1) Consider the signal \( x(t) = A \text{sinc}(4f_0 t) \):

   a) Sketch \( x(t) \) for the range \([-1/f_0, +1/f_0]\).

   b) Compute its Fourier Transform \( X(j\omega) \). **Hint** There is a hard way to do it, and an easy way to do it.

   c) Sketch \( X(j\omega) \) for the range \([-8\pi f_0, +8\pi f_0]\)

2) Compute the Fourier Transform \( X(j\omega) \) for:

   a) \( x(t) = 3\sin(2\pi t/5) \)

   b) \( x(t) = 3\sin(2\pi t/5) + 1 \)

3) For each of these functions, plot it for the range \([-2T_1, +2T_1]\) and compute its Fourier Transform. Use the properties of the Fourier Transform to simplify the calculation whenever possible.

   a) \( x_a(t) = t [u(t + T_1/2) - u(t - T_1/2)] \)

   b) \( x_b(t) = \frac{1}{2} [u(\frac{t}{2} + T_1/2) - u(\frac{t}{2} - T_1/2)] \)

   c) \( x_c(t) = t [u(t) - u(t - T_1)] \)

   d) \( x_d(t) = (-t) [u(-t) - u(-t - T_1)] \)

   e) \( x_e(t) = t [u(t + T_1) - u(t)] \)

   f) \( x_f(t) = x_e(t) + x_c(t) \)

   g) \( x_g(t) = x_e(t + T_1) - x_e(t - T_1) \)

4) As done in class and in the text, \( x(t) = u(t)e^{-at} \) has the Fourier Transform \( X(j\omega) = 1/(a + j\omega) \) for \( a > 0 \).

   a) Calculate the Fourier Transform of \( \frac{dx}{dt} \), entirely in the Fourier Domain (i.e. starting from \( X(j\omega) \)).

   b) Calculate \( \frac{dx}{dt} \) in the time domain.

   c) Calculate the Fourier Transform of \( \frac{dx}{dt} \) calculated in (b) using the standard equation.
d) Show that the answers to (a) and (c) are equal.

5) The amplitude modulation of a carrier signal with frequency \( f_c = \frac{\omega_c}{2\pi} \), by a (positive) signal \( x(t) \), is given by \( y(t) = x(t)\cos(\omega_c t) \). Calculate its Fourier Transform \( Y(j\omega) \), in terms of \( X(j\omega) \) the Fourier Transform of \( x(t) \). Optional: Interpret the Fourier Transform \( Y(j\omega) \) in terms of \( x(t) \) or \( X(j\omega) \) and \( \omega_c \).

6) Consider the following spatial impulse responses \( h(s) \). For each case, plot \( h(s) \) for the range \([-6/a, +6/a]\). Compute its Fourier Transform \( H(j\omega) \). Is it low pass, band pass, or high pass? Recall that \( f(|s|) = u(s)f(s) + u(-s)f(-s) \) for any signal \( f(s) \).
   a) \( h(s) = e^{-as} \), for \( a > 0 \).
   b) \( h(s) = as e^{-as} \), for \( a > 0 \).

7) Compute the Fourier Transforms of the following expressions, by any means, and simplify
   a) \( \cos(\omega_0 t) * u(t) \)
   b) \( \cos(\omega_0 t) \cdot (u(t)e^{-at}) \)
   c) \( u(t)e^{j\omega_0 t} \)
   d) \( (u(t)e^{j\omega_0 t}) * (u(t)e^{-at}) \)