Department of Physics
Physics 374 Spring 2009
Due Wednesday, April 22, 2009

1.) Consider the Fourier series expansion for a function that obeys $f(x) = f(x + 2L)$ and that takes the following form in the interval $-L < x < L$,

$$f(x) = x/L, \quad -L < x < L. \tag{1}$$

a.) Plot the function for the interval $-3L < x < 3L$.

b.) Use general symmetry arguments to extract all the Fourier series coefficients that can be determined from symmetry.

c.) Calculate the remaining Fourier coefficients.

d.) Make a plot of the Fourier series result in the interval $-L < x < L$ including terms up to $n = 9$.

2.) Consider the periodic function that obeys $f(t + 2T) = f(t)$ and takes the following form on the interval $-T < t < T$,

$$f(t) = 1 - |t|/T, \quad -T < t < T. \tag{2}$$

a.) Plot the function for the interval $-3T < x < 3T$.

b.) Use general symmetry arguments to extract all the Fourier series coefficients that can be determined from symmetry.

c.) Calculate the remaining Fourier coefficients.

d.) Make a plot of the Fourier series result in the interval $-T < x < T$ including terms up to $n = 9$.

3.) An input signal has the Fourier representation

$$v(t) = \int_{-\infty}^{\infty} dt e^{i\omega t} V(\omega), \tag{3}$$
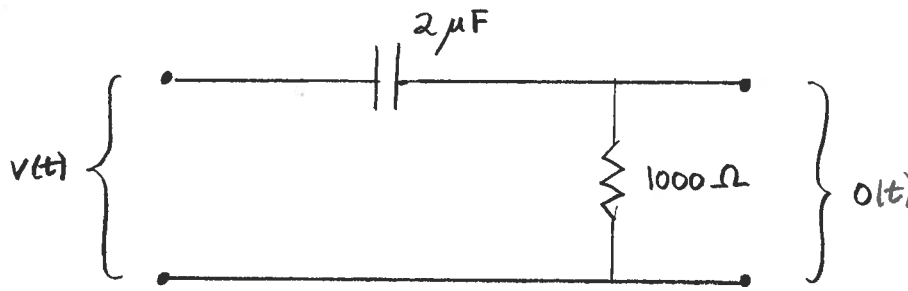
where

$$V(\omega) = 1, \quad \text{for} \ \omega < \omega_c,$$
$$V(\omega) = 0, \quad \text{for} \ \omega > \omega_c,$$
$$\omega_c = 2\pi(250Hz). \tag{4}$$

**a.)** Plot $|V(\omega)|^2$ versus ω in the interval $0 < \omega < 1.5\omega_c$.

b.) The signal $v(t)$ is passed into a RC circuit as shown below to obtain the output signal $o(t)$. The signal $o(t)$ can also be expressed as a Fourier transform,

$$o(t) = \int_{-\infty}^{\infty} dt e^{i\omega t} O(\omega). \tag{5}$$

Plot the value of $|O(\omega)|^2$ versus omega using the same scales as in part **a.)**.

$2\,\mu F$

$v(t)$ $1000\,\Omega$ $o(t)$

c.) The same signal is passed into a RL circuit as shown below. Plot the absolute value of $|O(\omega)|^2$ versus ω.

$2\,mH$

$v(t)$ $0.5\,\Omega$ $o(t)$
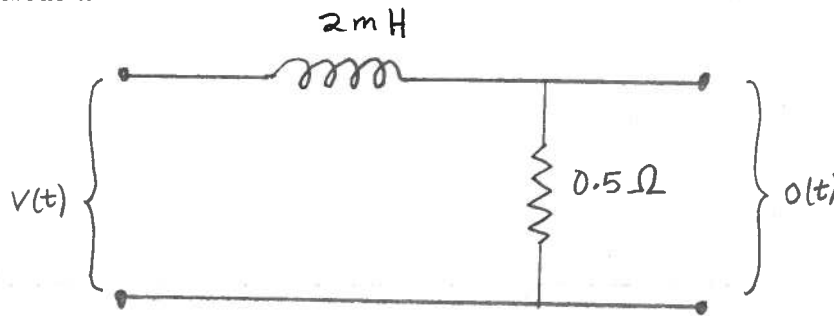
c.) The same signal is passed into a RLC as below. Plot the absolute value of $|O(\omega)|^2$ versus ω.

$10\,\mu F$

$V(t)$ $20\,\Omega$ $o(t)$

$0.2 H$