BME 171, Sec 2: Homework 5 **due Tue, Oct 14 by 5pm**

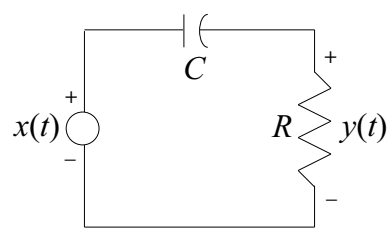
Note: in some of these problems, you are asked to use MATLAB to plot certain signals. Turn in all your MATLAB code together with printouts of your plots with axes clearly labeled, just as in Kamen and Heck. Make sure that it is clear from the printout which plot corresponds to which problem.

1. **Computing signal spectra.** Consider the signal $x(t)$ that you have seen in Problem 1 in the previous homework, namely the periodic extension of the function

$$s(t) = \begin{cases} -1 + \sqrt{-t}e^{t}, & -1 \le t \le 0 \\ 1 - \sqrt{t}e^{-t}, & 0 < t \le 1 \end{cases}$$

   Modify your MATLAB code from the last homework to compute and plot the amplitude and phase spectra of $x(t)$ up to the 15th harmonic ($-15\omega_0$ to $15\omega_0$).

2. **High-pass filter.** Consider the following circuit:



   (a) Write down the input-output differential equation describing this system.

   (b) Use your result from part (a) to find the frequency response $H(\omega)$ of this system.

   (c) Sketch the amplitude response $|H(\omega)|$ and the phase response $\angle H(\omega)$.

   (d) If an input $x(t)$ is given as a complex exponential Fourier series

$$x(t) = \sum_{k=-\infty}^{\infty} c_k e^{jk\omega_0 t},$$

   what is the largest number of frequency components (harmonics) of $x(t)$ whose squared amplitudes will be attenuated by a factor of 1/2 or more?

3. **Textbook problems.** Work problems 3.19(a,b,d), 3.21, 3.24, 3.25, 3.26.