**ENED 1090: Engineering Models I**

**Homework Assignment #1**

**Due: Week of September 7th at the beginning of your Recitation Section**

**Instructions:**

1. Before you begin editing this document, you must **SAVE** this document to your laptop or you will end up losing all of your work. If you opened this document directly from Blackboard, click on the Enable Editing button then choose File → Save As and save the document to your laptop. You should set up a folder on your laptop for ENED1090 where you keep all of your homework assignments and lab reports.
2. It is fine to work with other students, but what you turn in must be your own work - not something copied from someone else.
3. Submit an electronic copy of your work to your ***individual section*** of Blackboard – look for Homework #1***.*** Include your completed .docx file (pdf O.K. too).

***Note: You can attach more than one document in a single submission. Once you hit submit, be patient and wait – attachments take a while to upload. Hitting submit multiple times will result in multiple submissions.***

**Problem 1: 1-d Arrays (Vectors)**

Do this problem in the Command Window. Leave semicolons off the commands so you see the results in the command window as well.

1. Use the Start:Inc:Max method to create a variable called t1 which is a vector of values starting at -1, incrementing by 0.4, and ending at 1.4. Paste your MATLAB command and result below.

>> t1 = -1:.4:1.4

t1 =

-1.0000 -0.6000 -0.2000 0.2000 0.6000 1.0000 1.4000

1. Use the linspace command to create a variable called t2 which is a vector of 9 equally spaced values starting at 0 and ending at 12. Paste your MATLAB command and result below.

>> linspace(0,12,9)

ans =

Columns 1 through 7

0 1.5000 3.0000 4.5000 6.0000 7.5000 9.0000

Columns 8 through 9

10.5000 12.0000

You will need your vector, t1, from part (a) for the rest of this problem. If you have cleared it, re-create it. Run each of the following commands in the command window leaving the semicolon off as indicated. Paste the result into the space indicated and ***explain in your own words*** what each of these commands do.

1. >> t1

t1 =

-1.0000 -0.6000 -0.2000 0.2000 0.6000 1.0000 1.4000

Displays the values of t1

1. >> t1(1)

ans =

-1

Displays the 1st value on the vector t1

1. >> t1(4)

ans =

0.2000

Displays the 4th value of the vector t1

1. >> t1(10)

Index exceeds matrix dimensions.

The vector t1 only has 7 entries so no 10th entry exists

1. >> length(t1)

ans =

7

The vector t1 has 7 entries

1. >> t1(2) = 42

t1 =

-1.0000 42.0000 -0.2000 0.2000 0.6000 1.0000 1.4000

Edits the second value of the vector t1 to be 42

1. >> t1(4:7) = 73

t1 =

-1.0000 42.0000 -0.2000 73.0000 73.0000 73.0000 73.0000

Edits the entries 4-7 to be 73

**Problem 2: Plotting Polynomials**

When choosing values for the x-axis, it is often nice to show all the zero crossings (roots) of the polynomial on the plot. MATLAB has a function called **roots** that is quite useful.

Example: To find the roots of the polynomial, t3 – 6.6 t2 + 3.2t + 2.4, simply put the numerical coefficients of the polynomial in a vector and run the roots function as shown below.

>> roots([1 -6.6 3.2 2.4])

ans = 6.0000

1.0000

-0.4000

1. Using MATLAB, find the roots of the polynomial: t4 – 3.5t3 – 7.5t2 + 17t + 20

ans =

4.0000

2.5000

-2.0000

-1.0000

1. Plot the polynomial choosing a range for t that will include all roots. Paste your plot and MATLAB commands in the spaces indicated below. Labels and title not required.

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t = -5:.5:5;

y = (t.^4) - 3.5\*(t.^3) - 7.5\*(t.^2) + 17\*t + 20;

plot(t,y,'bs--')

**Problem 3: Plotting Exponential Functions**

Many physical processes can be modeled using the exponential function. Some examples include charging or discharging a capacitor, population growth or decay, heating and cooling, radioactive decay, and first order chemical reactions.

* When choosing the values for the x-axis, keep in mind that e-5 is a small number. So, for example, if plotting e-10t, a good choice of values for t would be from 0 to 0.5.
* Also remember that in MATLAB, e-10t is entered as exp(-10\*t)

1. Hydrogen Peroxide (H2O2) decomposes as a 1st order reaction into water and oxygen gas. At a certain temperature, the concentration decreases exponentially as: C = e-0.4t. What would be a good range of t for plotting e-0.4t? **GOOD RANGE FOR t:** t = 0:1:10
2. Plot the exponential function. Label the x-axis as Time (sec), the y-axis as Concentration (M), and add a title. Paste your plot and all MATLAB commands in the spaces indicated below.

****

t = 0:1:10;

C = exp(-0.4\*t);

figure(1)

plot(t,C,'bs-');

xlabel('\bfTime (sec)','FontSize',14);

ylabel('\bfConcentration (M)','FontSize',14);

title('\bfDecomposition of Hydrogen Peroxide','FontSize',20);

**Problem 4: Plotting sine and cosine functions**

To plot a sine or cosine function, first determine the period, T. Then decide how many periods you want to plot.

Example: sin(2π(100)t) has a period of 1/100 = 0.01. To plot 4 cycles, choose t-values from 0 to 0.04. A good choice for the time increment would be T/100 or 100 points every cycle.

1. What is the period of the function: sin(2π(250)t)? **PERIOD:** 1/250 = .004
2. Plot 5 periods (cycles) of sin(2π(250)t). Label the x-axis as time (sec). Paste your plot and MATLAB commands in the spaces indicated below.

****

t = 0:.001:.02;

y = sin(2\*pi\*250\*t);

figure(2)

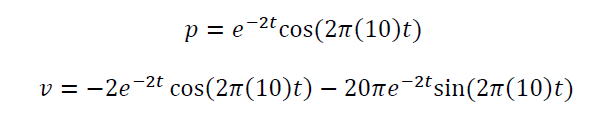
plot(t,y,'rs-');

xlabel('\bfTime (sec)','FontSize',14);

**Problem 5: Plotting exponentially decaying sinusoids & using Subplot Command**

Many physical responses can be modeled by damped sinusoidal motion. For example, the shock absorbers in a car allow the passengers to experience damped vibrations when hitting a pothole or a speed bump.

Suppose the position (p) and velocity (v) of a mass connected to a spring are described by the following equations:



Assume time, t, is in seconds, and position, p, is in cm.

1. What is a good time range to ensure the exponential piece of the function has decayed to nearly zero? **GOOD RANGE FOR t:** t = 0,3
2. What is the period of the cosine and sine functions? **PERIOD:** 1/10 = 0.1
3. Plot the position and velocity of the mass by doing the following:

* Create a vector of t-values using your answers above. Your increment should be significantly smaller than the period of the sine and cosine functions.
* Use the subplot command to sub-divide the figure into 2 rows and 1 column (top plot and bottom plot).
* Plot position in the top window then add labels on the x-axis and y-axis (include units), and a title.
* Plot velocity in the bottom window then add labels on the x-axis and y-axis (include units).

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t = 0:.05:3;

p = exp(-2\*t).\*cos(20\*pi\*t);

v = -2\*exp(-2\*t).\*(cos(20\*pi\*t))-(20\*pi\*exp(-2\*t).\*(sin(20\*pi\*t)));

figure(3)

plot(t,p,'rs-');

xlabel('\bfTime (sec)','FontSize',14);

ylabel('\bfPosition (cm)','FontSize',14);

title('\bfPosition of Shock Absorber','FontSize',20);

figure(4)

plot(t,v,'bs-');

xlabel('\bfTime (sec)','FontSize',14);

ylabel('\bfVelocity (cm/s)','FontSize',14);

title('\bfVelocity of Shock Absorber','FontSize',20);

**What to turn in:**

Submit an electronic copy of your work to your *individual section* of Blackboard – look for Homework #1***.***  You must submit either a Word doc or a pdf file. Google docs and other file document file formats simply won’t open in Blackboard.