Problem 15.1: A periodic continuous-time signal $x(t)$ has fundamental period $T = 5$ and non-zero Fourier series coefficients

$$a_0 = 1, \quad a_1 = a_{-1} = 2, \quad a_3 = a_{-3} = 1.$$

The signal is the input to an LTI system with frequency response $H(j\omega) = \frac{1}{1+j\omega}$.

(a) Determine the non-zero Fourier series coefficients of the output of the system.

(b) Write an equation for the output of the system $y(t)$.

Problem 15.2: A periodic discrete-time signal $x[n]$ has fundamental period $N = 4$ and non-zero Fourier series coefficients over one period

$$a_1 = a_{-1}^* = j.$$

The signal is the input to an LTI system with frequency response $H(e^{j\omega}) = \frac{1}{1-\frac{1}{2}e^{-j\omega}}$.

(a) Write an equation for the input of the system $x[n]$.

(b) Determine the non-zero Fourier series coefficients of the output of the system.

(c) Write an equation for the output of the system $y[n]$.

Problem 15.3: Figure 1 shows an RL circuit for which the input $x(t)$ is the voltage across the series combination, and the output $y(t)$ is the voltage across the resistor. The impedance of an inductor is $Z_L = j\omega L$, and one can apply voltage division to find the circuit's frequency response

$$H(j\omega) = \frac{R}{j\omega L + R},$$

where $R,\ L > 0$ are real constants.

(a) Find an expression for the circuit's magnitude response $|H(j\omega)|$. Use a straightedge to plot $|H(j\omega)|$ and label both axes and any important features. Show the origin for context.

(b) Find an expression for the circuit's phase response $\angle H(j\omega)$. Use a straightedge to plot $\angle H(j\omega)$ and label both axes and any important features. Show the origin for context.

(c) What kind of filter is this circuit? Use your answers from the previous parts to justify your response.

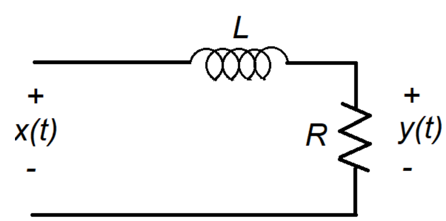

Figure 1

Optional, but testable, problems: From the textbook, Problems 3.16, 3.35, 3.39.