

Lab 5 Continuous-Time Signals

I. Lab Assignments

Part A: Ramp/Unit Step Functions

1. Write a function, $y = \text{ustep}(t)$, for the unit step function.
2. Write a function, $y = \text{uramp}(t)$, for the unit ramp function.
3. Plot the following continuous time signals over $-10 \leq t \leq 10$:
 - $u(t)$
 - $r(t)$
 - $5u(t - 2)$
 - $3r(t + 5)$
 - $y(t) = 3r(t + 3) - 6r(t + 1) + 3r(t) - 3u(t - 3)$
 - $y(t) = 2r(t + 2.5) - 5r(t) + 3r(t - 2) + u(t - 4)$
 - $y(t) = \sin(t) * [u(t + 3) - u(t - 3)]$

Part B: Even/Odd signals

4. Create a function which returns the even and odd parts of a signal as follows.

```
function [ye,yo] = evenodd(y)
% even/odd decomposition
% y: analog signal
% ye, yo: even and odd components
% USE [ye,yo] = evenodd(y)
%
yr = fliplr(y);
ye = 0.5 * (y + yr);
yo = 0.5 * (y - yr);
```

5. Use the above function to find the even and odd parts of the following continuous signal and plot the main signal beside its odd and even parts inside one figure with different colors: (assume $-10 \leq t \leq 10$)
 - $y(t) = 2r(t + 2.5) - 5r(t) + 3r(t - 2) + u(t - 4)$

Part C: Sum of Periodic Signals

6. Plot the following signal over $-10 \leq t \leq 10$. Is the sum signal still periodic? If so, what is the period?
 - $x_1(t) = 1 + 1.5 \cos(2\Omega_0 t) - 0.6 \cos(4\Omega_0 t)$ $\Omega_0 = \pi/10$

7. Plot the following signal over $-10 \leq t \leq 10$. Is the sum signal still periodic? If so what is the period?
- $x_1(t) = 1 + 1.5 \cos(6\Omega_0 t) - 0.6 \cos(4\Omega_0 t) \quad \Omega_0 = \pi/10$

Part D: Energy/Power of Signals

8. Energy of a signal over $[-\frac{T}{2}, +\frac{T}{2}]$ is defined as $E = \int_{-\frac{T}{2}}^{+\frac{T}{2}} |x(t)|^2 dt$. The power, on the other hand, is defined as $P = \frac{1}{T} \int_{-\frac{T}{2}}^{+\frac{T}{2}} |x(t)|^2 dt$. Find the energy and power of the following signals over $-10 \leq t \leq 10$ by using the symbol operations of Matlab.
- $x(t) = e^{-|t|}$
 - $x(t) = e^{-t} \cos(2\pi t) u(t)$

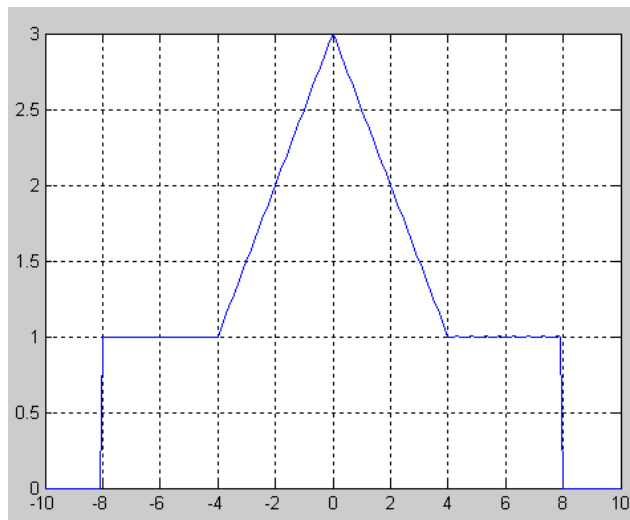
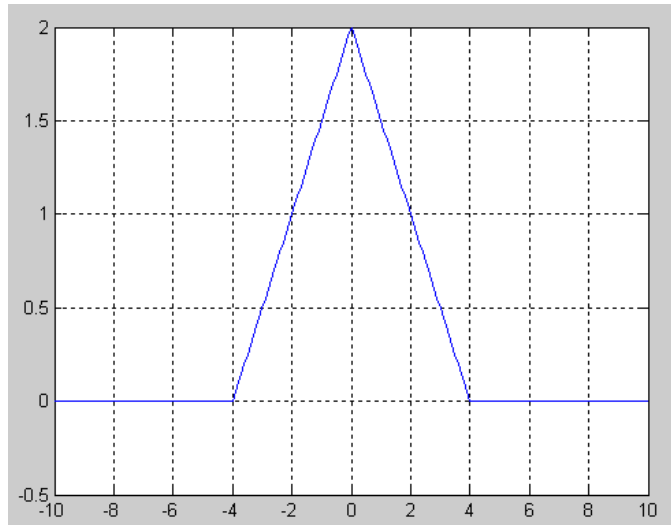
Part E: Shift/Scale/Reflect of Signals

9. For the following function plot $x(t)$, $x(t - 2)$, and $x(t + 2)$ in one figure with different colors (assume $-10 \leq t \leq 10$):
- $x(t) = e^{-|t|}$
10. For each one of the following functions plot $x(t)$, $x(2t)$, and $x(0.5t)$ in one figure with different colors (assume $-10 \leq t \leq 10$):
- $x(t) = e^{-|t|}$
11. For each one of the following functions plot $x(t)$ and $x(-t)$ in one figure with different colors (assume $-10 \leq t \leq 10$):
- $x(t) = t^3$
 - $x(t) = e^{-0.2t} \sin(t)$

II. Homework Assignments

Part A: Ramp/Unit Step Functions

1. Use ramp/ustep functions to create the following signals:



Part B: Even/Odd signals

2. Plot the even/odd parts of the following signal: (assume $-10 \leq t \leq 10$)
 - $y(t) = 3 + r(t+3) - r(t-2) - 6u(t-6)$

Part C: Energy/Power of Signals

3. Calculate the energy and power of the following signal over $-10 \leq t \leq 10$:
 - $x(t) = 2 \cos^2\left(2\pi t + \frac{\pi}{4}\right)$

Part D: Shift/Scale/Reflect of Signals

4. Plot $x(t)$, $x(2t - 3)$, and $x(-2t + 1)$ for the following signal (assume $-10 \leq t \leq 10$):

- $x(t) = t^2 \sin(t)$