HW 2 CENG 4331 DUE Sept 9

Check out the MATLAB store and Buy MATLAB for an incredible price $49 or $99.

https://www.mathworks.com/store/link/products/student

Kamen and Heck have a useful WEB site http://users.ece.gatech.edu/bonnie/book3/ with M-files, a Tutorial, ON-line Demos, and Worked problems. The Tabs are:

Home Book Contents M-Files in Book MATLAB Tutorial On-Line Demos Worked Problems

Here are the categories of problems and solutions in Chapter 1 and 2.

Chapter 1
Periodicity of Signals
Plotting Signals
System Properties

Chapter 2
Solving Differential Equations
Continuous Time Convolution
Solving Difference Equations
Discrete Time Convolution

Problem 1
30 Points
Go through the WEB site and explore a bit. Get familiar with the site.

1. Download an m-file for Chapter 1 or 2 and run it. Turn in the file and results.
2. Go through the beginning of the MATLAB tutorial and describe briefly what you learned.
3. Study the Worked Problems from Chapter 1 and 2. Pick one you like and describe it.

Problem 2 20 Points

Study K&H Example 2.11 (Pg 72) after Reading Section 2.5.1. Then, do the following:

1. Show that the true solution to the first-order equation 2.67 with a step function input is the step response

$$y(t) = 1 - e^{-t/1} \quad \text{volts}$$

since $\tau = RC = 1$ second in this case.

2. Using the Euler approximation Equation 2.61, show that the approximate solution here is the difference equation

$$y[n] = \left(1 - \frac{T}{RC}\right)\, y[n-1] + \frac{T}{RC}\, x[n-1]$$

3. The sampling period is $T = 8/40 = 0.2$ seconds so that $T << \tau = RC$ so Figure 2.16 is reasonable for the approximate solution but is still in error. Look up the tolerance for ODE45 and list it.

Problem 3 10 Points

Show that EWMA filter becomes MA filter when b approaches 1.

$$y[n] = \sum_{i=0}^{N-1}\, a(b^i\, x[n-i]), \quad a = \frac{1-b}{1-b^N}$$

Hint: Where do you go when you are injured!

Problem 4 20 Points

Convolve the discrete-time signals $v[n] * x[n]$, with both signals starting at $n = 0$ as defined below. Do the convolution by hand **Writing out each term** $y[0], y[1], \cdots y[5]$.

Check with MATLAB conv. Turn in your calculation and the MATLAB program and results.

The vectors are

$$\begin{aligned} \mathbf{v} &= [1, -2, 3, -4]\,, \\ \mathbf{x} &= [4, 1, -1]\,, \end{aligned} \tag{1}$$

Problem 5 20 Points
Consider the differential equation

$$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 0 \qquad y(0) = 1, \quad \dot{y(0)} = 0$$

1. Solve for $y(t)$ and check your results. Check it by testing the initial conditions and then plug your solution in the equation.
   (**Any problems with this - review your DEs**)

2. Use MATLAB Symbolic Toolbox commands to solve for $y(t)$ as in Example 2.13.