EEE321 Lab Work 2

(Clearly justify all answers.)

(Due 23 October 2018 for Sec. 3, 24 October 2018 for Sec. 1 and 26 October 2018 for Secs. 2 and 4)

Work on these questions as a homework first: answer the analytical parts of the questions and write the answers on a paper, write a MATLAB program (or many such programs) to perform the tasks that need computation, print your MATLAB code(s), print your computer outputs (numerical and graphic) whenever needed; the collection of all those will be your lab report. Bring your code (in a computer readible form) to the lab; transfer your code to one of the lab computers; run and show your TA the results. Answer all the questions your TAs may ask. Modify your lab report, including any modifications needed in your MATLAB codes, during the lab hours in the lab. Finally, hand your TAs the lab report prepared as described above. Your report will get a grade based on your preparedness when you come to the lab, performance of your codes in the lab (any modifications needed and conducted during the lab hours included), your answers to the oral questions during your demo(s) in the lab, and the entire content of the submitted report at the end of the lab.

YOU MAY NOT USE THE RELATED MATLAB COMMAND DIRECTLY TO PERFORM CONVOLUTIONS, FOR THIS LAB WORK. INSTEAD, YOU SHOULD COMPUTE THE CONVOLUTIONS VIA YOUR OWN EXPLICIT PROCEDURES USING ADDITIONS, MULTIPLICATIONS, ETC.

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1- The impulse response of a discrete linear time invariant system is $h[n] = (1/2)^n u[n-2]$. Plot this impulse response. Is this system causal? Is it stable?

Find the output of this system to the input functions below, analytically. Then write MATLAB programs to compute the outputs and compare your analytical answers to those MATLAB outputs. (For infinite size outputs, it is sufficient to compute a meaningful finite size segment of those signals.) Print the MATLAB outputs. Make sure that the graphs are correctly labeled; also make sure that the index n in your graphs shows the correct index.

a)

$$x_1[n] = \begin{cases} -1 & \text{if} \quad 0 \le n \le 10 \\ 0 & \text{else} \end{cases}$$

b)

$$x_2[n] = \begin{cases} -1 & \text{if} \quad 0 \le n \le 5 \\ 1 & \text{if} \quad 6 \le n \le 10 \\ 2 & \text{if} \quad 11 \le n \le 16 \\ 0 & \text{else} \end{cases}$$

(Hint: Note that you may write $x_2[n] = x_1[n] - 2x[n-6]$ and use the fact that the system is LTI.)

c)

$$x_3[n] = \begin{cases} e^{j(2/3)n} & \text{if} \quad 4 \le n \le 16 \\ 0 & \text{else} \end{cases}$$

d)

$$x_4[n] \;=\; \begin{cases} \sin[(2/3)n] & \text{if} \quad 4 \le n \le 16 \\ 0 & \text{else} \end{cases}$$

(Hint: Note that $x_4[n] \;=\; Im\{x_3[n]\}$.)

e)

$$x_5[n] \;=\; \begin{cases} \cos[(2/3)n] & \text{if} \quad 4 \le n \le 16 \\ 0 & \text{else} \end{cases}$$

(Hint: Note that $x_5[n] \;=\; Re\{x_3[n]\}$.)

f)

$$x_6[n] \;=\; 2x_1[n] - j3x_2[n]$$

(Hint: You might get the answers quickly if you use the properties of LTI systems.)

2- Repeat Q1 for another LTI system whose impulse response is $h_1[n] = 3(1/2)^n u[n-2] + (1/2)^{(n-5)} u[n-7]$.

(Hint: You may want to use your answers to Q1 and the fact that the system is LTI.)