HW1 ECE2100 Autumn 2014

Lessons Covered: Lesson33 - Lesson37

HW should be turned in by Monday, Sept. 22, before 4:30pm

Solve all the problems. All problems will not be graded, only a selection of HW problems will be graded.

Show all relevant steps. Don’t just write down the answers.

Late HWs will not be accepted. HW with lowest grade will be dropped. Lecture Students: turn in your HW in class. Recitation students: turn in your HW at the ECE Office Front Desk. HWs turned-in anywhere else will not be accepted.

Show your work on these pages, attach additional pages if necessary.

- Be sure to organize the pages in order and staple them all together, otherwise you will lose one point

- Fill out the following section. You will lose an additional point if you fail to provide these details

Your Last Name_____________________________
Your First Name__________________________

1. Lecture Student ________ or Recitation Student__________ (check one)
2. If Recitation then fill out the following
   Name of recitation instruction________________________ Date/time of recitation_________
Problem 1:

Draw the block diagram realizations of the following difference equations:

a) \( y[n] = 2y[n-1] + x[n] - \frac{1}{2}x[n-1] \)

b) \( y[n] = 0.5y[n-3] + x[n] \)

c) \( y[n] = 3x[n] + 2x[n-1] + x[n-2] \)
**Problem 2:**

What is the degree of the difference equations in Problem 1?

**Problem 3:**

Which of the difference equations in Problem 1 constitute IIR systems and which ones FIR systems, and why?
Problem 4:

Which of the difference equations in Problem 1 are recursive systems and which ones not recursive. Explain your answer.

Problem 5:

Express the signal $y[n]$ as a sum of unit impulse signals:

$$y[n] = \begin{cases} 
0.5 & \text{if } n = -1 \\
1 & \text{if } n = 0 \\
1.5 & \text{if } n = 2 \\
0 & \text{otherwise}
\end{cases}$$
Problem 6:

Determine $y[-1]$, $y[0]$ and $y[20]$ manually (by hand). Show your steps.

\[ y[n] = x_1[n] \ast x_2[n] \]

\[ x_1[n] = \begin{cases} 
1 & \text{if } n = -1 \\
1 & \text{if } n = 0 \\
0 & \text{otherwise} 
\end{cases} \]

\[ x_2[n] = \begin{cases} 
1 & \text{if } n = -1 \\
0 & \text{otherwise} 
\end{cases} \]
Problem 7:

Is the system described by the following difference equations time-invariant or not. Show the steps of your work in detail.

a) \( y[n] = n^2 x[n] \)

b) \( y[n] = cx[-n] \)

c) \( y[n] = 4x[n] \)
**Problem 8:**
Is the system described by the difference equations in Problem 7 linear or not. Show the steps of your work in detail.
**Problem 9:**
Determine $h[-1]$, $h[0]$, $h[1]$, and $h[2]$ for a system described by the following difference equation ($h$ is the impulse response):

$$y[n] = \frac{1}{2}y[n-1] + \frac{1}{4}y[n-2] + \frac{1}{2}x[n]$$
Problem 10:
Determine the System Function $H(z)$ of a system described by the following difference equation (do not use $z$ transforms):

$$y[n] = \frac{1}{2} x[n] + \frac{1}{4} x[n-1]$$

Hint: Follow the definition of $H(z)$ given in Lesson37 Page 7