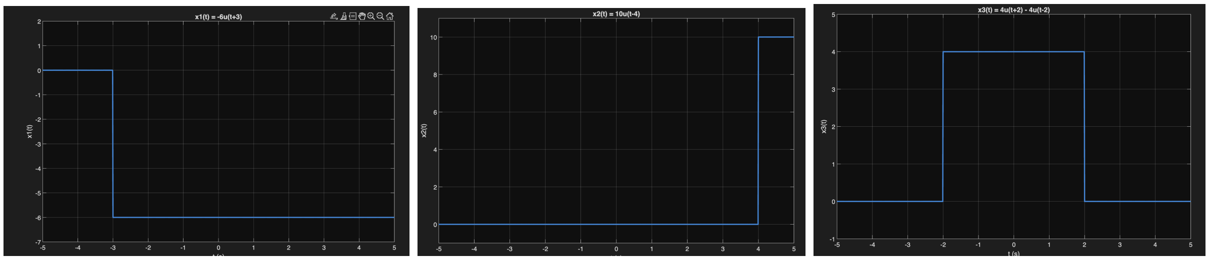
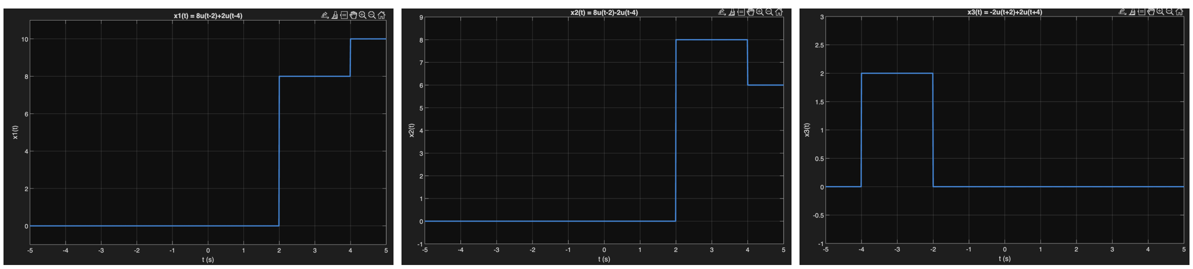
Problem 1.19:



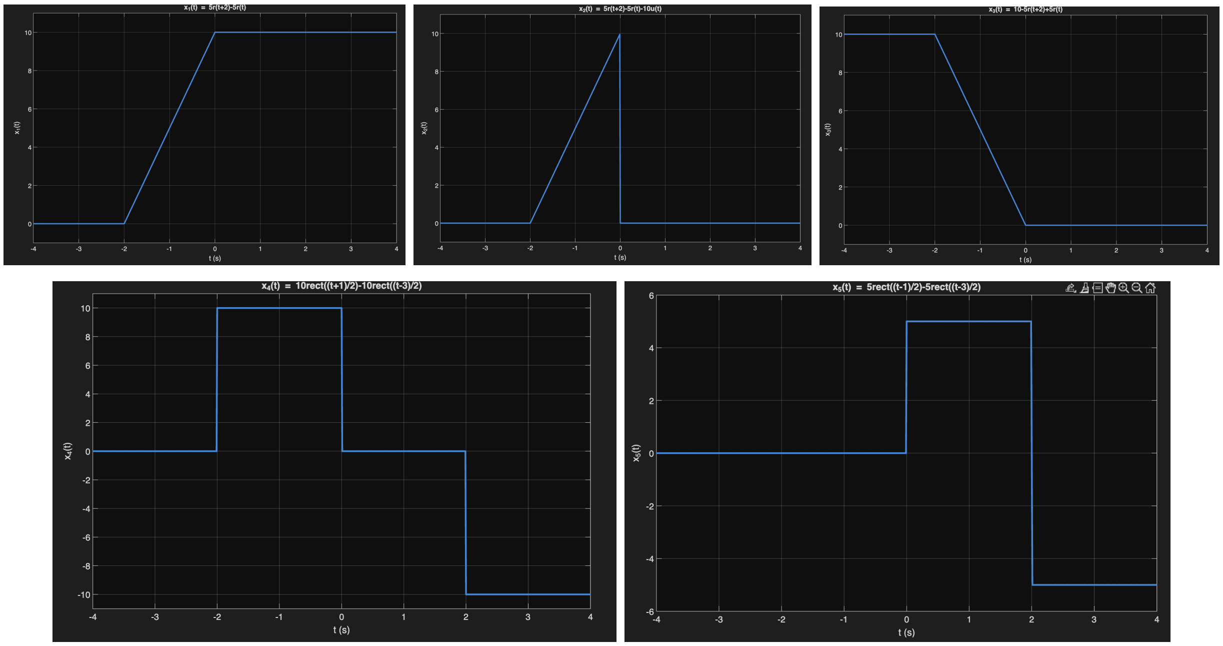
The three signals were plotted over [-5, 5] seconds using a MATLAB time vector and a unit step function defined as u(t) = 1 for all values of $t \geq 0$, and 0 otherwise. $x_1(t)$ steps to -6 at t = 3, $x_2(t)$ steps to 10 at t = 4, and $x_3(t)$ forms a rectangular pulse of amplitude 4 between -2 seconds and 2 seconds.

Problem 1.20:



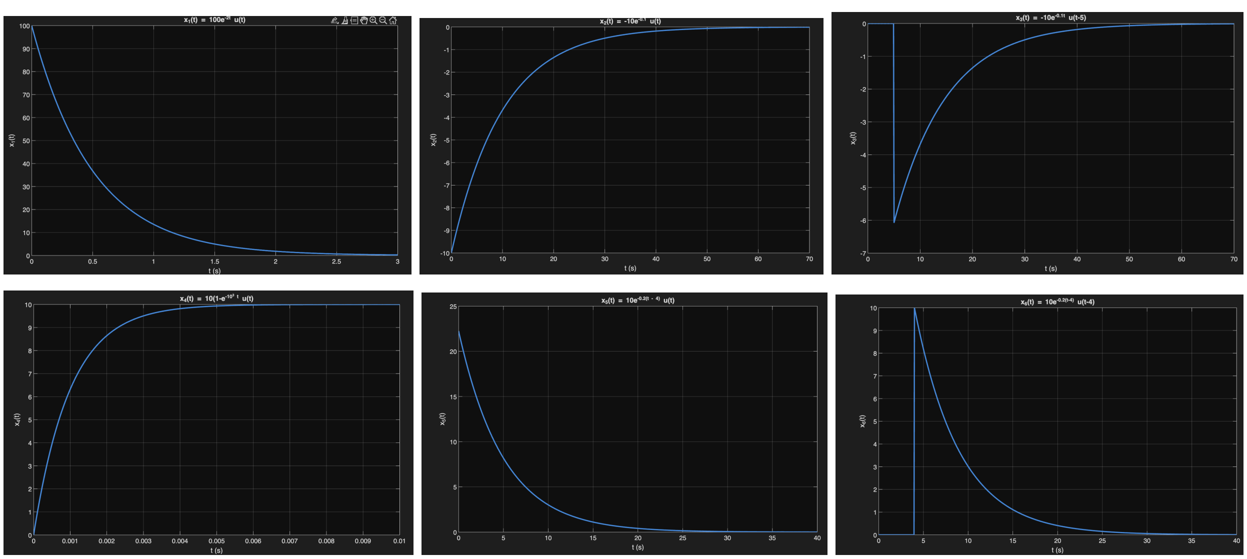
Over [-5, 5] seconds, $x_1(t)$ has steps at t = 2 and t = 4, taking values 0 for $t < 2$, 8 for $2 \leq t < 4$, and 10 for $t \geq 4$; $x_2(t)$ is 0 for $t < 2$, steps up to 8 at t = 2, then down to 6 at t = 4; $x_3(t)$ forms a rectangular pulse of amplitude 2 on [-4, -2) and is 0 elsewhere, stepping up at t = -4 and back to 0 at t = -2.

Problem 1.22



These signals were plotted over [-4, 4] seconds using definitions for ramp r(t) = tu(t), step u(t), and rect(x), which is 1 when $|x| \leq .5$. $x_1(t)$ and $x_2(t)$ are ramp-based signals with step offsets, $x_3(t)$ is a linearly decreasing ramp combination, and $x_4(t)$ and $x_5(t)$ produce rectangular pulses centered at -1, 3, and 1, 3 respectively.

Problem 1.25



Each waveform was plotted with a time span chosen to clearly show its exponential behavior, using the "~5-7 time-constants" rule tau = ½ for (a), tau = 10 for (b)-(c), tau = 1/1000 for (d), and tau = 5 for (e)-(f). Signals (a) starts at 100 and decays to 0, (b) starts at -10 and rises toward 0, (c) is identical to (b) but delayed by 5 seconds (zero for t<5, then reises toward 0 from - 10); (d) starts at 0 at t=0 and rises rapidly to 10; (e) is active from t≥0 with value 10e^{.8} at t=0 and then decays; and (f) is zero for t<4, equals 10 at t=4, and then decays.

Appendix:

Problem 1.19:

```
% Time vector
t = -5:0.01:5;  % from -5s to 5s with step size 0.01
% Define the unit step function
u = @(x) double(x >= 0);
% Define signals
x1 = -6 * u(t+3);
x2 = 10 * u(t - 4);
x3 = 4 * u(t + 2) - 4 * u(t - 2);
% Plot x1(t)
figure;
plot(t, x1, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x1(t)');
title('x1(t) = -6u(t+3)');
ylim([-7 2]);
% Plot x2(t)
figure;
plot(t, x2, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x2(t)')
title('x2(t) = 10u(t-4)');
ylim([-1 11]);
% Plot x3(t)
figure;
plot(t, x3, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x3(t)');
title('x3(t) = 4u(t+2) - 4u(t-2)');
ylim([-1 5]);
```

Problem 1.20:

```
% Time vector
t = -5:0.01:5;  % from -5s to 5s with step size 0.01
% Define the unit step function
u = @(x) double(x >= 0);
% Define signals
x1 = 8 * u(t-2) + 2 * u(t-4);
x2 = 8 * u(t - 2) - 2 * u(t-4);
```

```
x3 = -2 * u(t + 2) + 2 * u(t + 4);
% Plot x1(t)
figure;
plot(t, x1, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x1(t)');
title('x1(t) = 8u(t-2)+2u(t-4)');
ylim([-1 11]);
% Plot x2(t)
figure;
plot(t, x2, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x2(t)')
title('x2(t) = 8u(t-2)-2u(t-4)');
ylim([-1 9]);
% Plot x3(t)
figure;
plot(t, x3, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x3(t)');
title('x3(t) = -2u(t+2)+2u(t+4)');
ylim([-1 3]);
```

Problem 1.22:

```
% Time vector
t = -4:0.01:4;
% Step, ramp, and rect functions
u = @(x) double(x >= 0);
r = @(x) x .* u(x);
rect = @(x) double(abs(x) <= 0.5);  % rect is 1 if |x| <= 0.5
% Signals
x1 = 5 * r(t + 2) - 5 * r(t);
x2 = 5 * r(t + 2) - 5 * r(t) - 10 * u(t);
x3 = 10 - 5 * r(t + 2) + 5 * r(t);
x4 = 10 * rect((t + 1) / 2) - 10 * rect((t - 3) / 2);
x5 = 5 * rect((t - 1) / 2) - 5 * rect((t - 3) / 2);
% Plotting each function
figure;
plot(t, x1, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x_1(t)');
title('x_1(t) = 5r(t+2)-5r(t)');
ylim([-1 11]);
figure;
plot(t, x2, 'LineWidth', 2);
```

```
grid on;
xlabel('t (s)');
ylabel('x_2(t)');
title('x_2(t) = 5r(t+2)-5r(t)-10u(t)');
ylim([-1 11]);
figure;
plot(t, x3, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x_3(t)');
title('x_3(t) = 10-5r(t+2)+5r(t)');
ylim([-1 11]);
figure;
plot(t, x4, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x_4(t)');
title('x_4(t) = 10rect((t+1)/2)-10rect((t-3)/2)');
ylim([-11 11]);
figure;
plot(t, x5, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x_5(t)');
title('x_5(t) = 5rect((t-1)/2)-5rect((t-3)/2)');
ylim([-6 6]);
```

Problem 1.25:

```
close all;
clear;
clc;
u = @(x) double(x >= 0);  % Unit step
% (a) --- x1(t) = 100e^{-2t} u(t)  -> tau = 1/2
t = 0:0.001:3;
x1 = 100 * exp(-2 * t).*u (t);
figure;
plot(t,x1,'LineWidth',2);
grid on;
xlabel('t (s)');
ylabel('x_1(t)');
title('x_1(t) = 100e^{-2t} u(t)');
% (b) --- x2(t) = -10e^{-0.1t} u(t)  --> tau = 10
t = 0:0.1:70;  % ~7 * tau to show decay to near zero
x2 = -10 * exp(-0.1 * t).*u(t);
figure;
plot(t, x2, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x_2(t)');
```

```
title('x_2(t) = -10e^{-0.1} u(t)');
% (c) --- x3(t) = -10e^{-0.1t} u(t-5) --> starts at t = 5
t = 0:0.1:70;
x3 = -10 * exp(-0.1 * t).*u(t-5);
figure;
plot(t, x3, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x_3(t)');
title('x_3(t) = -10e^{-0.1t} u(t-5)')
% (d) --- x4(t) = 10(1 - e^{-10^3 t}) u(t) --> tau = 1/1000
t = 0:1e-5:0.01;  % very fast rise; show first 10 ms
x4 = 10 * (1 - exp(-1e3*t)).*u(t);
figure;
plot(t, x4, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x_4(t)');
title('x_4(t) = 10(1-e^{-10^3 t} u(t)')
% (e) --- x5(t) = 10e^{-0.2 (t - 4)} u(t)  --> tau = 5, active from t≥0
t = 0:0.05:40;
x5 = 10*exp(-0.2*(t - 4)).*u(t);
figure;
plot(t, x5, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x_5(t)');
title('x_5(t) = 10e^{-0.2(t - 4)} u(t)');
% (f) --- x6(t) = 10e^{-0.2 (t - 4)} u(t - 4)  --> tau = 5, starts at t = 4
t = 0:0.05:40;
x6 = 10*exp(-0.2*(t-4)).*u(t-4);
figure;
plot(t, x6, 'LineWidth', 2);
grid on;
xlabel('t (s)');
ylabel('x_6(t)');
title('x_6(t) = 10e^{-0.2(t-4)} u(t-4)');
```