EEE321 Lab Work 2

(Clearly justify all answers.)

(Due 14 October 2022)

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. Be ready to run your computer codes during the lab session. During your lab session, your TA will ask you questions, observe your results as you run them while sharing your screen, and may go over your codes as needed. Based on your results, you may be asked to modify your lab report, including any modifications needed in your MATLAB codes, during the lab hours. Your lab session will continue until your TA is satisfied with your results, during the allocated lab hours. You may upload your entire lab report during or right after your on-line lab session to MOODLE. If you need some more time to modify your report, you may do so, until the end of the day. Your report will get a grade based on your preparedness when you come to the lab session, performance of your codes during the lab session, (including any modifications done during the lab session) your answers to the oral questions during your demo(s), and the entire content of the submitted report.

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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 $h[n] = (8/9)^n u[n-3]$. Plot this impulse response. Is this system causal? Is it stable?

Find the output of this system to the input functions below, analytically; write a MATLAB program to plot your analytically found results. Then write MATLAB programs to compute the outputs via numerical convolution and plot them, too. Compare your analytical results and corresponding numerically computed outputs. (For infinite size outputs, it is sufficient to compute a meaningful finite size segment of those signals.) Make sure that the graphs are correctly labeled; also make sure that the index n in your graphs shows the correct index of the functions.

a)

$$x_1[n] = \begin{cases} 2 & \text{if} \quad 0 \leq n \leq 9 \\ 0 & \text{else} \end{cases}$$

b)

$$x_2[n] = \begin{cases} 2 & \text{if} \quad 0 \leq n \leq 5 \\ -2 & \text{if} \quad 6 \leq n \leq 9 \\ -4 & \text{if} \quad 10 \leq n \leq 15 \\ 0 & \text{else} \end{cases}$$

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

c)

$$x_3[n] = \begin{cases} e^{j(1/4)n} & \text{if} \quad 3 \leq n \leq 23 \\ 0 & \text{else} \end{cases}$$

(Hint: Note that $e^{j(1/2)n} = \left[e^{j(1/2)}\right]^n$.)

d)

$$x_4[n] = \begin{cases} -2\sin[(1/4)n] & \text{if} \quad 3 \leq n \leq 23 \\ 0 & \text{else} \end{cases}$$

(Hint: Note that $x_4[n] = -2Im\{x_3[n]\}$.)

e)

$$x_5[n] = \begin{cases} \cos[(1/4)n] & \text{if} \quad 3 \leq n \leq 23 \\ 0 & \text{else} \end{cases}$$

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

f)

$$x_6[n] = x_1[n] - j3x_2[n]$$

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