ECE 320 - Quiz #7 - Name ____________________

Fourier Transforms, DC to AC, SCR

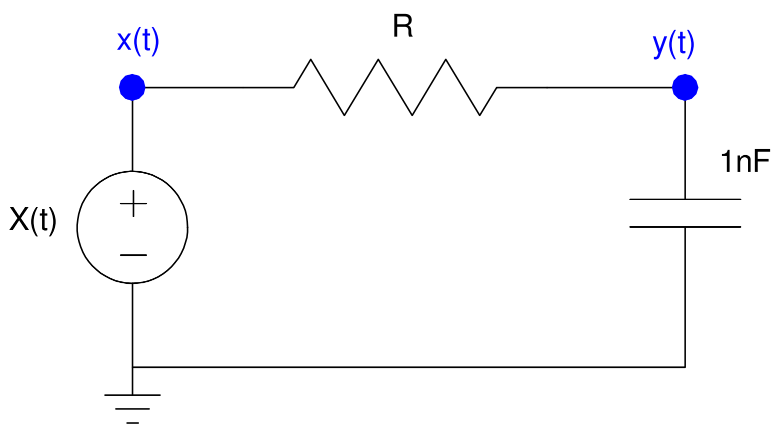
Fourier Transforms

1) Assume the Fourier transform for X(t) is

$$x(t) = 10 + 11\sin(t) + 12\cos(2t)$$

Find y(t). Let R be 1000 + 100*(your birth month) + (your birth day). March 14th would give R = 1514 Ohms.

R 1000 + 100*Month + Day	y(t)



Fourier Transforms

2) Assume a 1 rad/sec parabolic sine wave (of Ninja Turtles fame).

$$x(t) = \begin{cases} t(\pi - t) & 0 < t < \pi \\ t(\pi + t) & -\pi < t < 0 \end{cases} \qquad x(t+\pi) = x(t)$$

Determine the magnitude of the 3rd harmonic of the Fourier Transform for x(t):

$$a_3 = \frac{1}{\pi}\int_{-\pi}^{\pi} x(t) \cdot \cos(3t) \cdot dt = 0 \qquad \textit{it's an odd funciton}$$

$$b_3 = \frac{1}{\pi}\int_{-\pi}^{\pi} x(t) \cdot \sin(3t) \cdot dt \qquad \textit{solve for b3}$$

note:

- Hand calculations, Matlab, calculators, etc. are allowed...

b3	Method / Resource used to solve for b3

DC to AC Converter

3) Assume the Fourier transform for the output of a DC to AC converter driving a 1 Ohms reisistor is as follows:
   - note: units are Vp (peak voltage)

Harmonic	0 (DC)	1	2	3	4	5
an (cosine)	0	18.3	0	2.6	0	0.7
bn (sine)	0	2.7	0	0	1.4	0

Determine the following:

Total Energy in the signal	Energy in the 1st harmonic	Efficiency % of energy in the 1st harmonic

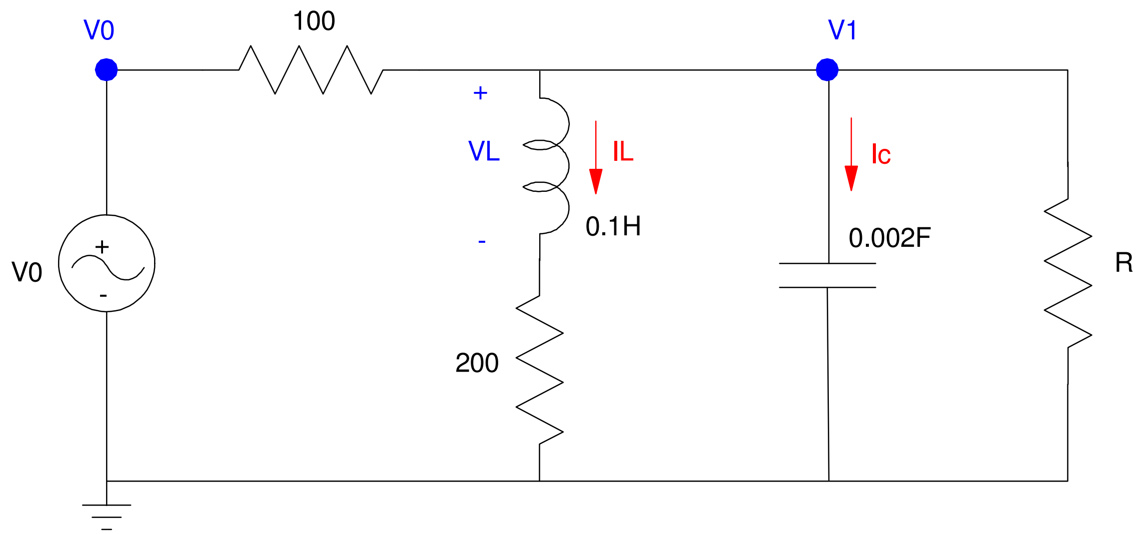
DC to AC Converter: Differential equations for a Circuit

4) Determine the differential equations which describe the following circuit. Note

- $V_L = L\,\frac{dI_L}{di}$
- $I_c = C\,\frac{dV_1}{dt}$

Assume R = 1000 + 100*(Birth Month) + (Birth day). For May 15th, for example, R = 1514 Ohms.

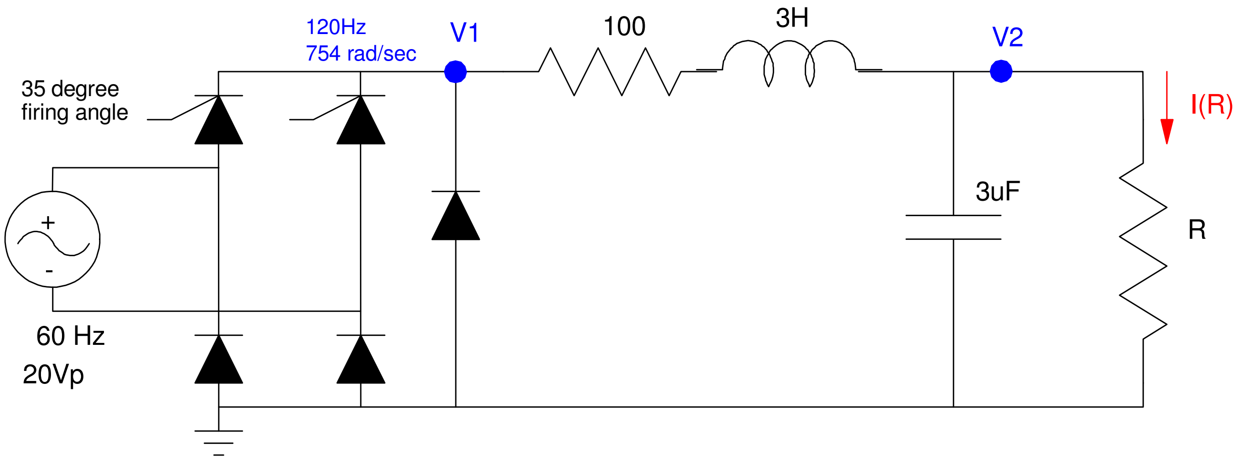
$\frac{sI_L}{dt} = f(V_0, I_L, V_1) = ?$
$\frac{sV_1}{dt} = g(V_0, I_L, V_1) = ?$



SCR (5 diode version)

5) SCR: Analysis. Determine the votlages at V1 and V2 (both DC). Assume a firing angle of 120 degrees.

R 1000 + 100*Mo + Day	V1		V2	
	DC	AC (V1pp)	DC	AC (V2pp)



6) SCR Design. Determine the firing angle and C so that

- V2(DC) = 4.5V
- V2(AC) = 500mVpp
- R = 1000 + 100*(Birth Month) + (Birth Day). May 14th would give R = 1514 Ohms.

V1(DC)	Firing Angle	C	R 1000 + 100*Mo + Day