EC401 HW04 Spring 2020

Due Date: Monday Feb 24, 2020

You must submit your homework on paper (all pages of your submission stapled together) during the first 10 minutes of lecture on the due date. Please be sure to write your name on the first page of the homework you submit. Additionally, if you have collaborated on the homework with other individuals enrolled in EC401 this semester, please identify them as your collaborators on the first page of the submitted homework.

HW04.1

Consider each of the following discrete-time systems and show that it is *time invariant*.

a) $S: x[n] \rightarrow y[n] = (x[n])^2$

b) $S: x[n] \rightarrow y[n] = x[n-1] + 2x[n+1]$

c) $S: x[n] \rightarrow y[n] = \cos(x[n-1])$

HW04.2

Consider each of the following discrete-time systems and show that it is ***not*** *time invariant* by producing a *counter example*.

a) $S: x[n] \rightarrow y[n] = (n-1)^2 x[n+1]$

b) $S: x[n] \rightarrow y[n] = \begin{cases} x[n] \text{ for } n \geq 0 \\ 0 \quad \text{for } n < 0 \end{cases}$

c) $S: x[n] \rightarrow y[n] = (-1)^n x[n]$

HW04.3

In each part of this problem, determine whether or not the given system is *causal*. Show your reasoning.

a) $S: x[n] \rightarrow y[n] = \cos(x[n+5])$

b) $S: x[n] \rightarrow y[n] = \sum_{k=-1}^{100} (0.5)^k \, x[n-k]$

c) $S: x[n] \rightarrow y[n] = x[-n]$

d) $S: x[n] \rightarrow y[n] = 2\cos(n+1)\,(x[n-3])^3$

HW04.4

In each part of this problem, determine whether or not the given system is *stable*. Show your reasoning.

a) S: $x[n] \rightarrow y[n] = (x[n-3])^3$

b) S: $x[n] \rightarrow y[n] = sin(x[n])$

c) S: $x[n] \rightarrow y[n] = 2x[n-1] + x[n-3] + 2$

d) S: $x[n] \rightarrow y[n] = \begin{cases} x[n]/|x[n]| & \text{if } x[n] \neq 0 \\ 0 & \text{if } x[n] = 0 \end{cases}$

e) S: $x[n] \rightarrow y[n] = (0.5)^{n-1}x[n]$

HW04.5

Use MATLAB to produce a stem plot of $x[n] = \cos(0.125\pi n) + \sin(0.25\pi n + 0.16\pi)$

for $-32 \le n \le 32$. Verify that the signal values repeat every 16 units in time within this interval. Can you explain why that is the case?