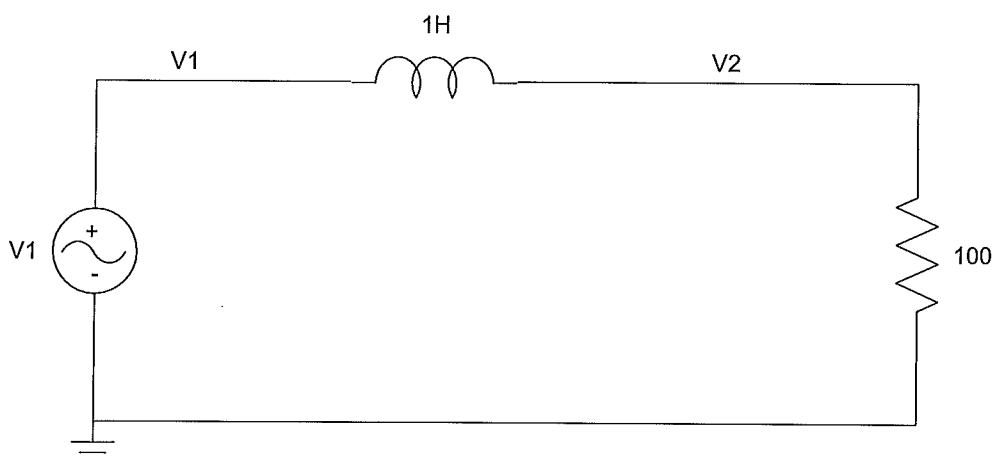
ECE 320: Quiz #7 Name _____ 9:00 / 11:00

Fourier Transform - SCR - March 2, 2017

1) The Fourier Transform for V1(t) is given below. Determine V2(t) for the following circuit:

$$V_1(t) = 10 + 6\sin(100t) + 2\sin(300t)$$

V2(t) = $10 + 4.24\sin(100t - 45^\circ) + .632\sin(300t - 71^\circ)$



DC) $y = x$

100) $\left(\frac{100}{100 + j100}\right) = .707\angle -45^\circ$

$y = 4.24\sin(100t - 45^\circ)$

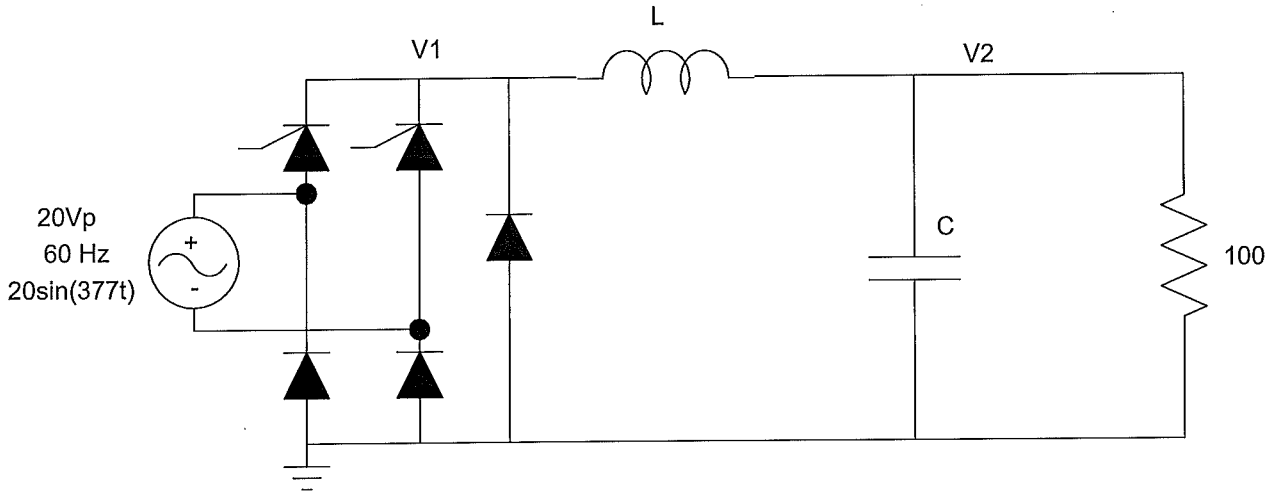
300) $\left(\frac{100}{100 + j300}\right) = .316\angle -71^\circ$

$y = .632\sin(300t - 71^\circ)$

2) SCR Design (DC): Determine the firing angle so that the following circuit has a DC voltage of 5 Volts

$$\frac{1}{\pi}\int_{\theta}^{\pi} 18.6\sin(t)\cdot dt = 5\,V$$

Firing Angle =	98.94°



$$\frac{18.6}{\pi}\int_{\theta}^{\pi} \sin(t)\,dt = 5$$

$$\left(-\cos(t)\right)\Big|_{\theta}^{\pi} = \frac{5\pi}{18.6}$$

$$(1+\cos\theta) = \frac{5\pi}{18.6}$$

$$\cos\theta = -0.1555$$

$$\theta = 98.94^\circ$$

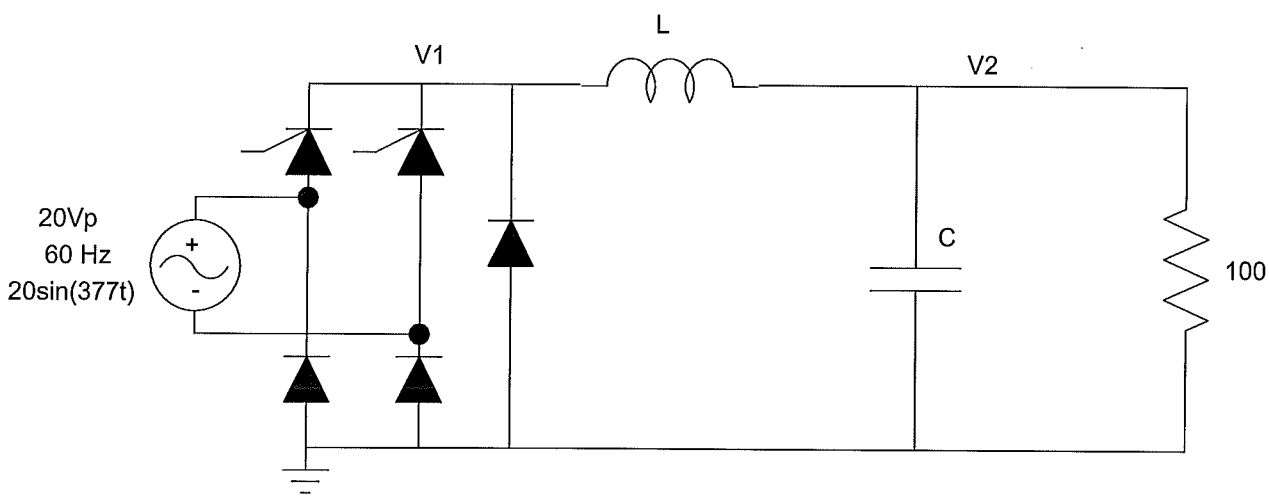
3) SCR Design (AC): Assume the firing angle results in the signal at V1 being

- 5.00V on average (DC), and
- 19.3Vpp (AC)

Determine L and C so that

- The DC signal at V2 is 5.00V
- L reduces the ripple at V2 to 5Vpp if C = 0, and
- C further reduces the ripple at V2 to 1Vpp

AC Impedance of the inductor	AC Impedance of the capacitor	L for 5Vpp ripple at V2 if C = 0	C for 1Vpp ripple at V2
$j386\,\Omega$	$-j20\,\Omega$	.5119H	66.3μF



$$jL\omega = \left(\frac{19.3}{5}\right)\cdot 100 = j386\,\Omega$$

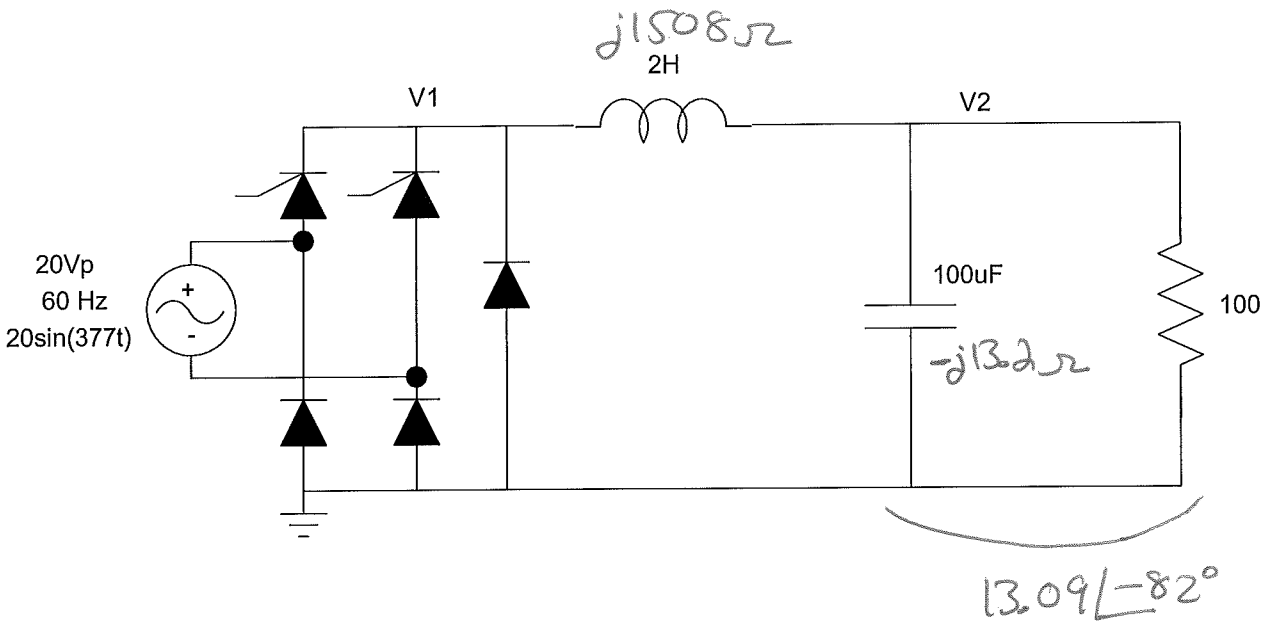
$$\left(\frac{1}{j\omega C}\right) = \left(\frac{1}{5}\right)\cdot 100 = 20\,\Omega$$

4) (SCR Analysis): Assume the firing angle results in

- avg(V1) = 5.00V
- max(V1) - min(V1) = 19.3Vpp

Determine the voltage at V2

V2 (DC) average(V2)	V2pp (AC) peak-to-peak votlage at V2
5.00V	.1689 V_{pp}

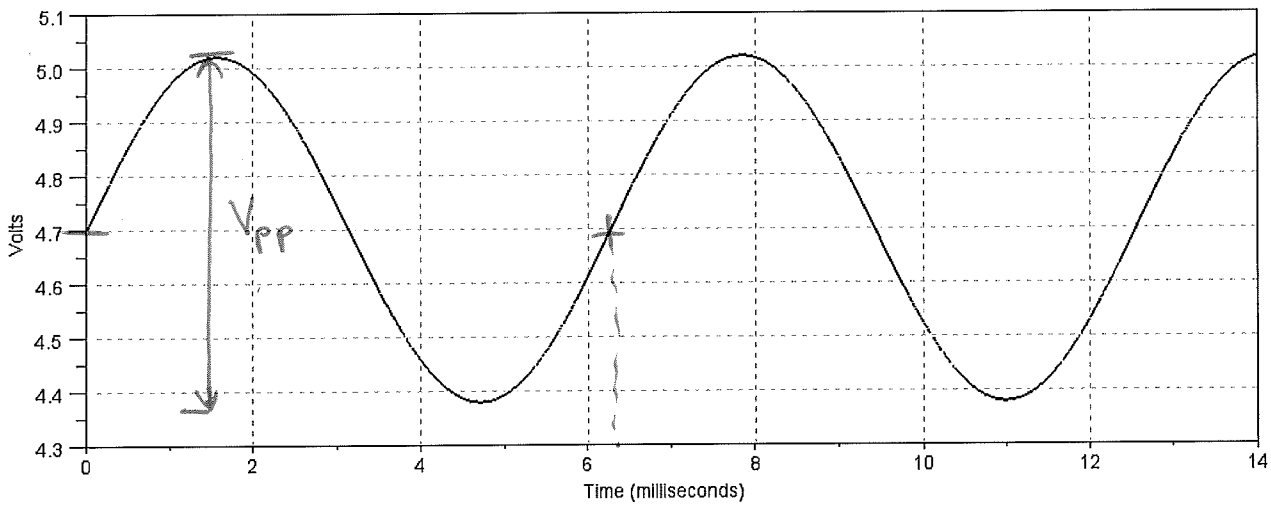


$$V_2 = \left(\frac{13.09\angle -82^\circ}{13.09\angle -82^\circ + j1508}\right) 19.3V_{pp}$$

$$V_2 = .1689 V_{pp}$$

5) The waveform at the load (V2) is found to be as follows. Determine the following

DC Voltage average of V2	AC (V2pp) peak-to-peak voltage	AC (V2rms) rms voltage of the AC signal	Frequency of the waveform Hertz
4.7V	0.64 V_{pp}	226m V_{rms}	1587Hz



$V_{pp} = 5.02 - 4.38$
$= 0.64\ V_{pp}$

period = 0.63ms

$f = \frac{1}{.63ms} = 1587Hz$

$V_{rms} = \frac{V_{pp}}{2\sqrt{2}} =$

Bonus! EPA Trivia!!! How many times did the Cuyahoga river catch fire prior to the creation of the EPA? (note: The Cuyahoga river flows through Cleveland, Ohio)

13!