



**WENTWORTH**  
Institute of Technology

# Lab 1 – Introduction to MATLAB

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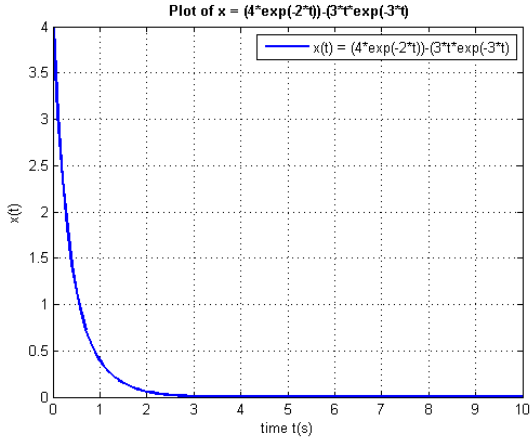
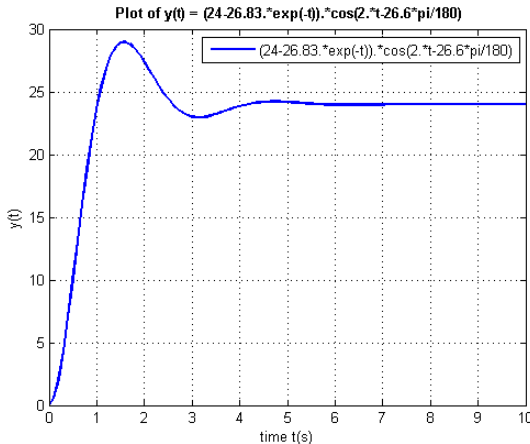
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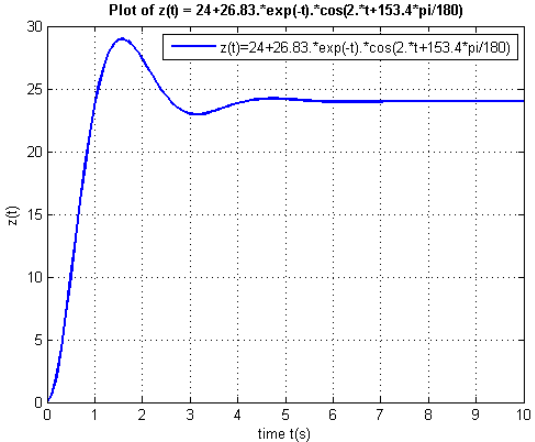
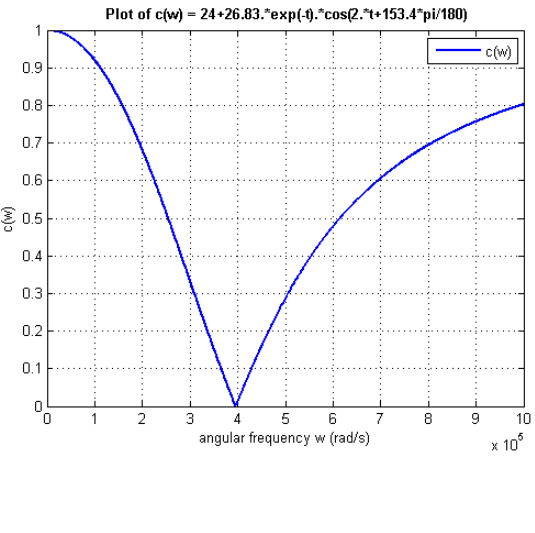
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## Introduction

Signals and Systems is the study and application of data processing, taking various inputs and processing them through the use of time-domain and Fourier Transforms into the desired output ranges. This lab serves as an introduction to Matlab; a program used for signal processing. The goal of this lab was to introduce students to Matlab scripting, as well as graphing the outs from these scripts.

## Part One

Signal	MATLAB Code
 <p>Plot of <math>x = (4 \cdot \exp(-2t)) - (3t \cdot \exp(-3t))</math></p> <p>The plot shows a blue curve starting at (0, 4), decreasing rapidly, and approaching zero as time increases. The x-axis is labeled 'time t(s)' and ranges from 0 to 10. The y-axis is labeled 'x(t)' and ranges from 0 to 4. A legend indicates the equation <math>x(t) = (4 \cdot \exp(-2t)) - (3t \cdot \exp(-3t))</math>.</p>	<pre>t = 0:0.1:10; x = (4.*exp(-2.*t)) - (3.*t.*exp(-3.*t)); plot(t,x,'linewidth',2); legend('x(t) = (4*exp(-2*t)) - (3*t*exp(-3*t))'); title('\bf Plot of x = (4*exp(-2*t)) - (3*t*exp(-3*t))'); xlabel('time t(s)'); ylabel('x(t)'); grid on;</pre>
 <p>Plot of <math>y(t) = (24 - 26.83 \cdot \exp(-t)) \cdot \cos(2 \cdot t - 26.6 \cdot \pi/180)</math></p> <p>The plot shows a blue curve starting at (0, 0), rising to a peak of approximately 28 at t ≈ 1.5, then settling to a steady-state value of approximately 24. The x-axis is labeled 'time t(s)' and ranges from 0 to 10. The y-axis is labeled 'y(t)' and ranges from 0 to 30. A legend indicates the equation <math>(24 - 26.83 \cdot \exp(-t)) \cdot \cos(2 \cdot t - 26.6 \cdot \pi/180)</math>.</p>	<pre>t = 0:0.1:10; y = (24 - 26.83.*exp(-t)).*cos(2.*t - 26.6*pi/180); plot(t,y,'linewidth',2); legend('(24-26.83.*exp(-t)).*cos(2.*t-26.6*pi/180)'); title('\bf Plot of y(t) = (24-26.83.*exp(-t)).*cos(2.*t-26.6*pi/180)'); xlabel('time t(s)'); ylabel('y(t)'); grid on;</pre>

Signal	MATLAB Code
	<pre> t = 0:0.1:10; z = 24 + 26.83 * exp(- t) .* cos(2 .* t + 153.4 * pi / 180); plot(t, z, 'linewidth', 2); legend('z(t) = 24 + 26.83 * exp(- t) .* cos(2 .* t + 153.4 * pi / 180)'); title('\bf Plot of z(t) = 24 + 26.83 * exp(- t) .* cos(2 .* t + 153.4 * pi / 180)'); xlabel('time t(s)'); ylabel('z(t)'); grid on; </pre>
	<pre> w = 0:10:10000000; R = 1000; L = 0.004; C = 0.0016 * 10^-6;  c = (abs((1 ./ (L * C)) - w.^2)) ./ (sqrt(((1 ./ (L * C)) - w.^2).^2 + (w ./ (R * C)).^2)); plot(w, c, 'linewidth', 2); legend('c(w)'); title('\bf Plot of c(w) = 24 + 26.83 * exp(- t) .* cos(2 .* t + 153.4 * pi / 180)'); xlabel('angular frequency w (rad/s)'); ylabel('c(w)'); grid on; </pre>

The plots for  $y(t)$  and  $z(t)$  are identical because they are the same signal, with a  $180^\circ$  phase shift applied.

## Part Two

Data

Simulation

Time(s)	Values
0	0.04
0.5	0.85
1	1.15
1.5	0.95
2	1
2.5	0.97
3	0.98

Table 1: Simulated result data for an unknown process

Experimental

Time(s)	Values
0	0.03
0.5	0.86
1	1.15
1.5	1
2	1.01
2.5	0.98
3	0.99

Table 2: "Experimental" result data for an unknown process

## MATLAB Code

```
clear all; close all;

% analytical
t = 0:0.1:3;
c = 1-1.1577*exp(-2.0363*t).*cos(3.49*t-30.25*pi/180);
plot(t,c, 'r');
hold on;

% simulation
sim_data =
[0,0.03;0.5,0.86;1,1.15;1.5,1;2,1.01;2.5,0.98;3,0.99];

plot(sim_data(:,1),sim_data(:,2), 'b');

% experimental
exp_data = [0,0.04;.5,.85;1,1.15;1.5,.95;2,1;2.5,0.97;3,.98];
plot(exp_data(:,1),exp_data(:,2), 'bl*');
legend('Analytical','Simulation Data','Experimental Data');
xlabel('time (second)');
```

## Output

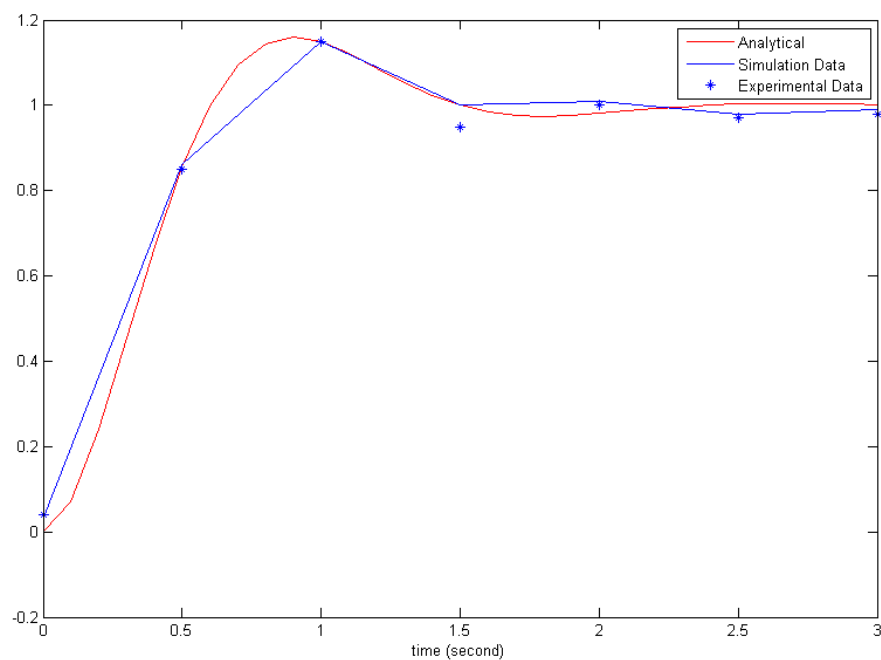


Figure 1: A comparison graph of result data gathered