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**Note:** in some of these problems, you are asked to use MATLAB to plot certain signals. Turn in printouts of your MATLAB 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. Consider a system governed by the second-order differential equation

$$a \frac{d^2 y(t)}{dt^2} + b \frac{dy(t)}{dt} + cy(t) = x(t),$$

where  $a$ ,  $b$  and  $c$  are nonnegative real numbers.

(a) Show that this system is LTI.

(b) Consider a complex exponential input  $x(t) = e^{j\omega t}$ . Show that the resulting output is of the form

$$y(t) = H(\omega)e^{j\omega t}$$

for some complex number  $H(\omega)$ . (Hint: try an output of the form  $Ke^{j\omega t}$  and solve for  $K$ .)

(c) Consider now the sinusoidal input  $x(t) = A \cos(\omega t + \theta)$  and express the resulting output as a sum of sinusoids with real coefficients.

2. **Textbook problems.** Work problems 1.16, 1.17, 1.19, 1.20, 1.24 and 2.20 from Kamen and Heck.