HW1 and Kamen and Heck Worked Problems Chapter 1 on WEB

1. a)

$$\frac{dy}{dt} + 6y(t) = 4x(t)$$

This is an ordinary differential equation with constant coefficients, therefore, it is linear and timeinvariant. It contains memory and it is causal.
Memory: Output $y(t_1)$ depends on values of input over time not just on $x(t_1)$.

See Page 32 in text.

b)

$$\frac{dy}{dt} + 4ty(t) = 2x(t)$$

This is an ordinary differential equation. The coefficients of 4t and 2 do not depend on y or x, so the system is linear. However, the coefficient 4t is not constant, so it is time-varying. The system is also causal and has memory.

c)

$$y[n] + 2y[n-1] = x[n+1]$$

This is a difference equation with constant coefficients; therefore, it is linear and time-invariant. It is noncausal since the output depends on future values of x. Specifically, let x[n] = u[n], then y[-1] = 1.

d) $y(t) = sin(x(t))$ Check linearity by seeing if Additive and Homogeneous properties are present (Page 33):

$$y_1(t) = \sin(x_1(t))$$

$$y_2(t) = \sin(x_2(t))$$

Solution to an input of $a_1x_1(t) + a_2x_2(t)$ is $\sin(a_1x_1(t) + a_2x_2(t))$.
This is NOT equal to $a1y1(t) + a2y2(t)$.
As a counter example, consider

$$x_1(t) = p \text{ and } x_2(t) = p/2, a1 = a2 = 1$$

the system is causal since the output does not depend on future values of time, and it is memoryless. The system is time-invariant.

You can continue the Worked Problems section on the WEB site.

Homework 1 to turn in for a grade-DUE August 31

Problem 1 30 points

(a) Let $x(t) = \cos(2\pi(t-4)) + \sin 5\pi t$ and determine the **period** of each term in seconds.

(b) Determine if $x(t)$ is periodic and determine the fundamental period.

(c) If $x1(t) = \cos[2\pi 500\ (t - 0.5 * 10^{-3})]$, what is the phase shift in radians for the cos term?

Problem 2 30 points

(a) **Prove** the operation $y(t) = tf(t)$ is linear.

(b) The response to the ramp function $x(t) = rt, t \geq 0$ is

$$y_r(t) = t - 1 + e^{-t}.$$

What is the response $y(t)$ to the step input $x(t) = r, t \geq 0$?
(See Problem 1.23)

(c) Is $y[n] = nx[n]$ time invariant? Prove you answer. (See K&H Web System Properties Chapter 1 - g)

Problem 3
20 Points
From the Kamen and Heck WEB site, create the m-file to plot Figure 1.10 Page 11 of the text. Add comments to the code. Turn in the m-file with comments and the plot.

Problem 4
20 Points
From the Kamen and Heck WEB site, create the m-file to plot Figure 1.12 Page 13 of the text. Add comments to the code. Turn in the m-file with comments and the plot.

REMEMBER THE HOMEWORK RULES

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A. -10 POINTS FOR EACH DAY LATE
B. For all Problems: (-10 points if violated)
1. Briefly describe the problem to be solved before attempting the solution.
2. Show all work.
3. Turn in problems in order
4. Make the results clear (Circle answers, explain results, etc.)
5. When an explanation of the results is requested, the numerical solution will not be suff
MATLAB Problems (-10 or more if violated)
1. Write the equations to be solved
2. Describe the solution method (flowchart, description, etc)
3. Comment the MATLAB code
4. Turn in the code and the results (Plots, etc.)
Be Neat -- if I cannot read the solution -- no credit!!
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