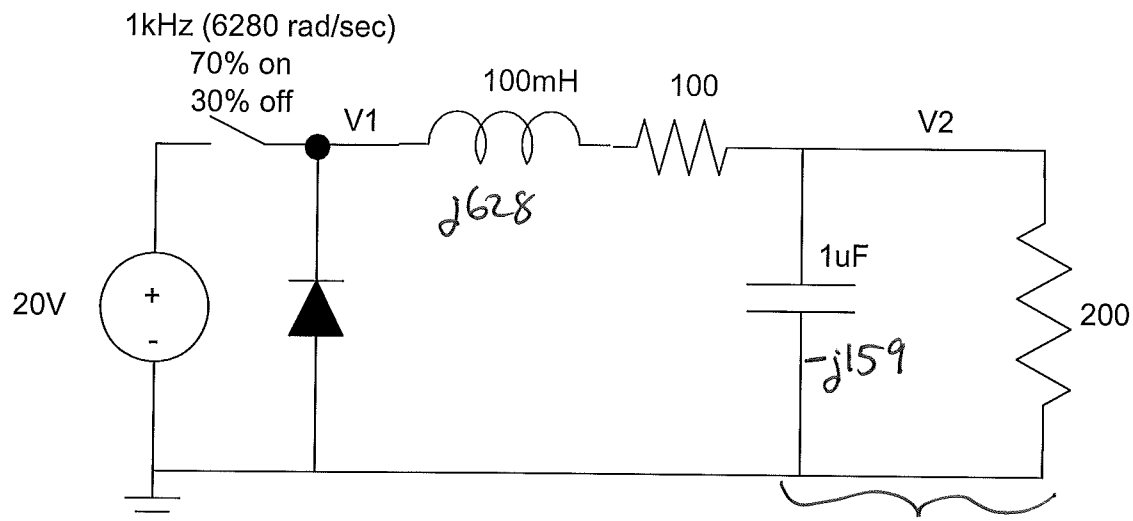
ECE 320 - Quiz #5 - Name _____

DC to DC Converters, Fourier Transforms. October 4, 2018

1) A Buck converter converts 20VDC to another voltage. Determine the DC and AC votlages at V1 and V2 for the followign DC to DC converter.

V1		V2	
DC: V1	AC: V1pp	DC: V2	~~AC~~DC: V2pp
13.79V	20.7 V_{pp}	9.19	4.609 V_{pp}



$V_1(DC) = 20(.7) - 0.7(.3) = 13.79$

$V_2(DC) = \left(\frac{200}{200+100}\right) 13.79 = 9.19V$

$V_1(AC) = 20.7 V_{pp}$

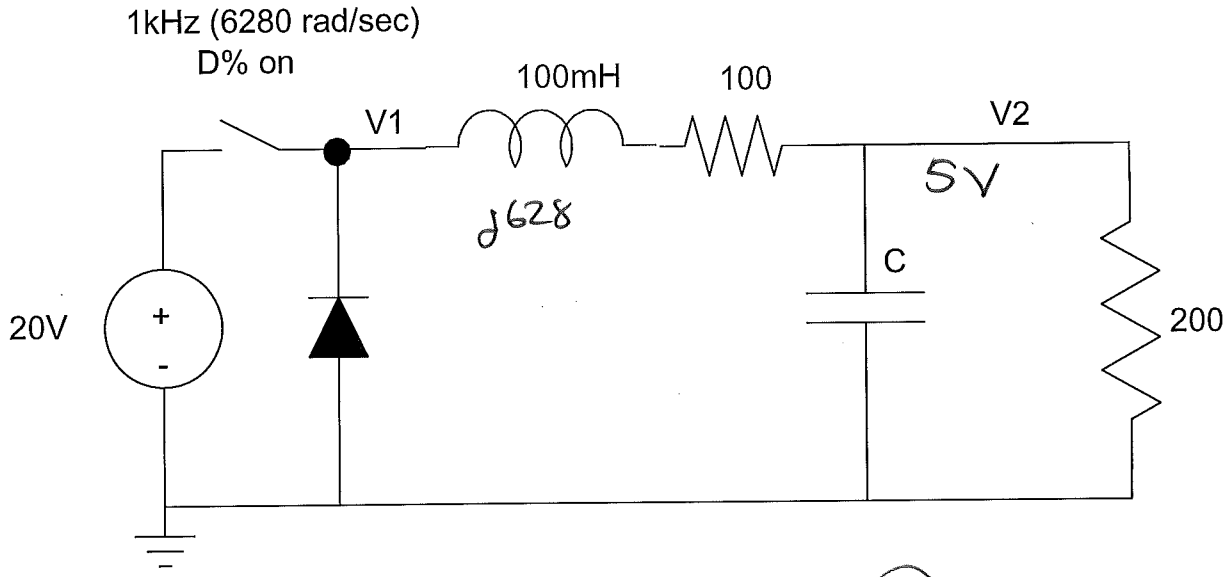
$V_2(AC) = \left|\frac{(77.5-j97.5)}{(77.5-j97.5)+(100+j628)}\right| \cdot 20.7 V_{pp}$

$V_2(AC) = 4.609 V_{pp}$

2) Determine the DC voltage at V1, the duty cycle (D), and C so that

- The DC votlage at V2 is 5.00V, and
- The ripple at V2 is 100mVpp

DC Voltage at V1	Duty Cycle (D)	C
7.5V	39.6%	47.3μF



DC)

$$V_2 = \left(\frac{200}{200+100}\right) V_1$$

$$V_1 = \left(\frac{300}{200}\right) 5 = 7.5V$$

$$\alpha(20) - 0.7(1-\alpha) = 7.5$$

$$\alpha = 39.6\%$$

AC) assume C=0

$$V_2 = \left(\frac{200}{200+100+j628}\right) 20.7V_{pp}$$

$$V_2 = 5.94V_{pp}$$

To reduce V_{2pp} to 100mV drop the ripple 59.4x

$$\frac{1}{\omega C} = \frac{1}{59.4} \cdot 200$$

$$\frac{1}{\omega C} = 3.36$$

$$C = 47.3\mu F$$

3) Assume x(t) is periodic in 2π. Determine the Fourier transform (DC term and the 1st-harmonic) for the following waveform:

$$x(t) = \begin{cases} 20V & 0 < t < 2 \\ 0V & 2 < t < 2\pi \end{cases}$$

DC Term	1st Harmonic (cosine and sine)	
$a_0 = \frac{1}{2\pi}\int_0^{2\pi} x(t)\cdot dt$	$a_1 = \frac{2}{2\pi}\int_0^{2\pi} x(t)\cdot\cos(t)\cdot dt$	$b_1 = \frac{2}{2\pi}\int_0^{2\pi} x(t)\cdot\sin(t)\cdot dt$
6.366	5.789	9.015

$a_0 = \frac{1}{2\pi}\int_0^2 20\, dt$

$a_0 = \frac{2\cdot 20}{2\pi} = 6.366$

$a_1 = \frac{1}{\pi}\int_0^2 20\cdot\cos(t)\, dt$

$= \frac{20}{\pi}\left(\sin(t)\right)_0^2$

$= \frac{20}{\pi}\sin(2)$

radians

$= 5.789$

0.222 if you used degrees (should be radians)

$b_1 = \frac{1}{\pi}\int_0^2 20\sin(t)\, dt$

$= \frac{20}{\pi}\left(-\cos(t)\right)_0^2$

$= \frac{20}{\pi}\left(1-\cos(2)\right)$

radians

$= 9.015$

0.004 if you use degrees

4) Assume x(t) is periodic in 2π. Determine the complex Fourier transform (1st-harmonic) for the following waveform:

$$x(t) = \begin{cases} 20V & 0 < t < 2 \\ 0V & 2 < t < 2\pi \end{cases}$$

$X_1 = \frac{2}{2\pi}\int_0^{2\pi} x(t)\cdot e^{-jt}\cdot dt$
$5.789 - j\,9.015$

$$X_1 = \frac{1}{\pi}\int_0^2 20\, e^{-jt}\, dt$$

$$= \frac{20}{\pi}\left(\frac{1}{-j}\right)\left(e^{-jt}\right)_0^2$$

$$= \left(\frac{20j}{\pi}\right)\left(1 - e^{-2j}\right)$$

note

$$e^{jx} = \cos(x) + j\sin(x)$$

$$= \left(\frac{20j}{\pi}\right)\left(1 - \cos(-2) - j\sin(-2)\right)$$

$$= 5.789 - j\,9.015$$

note) same answer as problem #3

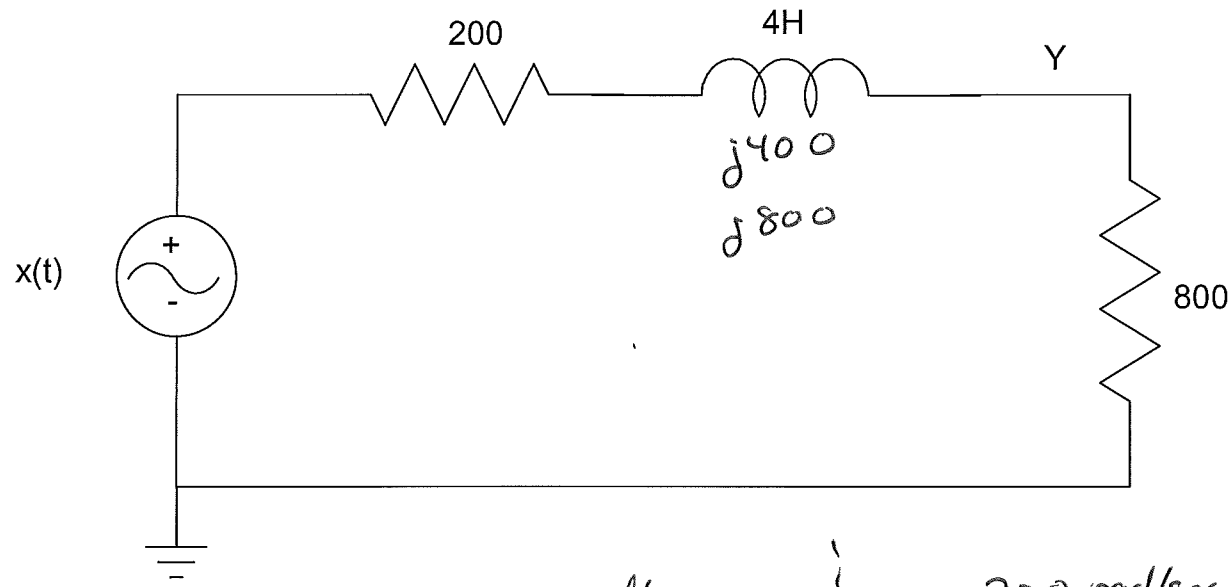
$a + jb \rightarrow a\cdot\cos - b\cdot\sin$

5) Assume the Fourier transform for x(t) is

$$x(t) = 3 + 4\cos(100t) + 5\sin(200t)$$

Find y(t)

y(t) = $2.4 + 2.759\cos(100t) + 1.103\sin(100t) - 1.951\cos(200t) + 2.439\sin(200t)$



DC

$X = 3$

$L = 0$

$y = \left(\frac{800}{800+200}\right) 3$

$y = 2.4$

100 rad/sec

$X = 4 + j0$

$L = j400$

$y = \left(\frac{800}{800+200+j400}\right) 4$

$y = 2.759 - j1.103$

200 rad/sec

$X = 0 - j5$

$L = j800$

$y = \left(\frac{800}{800+200+j800}\right)(-j5)$

$y = -1.951 - j2.439$

Bonus: Name one person who is running for the U.S. Senate from where you vote.

ND Cramer Heitkamp

Min Klobuchar Neuberger

Smith Hasley