BIRZEIT UNIVERSITY

Faculty of Engineering and Technology
Electrical and Computer Engineering Department

Signal and Systems
ENEE2313

MATLAB Assignment

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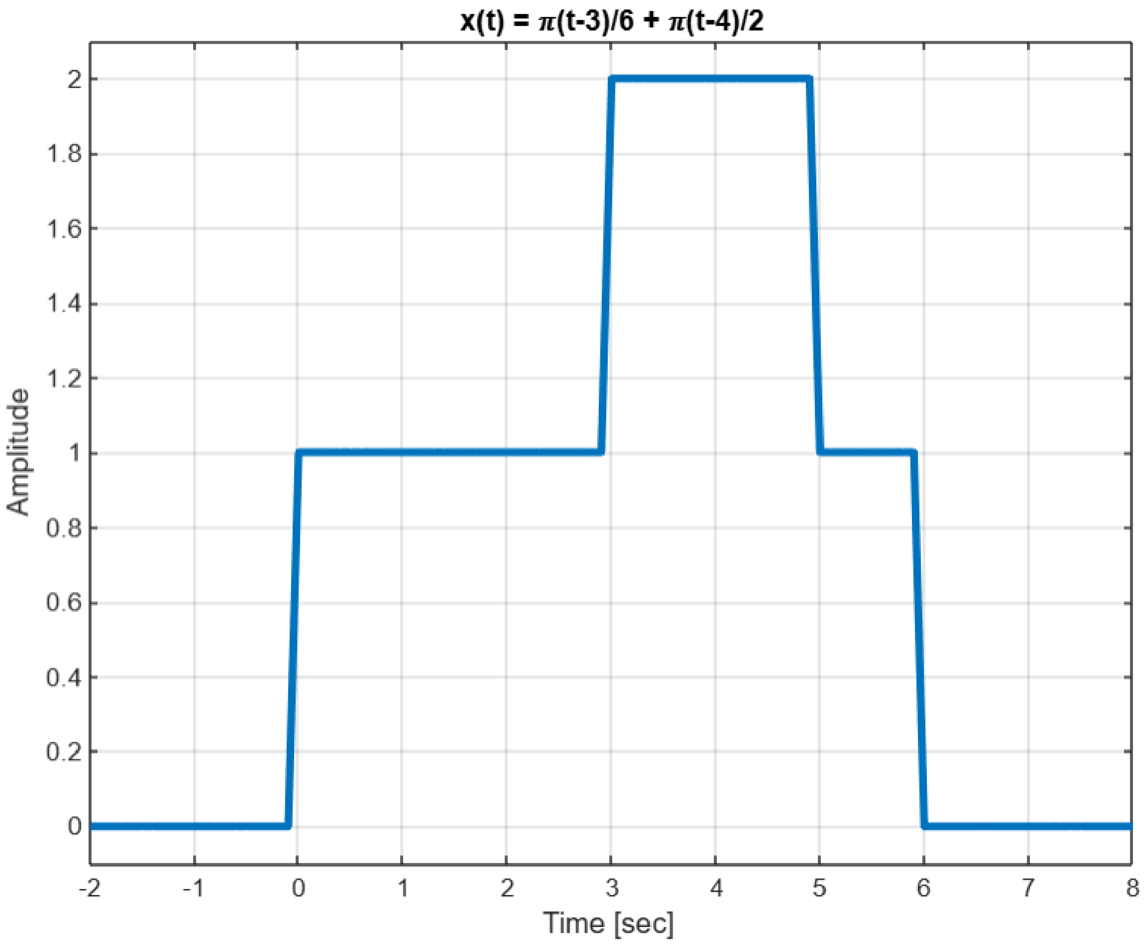
Question 1

1. Generate and Plot the following signals.

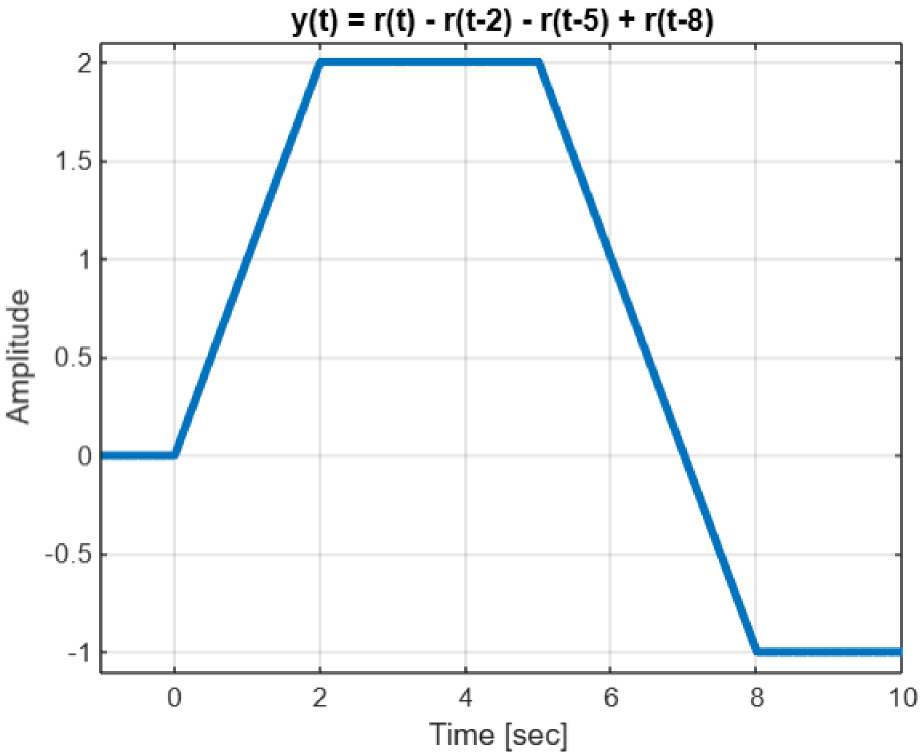
a. $x(t) = \pi\left(\frac{t-3}{6}\right) + \pi\left(\frac{t-4}{2}\right)$

```matlab
%Labiba Sharia 1220228
%Joud Thaher   1221381
% Q.1 part a
t=-4:0.1:10;
x1=rectpuls((t-3)/6);
x2=rectpuls((t-4)/2);
x=x1+x2;
plot(t,x, 'Linewidth',3);
title( 'x(t) = π(t-3)/6 + π(t-4)/2');
xlabel ('Time [sec] ');
ylabel ('Amplitude');
grid on;
axis([-2 8 -0.1 2.1]);
```



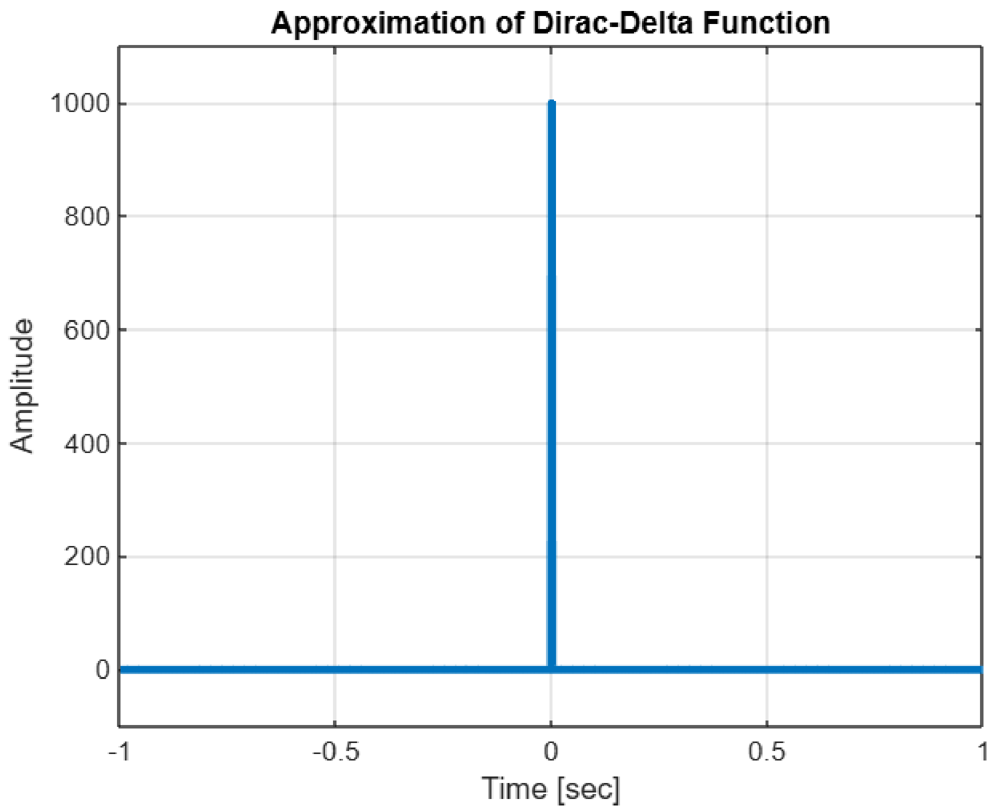
b. $y(t) = r(t) - r(t-2) - r(t-5) + r(t-8)$

```
%Labiba Sharia 1220228
%Joud Thaher   1221381
% Q.1 part b

t=-1:0.1:10;
x1=heaviside(t).*(t);
x2=-heaviside(t-2).*(t-2);
x3=-heaviside(t-5).*(t-5);
x4=heaviside(t-8).*(t-8);
x=x1+x2+x3+x4;
plot(t,x, 'Linewidth',3);
title( 'y(t) = r(t) - r(t-2) - r(t-5) + r(t-8)');
xlabel ('Time [sec] ');
ylabel ('Amplitude');
grid on;
axis([-1 10 -1.1 2.1]);
```



c. An approximation of the dirac-delta function using a pulse with an amplitude of 1000 and a pulse width of 0.001

```
%Labiba Sharia 1220228
%Joud Thaher   1221381
% Q.1 part c
t = -1:0.001:1;
amplitude = 1000;
width = 0.001;
x = amplitude * rectpuls(t, width);
plot(t, x, 'LineWidth', 3);
title('Approximation of Dirac-Delta Function');
xlabel('Time [sec]');
ylabel('Amplitude');
grid on;
axis([-1 1 -100 1100]);
```



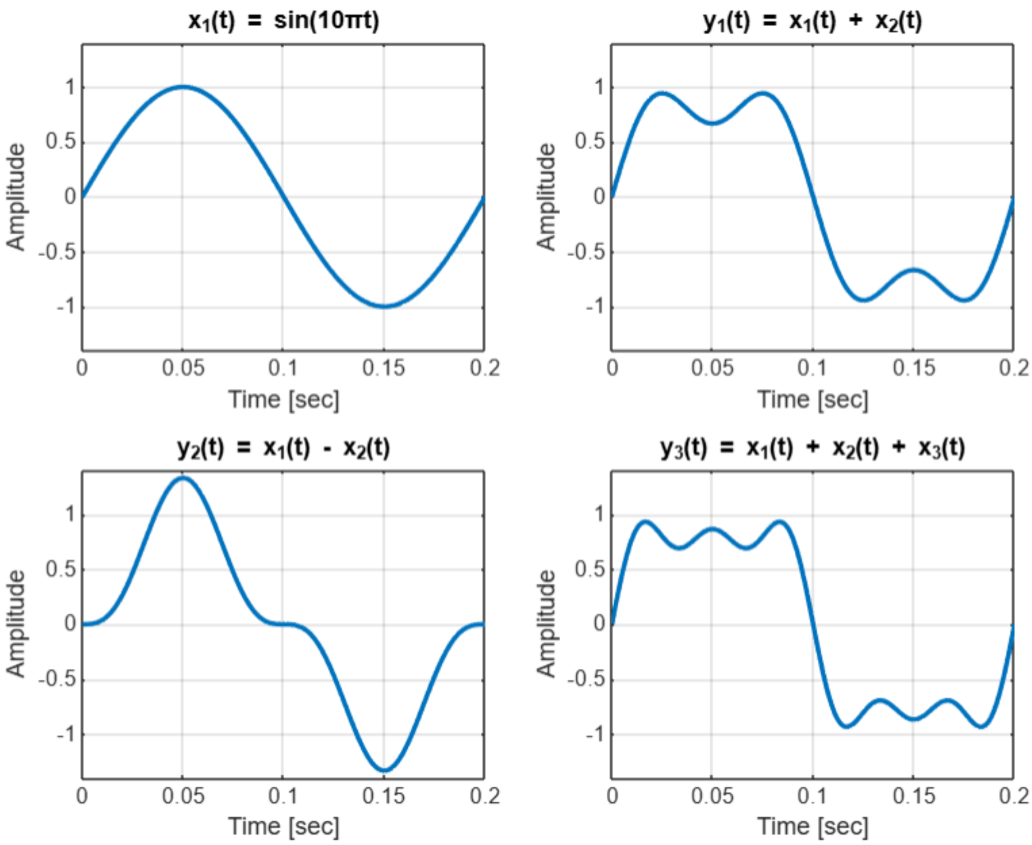
2. Consider the following signals:

$x_1(t) = \sin(10\pi t)$, $x_2(t) = \frac{1}{3}\sin(30\pi t)$, $x_3(t) = \frac{1}{5}\sin(50\pi t)$

a. Generate and plot $x_1(t)$ for one period.
b. Generate and plot $y_1(t)=x_1(t)+x_2(t)$ for one period.
c. Generate and plot $y_2(t)=x_1(t) - x_2(t)$ for one period.
d. Generate and plot $y_2(t)=x_1(t) + x_2(t) + x_3(t)$ for one period. Show all the results on one figure using subplot.
e. Determine whether the generated signals are periodic or not using Matlab plots.

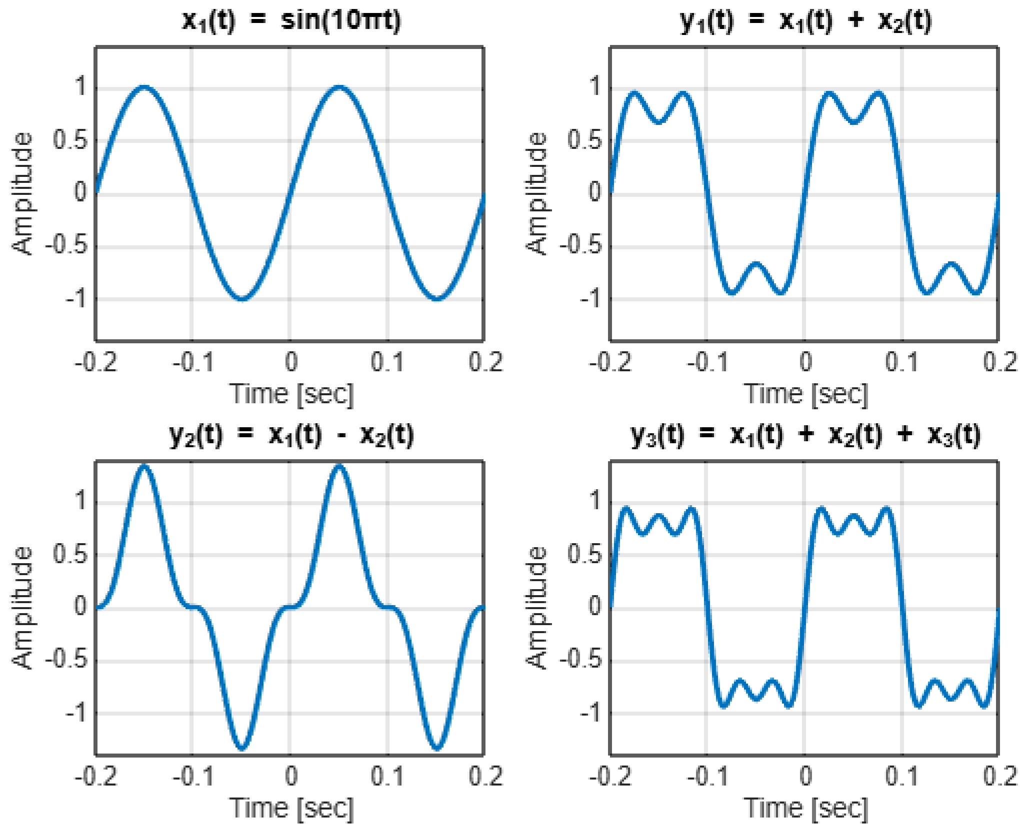
```
%Labiba Sharia 1220228
%Joud Thaher   1221381
% Q.2

t=0:0.001:0.2;
x1 = sin(10*pi*t);
x2 = sin(30*pi*t)/3;
x3 = sin(50*pi*t)/5;
y1 = x1 + x2;
y2 = x1 - x2;
y3 = x1 + x2 + x3;

figure;

subplot(2, 2, 1);
plot(t, x1, 'LineWidth', 2);
title('x_1(t) = sin(10πt)');
xlabel('Time [sec]');
ylabel('Amplitude');
grid on;
axis([0 0.2 -1.4 1.4]);

subplot(2, 2, 2);
plot(t, y1, 'LineWidth', 2);
title('y_1(t) = x_1(t) + x_2(t)');
xlabel('Time [sec]');
ylabel('Amplitude');
grid on;
axis([0 0.2 -1.4 1.4]);
```

```
subplot(2, 2, 3);
plot(t, y2, 'LineWidth', 2);
title('y_2(t) = x_1(t) - x_2(t)');
xlabel('Time [sec]');
ylabel('Amplitude');
grid on;
axis([0 0.2 -1.4 1.4]);

subplot(2, 2, 4);
plot(t, y3, 'LineWidth', 2);
title('y_3(t) = x_1(t) + x_2(t) + x_3(t)');
xlabel('Time [sec]');
ylabel('Amplitude');
grid on;
axis([0 0.2 -1.4 1.4]);
```



Part e:

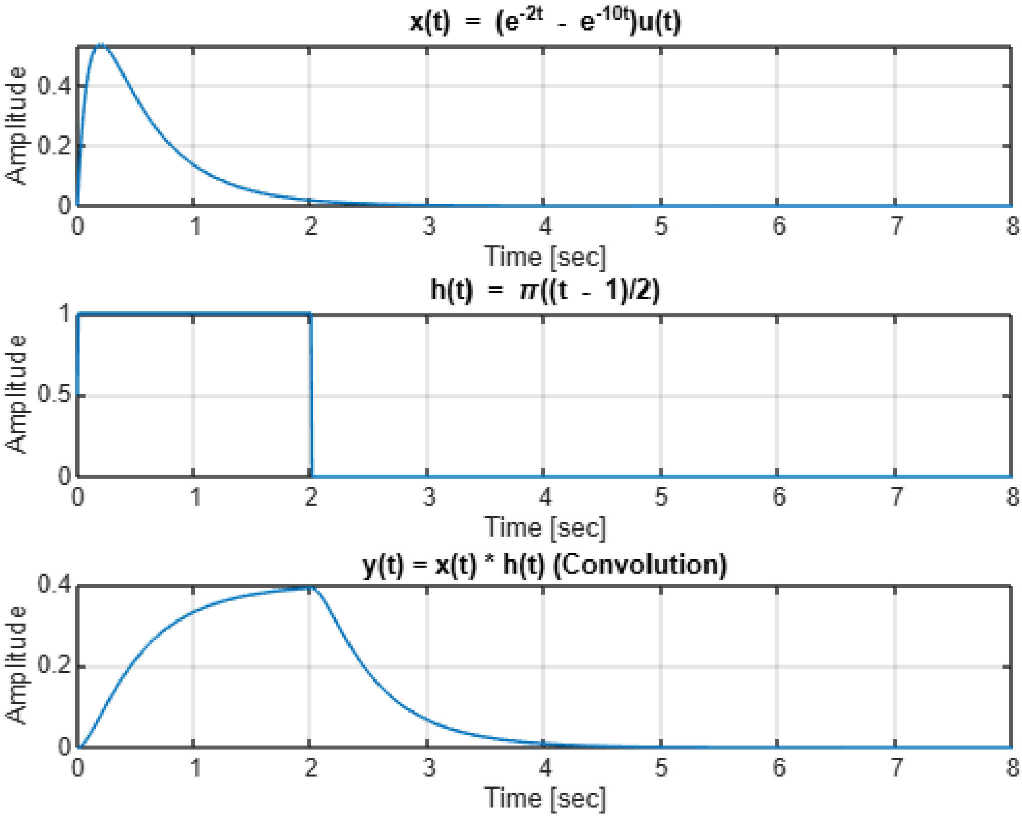
Figures using more than one period:



According to the plots, all signals are **periodic**.

3. Find and sketch the signal y(t) which is the convolution of the two pairs of signals.
$x(t) = (e^{-2t} - e^{-10t})u(t), h(t) = \pi\left(\frac{t-1}{2}\right)$

```
%Labiba Sharia 1220228
%Joud Thaher 1221381
% Q.3

syms t;
syms T;
x(t) = (exp(-2*t) - exp(-10*t)) .* heaviside(t);
h(t) = rectangularPulse((t - 1) / 2);
conv = int(x(T) * h(t - T), T, -inf, inf);
conv = simplify(conv);

figure;
subplot(3,1,1);
fplot(t, x(t), [0 8]);
title('x(t) = (e^{-2t} - e^{-10t})u(t)');
xlabel('Time [sec]');
ylabel('Amplitude');
grid on;



subplot(3,1,2);
fplot(t, h(t), [0 8]);
title('h(t) = \pi((t - 1)/2)');
xlabel('Time [sec]');
ylabel('Amplitude');
grid on;

subplot(3,1,3);
fplot(conv, [0 8]);
title('y(t) = x(t) * h(t) (Convolution)');
xlabel('Time [sec]');
ylabel('Amplitude');
xlim([0 8]);
grid on;
```



x(t) = (e-2t - e-10t)u(t)
Amplitude
0.4
0.2
0
0 1 2 3 4 5 6 7 8
Time [sec]
h(t) = π((t - 1)/2)
1
0.5
0
Time [sec]
y(t) = x(t) * h(t) (Convolution)
0.4
0.2
0
Time [sec]

4: Consider the following Differential Equation

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 3 + 5\,cos(\,1500\,t)$$

a. Solve it (write code) for t≥0 using zero initial conditions.

```
%Labiba Sharia 1220228
%Joud Thaher   1221381
% Q.4 part a

syms y(t)
dy(t) = diff(y, t);
dy2(t) = diff(y, t, 2);

Equation = dy2(t) + 3*dy(t) + 2*y(t) == 3 + 5*cos(1500*t);

% zero initial conditions
init = y(0) == 0;
init1 = dy(0) == 0;

solution = dsolve(Equation, init, init1);
disp('Part a');
disp('The solution is:');
disp(solution);
```

```
>> problem4_1
Part a
The solution is:
(843754*exp(-2*t))/562501 - (6750008*exp(-t))/2250001 - (5*1265627812501^(1/2)*cos(1500*t + atan(2250/1124999)))/2531255625002 + 3/2
```

b. Determine the response of the LTI systems for the given input and initial conditions: $y(0)=0$, $\acute{y}(0) = 3$.

```
%Labiba Sharia 1220228
%Joud Thaher   1221381
% Q.4 part b

syms y(t)
dy(t) = diff(y, t);
dy2(t) = diff(y, t, 2);

Equation = dy2(t) + 3*dy(t) + 2*y(t) == 3 + 5*cos(1500*t);

% zero initial conditions
init = y(0) == 0;
init1 = dy(0) == 3;

solution = dsolve(Equation, init, init1);
disp('Part b');
disp('The solution is:');
disp(solution);
```

```
>> problem4_2
Part b
The solution is:
3/2 - (843749*exp(-2*t))/562501 - (5*1265627812501^(1/2)*cos(1500*t + atan(2250/1124999)))/2531255625002 - (5*exp(-t))/2250001
```