This homework can be completed either individually or in pairs. Please clearly and neatly write the name(s) of the people doing the assignment in the top right corner of the top page turned of your submission. (If done in pairs, only one submission is needed.)

When sketching signals for graded assignments, students are expected to clearly label the horizontal and vertical axes, as well as characteristic points on the signals.

1. Sketch the signal \( x(t) = \exp(-t)[u(t) - u(t - 2)] \) on the interval \(-3 < t < 3\).
2. Sketch the signal \( y(t) = \cos(20\pi t)[u(t) - u(t - 0.2)] \) on the interval \(-0.5 < t < 0.5\).
3. Sketch the signal \( z(t) = t^3[u(t - 1) - u(t - 2)] \) on the interval \(0 < t < 3\).
4. Use MATLAB to plot the signals sketched in Problems 1 to 3. (Turn in both your sketch as well as your MATLAB code.)

5. Complete the following integrals (assume all variables are real-valued).
   
   a. \( I_a = \int_{-\infty}^{\infty} \frac{1}{t^3 + 1} \delta(t - 2) \, dt = 0 \) (Note: limits of integral)
   
   b. \( I_b = \int_{-\infty}^{\infty} \frac{1}{t^3 + 1} \delta(t - 2) \, dt = \frac{1}{4} \)
   
   c. \( I_c = \int_{-\infty}^{\infty} \frac{1}{t^3 + 1} \delta(t + 2) \, dt = \frac{1}{(-2)^3 + 1} = -\frac{1}{7} \)
   
   d. \( I_d = \int_{-\infty}^{\infty} \frac{1}{(t - \tau)^2 + 1} \delta(\tau) \, d\tau = \frac{1}{\tau^2 + 1} \)
   
   e. \( I_e = \int_{-\infty}^{\infty} x(t - \tau) \delta(\tau) \, d\tau = x(t) \)
   
   f. \( I_f = \int_{-\infty}^{\infty} x(\tau) \delta(t - \tau) \, d\tau = x(t) \)
   
   g. \( I_g = \int_{-\infty}^{\infty} x(t - \tau) \delta(\tau) \, d\tau = x(t) \)
   
   h. \( I_h = \int_{-1}^{1} \frac{1}{\tau + 1} \delta(\tau - 11) \, d\tau = \left\{ \begin{array}{ll} 0 & \text{if } t < 11 \\ \frac{1}{10} & \text{if } t > 11 \end{array} \right\} = \frac{1}{10} u(t - 11) \)
   
   i. \( I_i = \int_{-1}^{1} \frac{1}{\tau + 1} \delta(\tau + 11) \, d\tau = \left\{ \begin{array}{ll} 0 & \text{if } t > -11 \\ \left(-\frac{1}{10}\right) & \text{if } t < -11 \end{array} \right\} = -\frac{1}{10} u(t + 11) \)
HW 2 solutions.

close all; clear all; more on;

Problems 1-3.

Sketches should look similar to the MATLAB results shown below (thanks to our TA, John Thomas, for generating these).

format compact;

4. Use MATLAB to plot the signals sketched in Problems 1 to 3. ...

(Turn in both your sketch as well as your MATLAB code.)

4.1

\[ x(t) = \exp(-t) \cdot [u(t) - u(t-2)], -3 < t < 3 \]

\[ t1 = \text{linspace}(-3,3,121); \quad \% \text{Let's try twenty points per unit, plus one point for 0.} \]
\[ u01 = \text{zeros}(1, \text{length}(t1)); \quad u21 = \text{zeros}(1, \text{length}(t1)); \]
\[ u01(t1>=0) = 1; \quad \% \text{This is called Logical Indexing, and it's awesome,} \]
\[ u21(t1>=2) = 1; \quad \]
\[ x1 = \exp(-t1) \cdot (u01 - u21); \quad \% \text{The dot in front of the asterisk makes...} \]
\[ \% \text{it a termwise multiply. Without it, matlab will assume you mean...} \]
\[ \% \text{a matrix multiply. See documentation for "arithmetic"...} \]
\[ \% \text{(type "doc arithmetic" and press Enter in the command window)} \]

figure(1); clf;
h1=plot(t1,x1, 'r+-' );grid on; box on;...
\[ \text{xlabel('t (sec)'); ylabel('x(t)');...} \]
\[ \text{title('x(t) = \exp(-t) \cdot [u(t) - u(t-2)], -3\leqt\leq3');} \]
4.2

\[ y(t) = \cos(20\pi t) \cdot [u(t) - u(t-0.2)], \ -0.5 < t < 0.5 \]

As in HW1, we can determine how many sinusoid periods we'll plot: \( f = 10 \text{Hz}, T = 0.1 \text{s} \), so with a timespan of 1 sec we have 10 periods. 20 points per period seemed to work in HW1.

\[
\begin{align*}
t2 &= \text{linspace}(-0.5, 0.5, 201); \\
u02 &= \text{zeros}(1, \text{length}(t2)); \\
u0p22 &= \text{zeros}(1, \text{length}(t2)); \\
u02(t2 >= 0) &= 1; \\
u0p22(t2 >= 0.2) &= 1; \\
y2 &= \cos(20\pi t2) \cdot (u02 - u0p22);
\end{align*}
\]

figure(2); clf;
plot(t2, y2, 'r+-'); grid on; box on;
xlabel('t (sec)'); ylabel('y(t)');
title('y(t) = \cos(20\pi t) \cdot [u(t) - u(t-0.2)], \ -0.5 \leq t \leq 0.5');
%print -dpng HW2p42_JT.png
4.3

\[ y(t) = (t^3) \cdot [u(t-1) - u(t-2)], \quad 0 < t < 3 \]

```matlab
4.3

% y(t) = (t^3) * [u(t-1) - u(t-2)], 0 < t < 3

t3 = linspace(0,3,61);
u13 = zeros(1,length(t3)); u23 = zeros(1,length(t3));
u13(t3 >= 1) = 1; u23(t3 >= 2) = 1;
y3 = (t3.^3) .* (u13 - u23); % Note the .^ invokes the function "power",
% where a ^ invokes the function "mpower" (see documentation)
figure(3); clf;
h3 = plot(t3, y3, 'r+-'); grid on; box on;
xlabel('t (sec)'); ylabel('y(t)');
title('y(t) = (t^3) * [u(t-1) - u(t-2)], 0 \leq t \leq 0.5');
figure(3); clf;
h3 = plot(t3, y3, 'r+-'); grid on; box on;
xlabel('t (sec)'); ylabel('y(t)');
title('y(t) = (t^3) * [u(t-1) - u(t-2)], 0 \leq t \leq 0.5');
```

%print -dpng HW2p43_JT.png
\( y(t) = (t^3) \cdot [u(t-1) - u(t-2)], \ 0 \leq t \leq 3 \)