V_1(t) = \begin{cases} +20V & 0 < t < 600\mu s \\ -0.7V & 600\mu s < t < 1000\mu s \end{cases}$$



1) Determine the first five terms for the Fourier transform for V1(t)
   - DC
   - 1kHz, sine and cosine
   - 2kHz, sine and cosine

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

2) Determine V2(t) at each frequency
   - DC
   - 1kHz
   - 2kHz

3) Compare the results from this homework set vs. homework set #6, problem #4 and #5.
   - Does using the Fourier transform for V1(t) give more accurate results in predicting V2(t)?

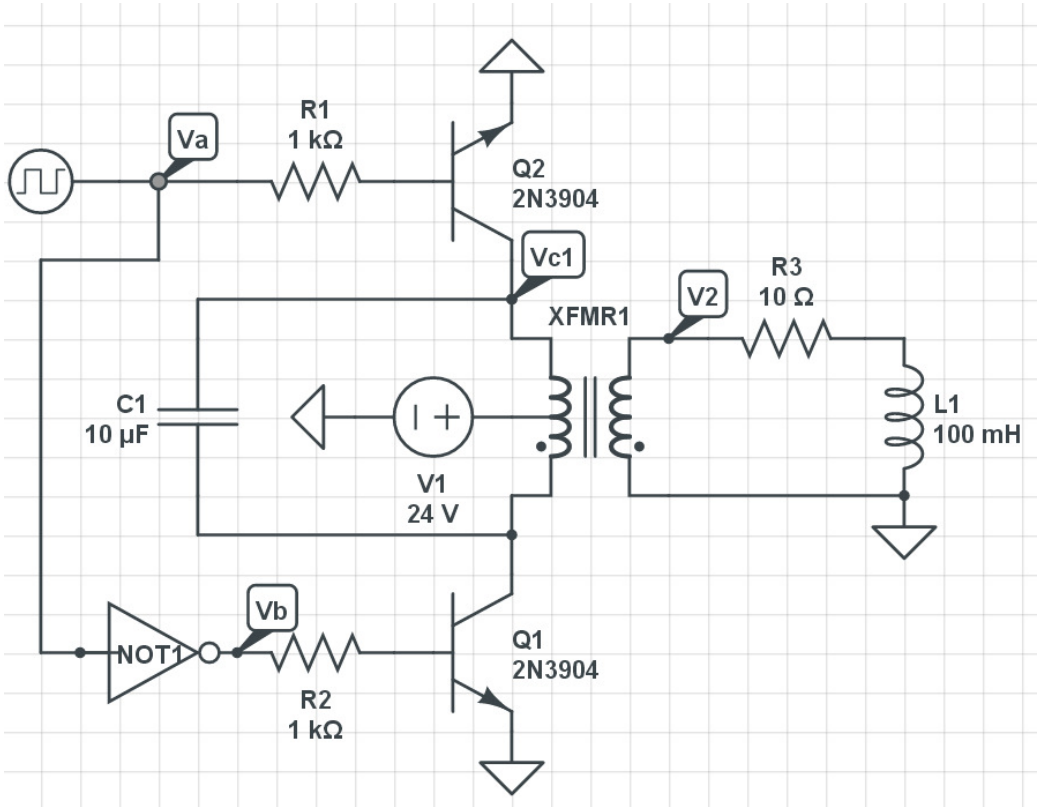
DC to AC

4) Let

- A = 0V / 5V square wave, 60Hz, 0 degree time delay
- B = 0V / 5V square wave, 60Hz, 180 degree time delay
- C1 = 10uF

Determine using CircuitLab the voltage V2 (i.e. the votlage across a DC motor, modeled as a 10 Ohm & 100mH load)

5) Adjust C1 so that the voltage across the motor is as close to a sine wave as possible (trial and error)



DC to AC Converter (problem 4 & 5)

SCR

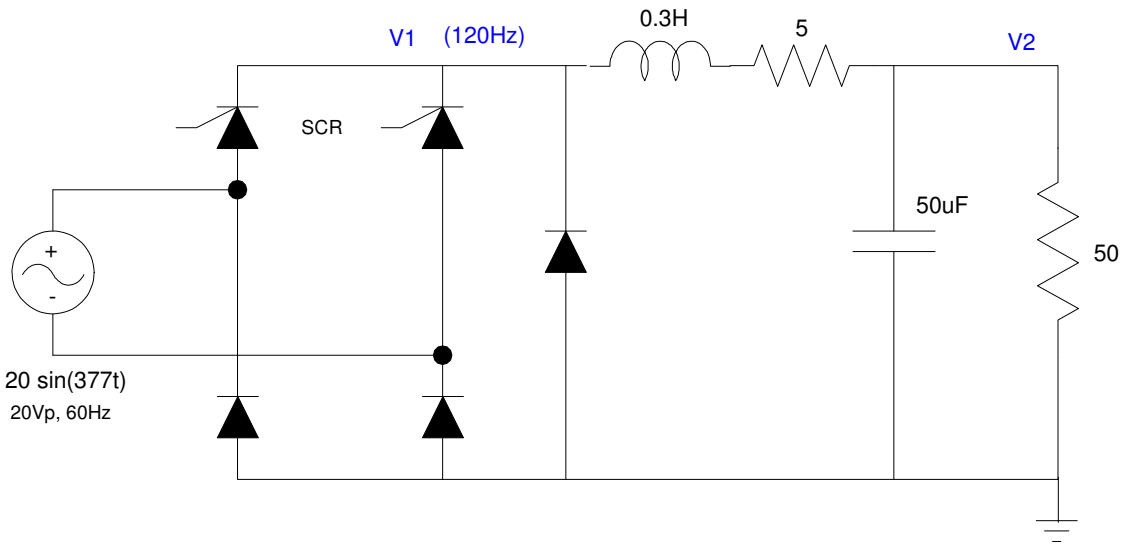
6) Assume a firing angle of 25 degrees. Determine the voltage at V1 and V2 (both DC and AC).

7) Change this circuit so that

- The voltge at V2 is 8.00V (DC)
- With a ripple of 500mVpp

8) Simulate this circuit in Matlab by

- Writing the differential eqautions which describe this circuit (state variables: IL and Vc)
- Specify V1(t) as a full-wave rectified sine wave, clipped at X degrees (from problem #4)
- Use numerical integration to find V2(t)



SCR: Problem 6 - 8