BLG 354E Homework - 3

Due Date: 12.05.2018 23:59

- Cheating is highly discouraged. It could mean a zero or negative grade. Please do your homework on your own. Team work is not allowed. Pattern of your solutions must be belong to only you.
- Prepare reports using LaTeX. Otherwise, you will get 0 point.
- After the deadline, your point will decrease with slope -10 according to the number of days past.
- You will get 25 points from completeness of your report and 50 points from selected 3 questions. 25 points from the last question.
- Upload your solutions with code files through Ninova (Do not forget to upload code files separately.).
- There will be no postponement on the due date.
- If you see any mistake in the homework, inform me as soon as possible.

For your questions: albay@itu.edu.tr

1. Determine whether each of the following LTI systems are Casual and Stable.

   (a) $y(t) = x(t-4) + x(t+2) + 5\frac{d(x)}{dt}$

   (b) $y(t) = \int_{-\infty}^{t} x(\tau)d\tau$

   (c) $h(t) = e^{-(t-5)}u(t-5)$

   (d) $h(t) = u(t) - e^{-3t}u(t)$

2. Convolve the following continuous-time input and filter:

$$\begin{aligned} h(t) =& 5e^{-0.5(t-3)}[u(t-3) - u(t-11)] \\ x(t) =& u(t-2) \end{aligned} \tag{1}$$

3. Implement FFT algorithm with Python 3.5+. Compare running time and result with built in FFT algorithm of Python 3.5+ (There are infinitely many FFT implementations on the Internet. You can analyze them. I expected you not an original implementation but very detailed explanation each line of your code.).

4. Convolve following square wave with itself using Numpy built-in convolution function at leat 10 times. Show the graph of the convolution result. Comment about the result.

$$x(t) = \begin{cases} 1, & 0 \leq t \leq 1 \\ 0, & \text{otherwise} \end{cases}$$

5. The impulse response of a continuous time system is:

$$h(t) = \delta(t-2) - 0.2e^{-0.2(t-2)}[u(t-2)]$$

   (a) Find the frequency response $H(jw)$ of the system.

   (b) Plot the magnitude squared response by hand and phase response of the system by Matlab.

   (c) Suppose that the input to the system is:

$$x(t) = 5 + 10cos(0.2t) + u(t)$$

   Use superposition to find the output $y(t)$ using frequency or impulse response method where it is the easiest.

6. Find Fourier or inverse Fourier Transforms of the following:

   (a) $\xrightarrow{F} \frac{sin(10w)^2}{2w^2}$

   (b) $\xrightarrow{F} \frac{1}{25+w^2}$

   (c) $e^{-a(t-2)}u(t-2)cos(w_0 t) \xrightarrow{F}$

7. (25 pt.) Solve your midterm exam. You can find it on the Ninova. Print the questions and solve the questions on the question paper. Scan and upload it with the solution of this homework.