Signals Systems and Transforms
EEET-332
Lab 2

Special lab instructions:

1) Create a new directory for this lab.
2) Copy the last lab's functions init.m and make_plot.m into this week's directory.
3) Create a new *.m file for each section and save it. Remember, no spaces in the file name!

A quiz will be given at the beginning (1st 10 minutes) of the lab covering the content of the prelab. One quiz will be dropped. NO make-up quizzes will be given.

Prelab:

1) Research L'Hopital's rule. Use the rule to determine:
   a. $y = \frac{\sin(x-4)}{x-4}$ when x = 4
   b. $y = \frac{x^3-7x^2+10x}{x^2+x-6}$ when x = 2
2) Research MATLAB's linspace command. Use linspace to create a 5 point vector starting at 1 and ending at 10. Help from MATLAB is provided below.

```
>> help linspace
 linspace Linearly spaced vector.
   linspace(X1, X2, N) generates N points between X1 and X2.
   For N = 1, linspace returns X2.
```

3) Identify the Euler Lite Phasor and complex s variable (see section 4).
   a) x(t)=10cos(2t+30)
   b) x(t)=7.5cos(3t+56)

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Section 1:

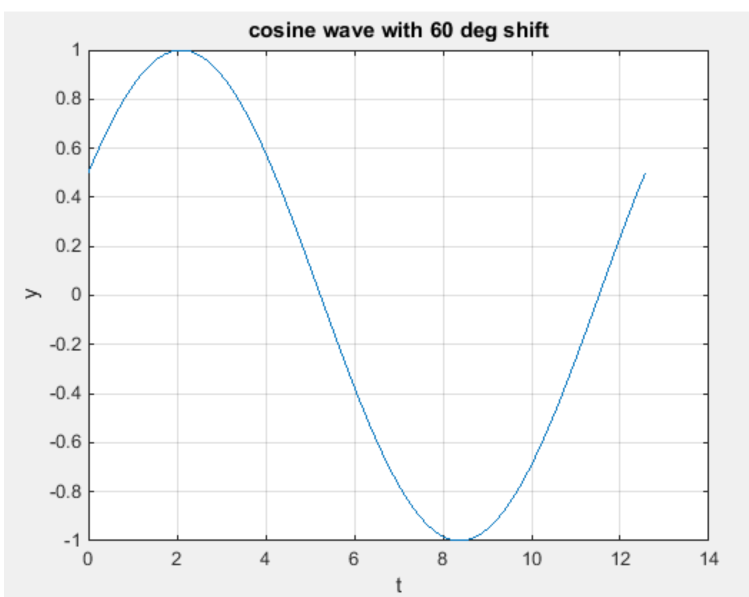
1) Open MATLAB.
2) Next, create a new script file. Save the script. Place a call to init.m on the first line as shown below.

```
init()
```

3) Replace the blanks in the code below to plot a cosine using Euler's Identity.
   a) After the call to init(), complete the code for a vector t with values between 0 and 4π that has 201 points using the linspace command.
   b) Plot a cosine wave using Euler's Identity with w=0.5 and phase = **-** 60 degrees (peak shifted to the right, not left). Make sure you convert the phase to radians.

```
t=linspace(____________________
w=__________________
phase=__________________
theta = w*t + phase;
y = ( exp(1j* theta) + exp(_______________) ) / 2;
make_plot(________________________________
```

4) Get a sign-off. The correct plot is shown below.



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Section 2:

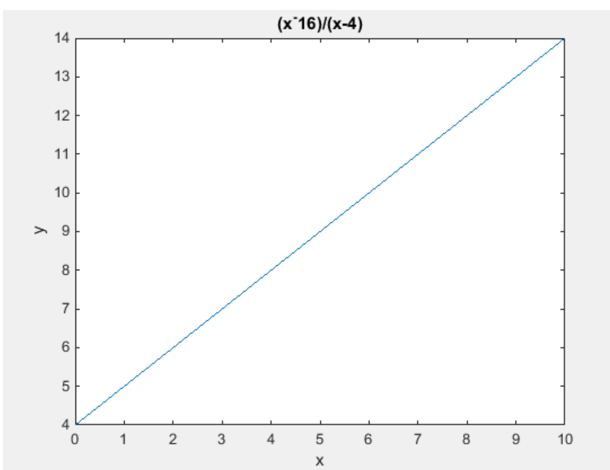
1) Create a new script file and place a call to init() on the first line.
2) Create a vector x with 1751 values between 0 and 10 using linspace.
3) Complete the <u>two</u> polyval functions below to create and plot:

$$y = \frac{x^2 - 16}{x - 4}$$

Frequently asked questions: 1) Question: what does `[1 0 -16]` represent? Answer: The coefficients of the equation are listed in the vector. Most people don't notice that x is missing in the equation because its coefficient is zero.

```
num=[1 0 -16];
ynum=polyval(num,x)
den=
yden=
y=ynum./
make_plot(
```

4) Verify your plot is correct.



5) Find the Workspace window in MATLAB.

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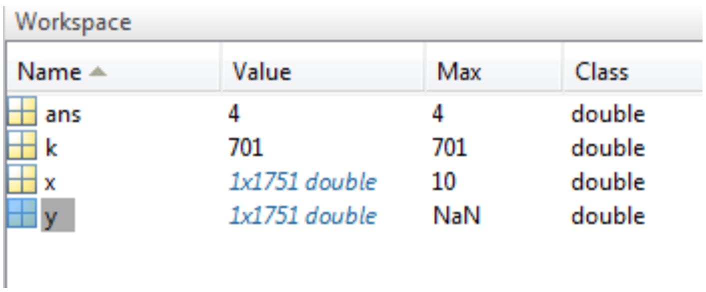
6) Examine the Workspace window. Note that the max of y is NaN (not a number). This is because the calculation of y when x = 4 is not a number.

Frequently asked questions: 1) Question: where is max in my workspace? Answer: It may need to be added. Right click next "Value" and add Max.


Workspace

Name	Value	Max	Class
ans	4	4	double
k	701	701	double
x	1x1751 double	10	double
y	1x1751 double	NaN	double

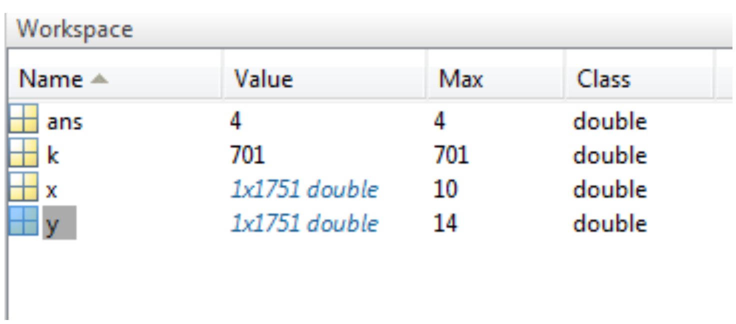
7) Using the find and isnan functions find the index of x where the discontinuity occurs.

```
k=find(isnan(y)) %gives you the array element index
x(k) %displays the x value
%L'Hopital's rule has us take derivative of top and bottom
% of (x^2-16)/(x-4) to find the function that gives the correct
% value of y(k).

%to fix enter the actual function value found using L'Hopital
%y(k) =
```

8) Using L'Hôpital's Rule determine the correct value of y. Then, in your MATLAB script, uncomment y(k). Then add the y value (the actual number, not the equation) after the equal sign. This will overwrite the incorrect value of y and fix the workspace allowing the correct max to be displayed.

9) Take a screenshot of the workspace window when it is correct (shown below) and copy the screenshot to Word for a sign-off. Add your code in Word (report).


Workspace

Name	Value	Max	Class
ans	4	4	double
k	701	701	double
x	1x1751 double	10	double
y	1x1751 double	14	double

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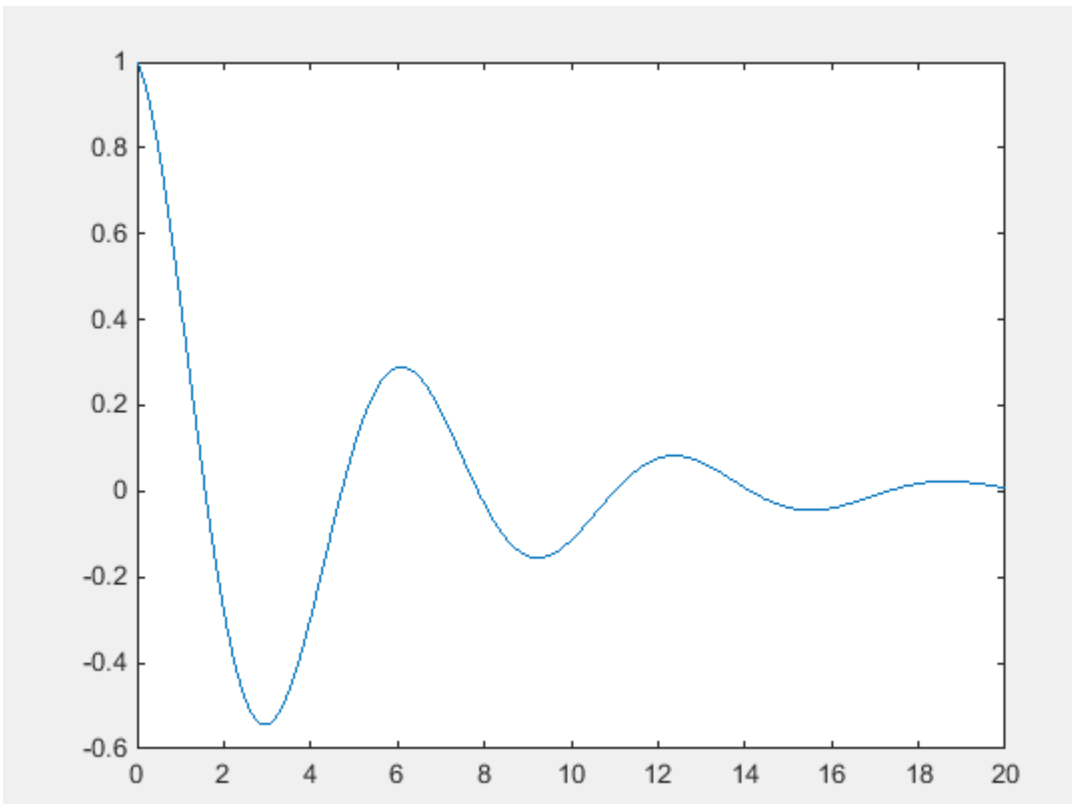
Section 3:

1) Create a new script file and place a call to init() on the first line.
2) Create a vector t with values between 0 and 20 that has 201 points using the linspace command.
3) Create and plot y using the make_plot function. Remember to use the dot times (.*) between the exponential and cosine to force element-by-element multiplication.

$$y = e^{-0.2t} \cos t$$

4) Compare your plot to the one below, and if correct, take a screenshot that includes the plot and code. Print the screenshot for your report.



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Section 4: MATLAB is not required for this section.

1) A handwritten solution will be accepted for this section, or if you prefer, you can write the solution using Word.
2) Identify the Euler Lite Phasor and complex s variable.
   a) x(t)=4cos(5t+60)
   b) x(t)=3cos(2t+12)
   c) x(t)=cos(t)

Helpful hint: Using Euler's identity, the time domain function

$$x(t) = |X|\cos(\omega t + \theta).$$

can be transformed into the frequency domain where:

$$\vec{X} = |X|e^{j\theta} \text{ and } s = j\omega.$$

$\vec{X} = |X|e^{j\theta}$ is called the Euler Lite phasor and is shown in exponential form. $|X|$ is the magnitude of the Euler Lite phasor (not absolute value). θ is the phase angle of the Euler phasor and is radians when in exponential form. Polar form can be used as a shorthand phasor notation: $\vec{X} = |X|\angle\theta$ where the phase angle is given in degrees. The complex variable $s = \sigma + j\omega$ contains the damping coefficient σ and the angular velocity ω. To start with, we are letting $\sigma = 0$.

$x(t)$ is not required to contain all elements of the general expression: When the magnitude of Euler Lite phasor $|X|$is not present, $|X| = 1$; when $\cos$ is not present both the angular velocity $\omega = 0$ and the phase angle $\theta = 0$; a one (1) can be place in front of either t when no number is present; and when the phase angle is not present, $\theta = 0$.

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Report:

Add a cover page to your Word document.

Submit the Word document (report) including the print-out from sections 2-3, the solution from section 4, and this sign-off sheet.

Sign-offs

Name ______________________

Section 1: shifted cosine wave

	/ /
Signature	Date

Section 2: L'Hôpital

	/ /
Signature	Date