ECE 469/569 --- Mobile and Embedded System Security

Homework 1

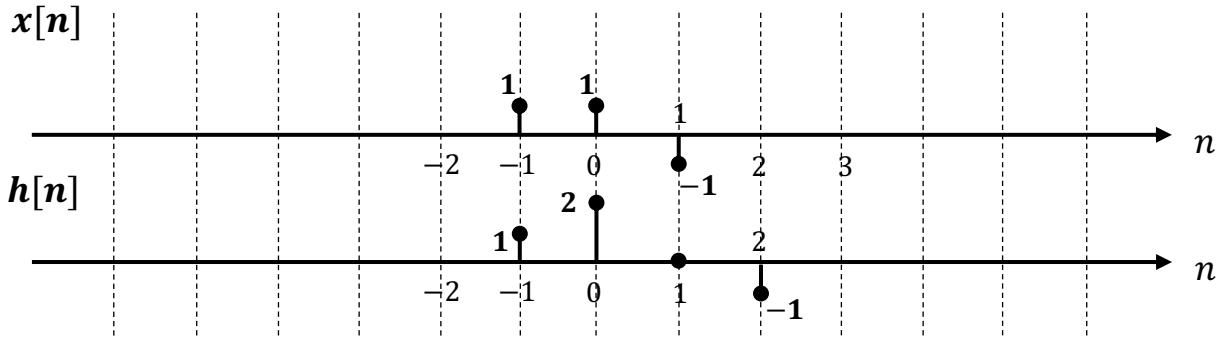
Name: _____ Date: _____

1. (20') Are the following systems time-invariant systems? Please explain why.

   A. $y(n) = n\,x(n)$
   B. $y(n) = x(n) - x(n-1)$
   C. $y(n) = x(-n)$
   D. $y(n) = x(n)\cos 2nf$

2. (20') Please describe the properties of Linear time-invariant (LTI) systems and also come up with two real life examples. Please explain why.

3. (30') Given the following input signal $x[n]$ and impulse response $h[n]$, please plot the output signal $y[n] = x[n] * h[n]$. Let the length/duration of x[n] and h[n] be L=3 and M=4, respectively. Please also verify in fact that the length of y[n] is equal to L+M-1.



4. (30') Please plot the spectrogram of the attached .mp3 audio file and analyze its major frequency components. Please also use a low-pass filter with different cut-off frequency (500Hz, 1kHz, 2kHz, 10kHz) to process the audio and generate a set of filtered audio files.

   - You can use any programming language. Please make your code into a single file and name it as hw1.m (if using matlab) or hw1.py (if using python), etc. The code should read the input from "Rocky Top.mp3" located in the same folder with the code and plot the spectrogram figure and write audio output to "lpf_500hz.mp3", "lpf_1khz.mp3", "lpf_2khz.mp3", "lpf_10khz.mp3" also in the same folder. Please also include a ReadMe file to show how to run the code as well as your analysis of its major frequency components.