In the name of God

School of Electrical and Computer Engineering

Signals and Systems

Computer Exercise 1

Delivery deadline: March 11th

Professor: Dr. Rabiei

Introduction to Mathematics

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*Dear students, before answering, pay attention to the following points:

1. In the first question, from items A to C, it is enough to choose one item.
2. In the sixth question, perform the theoretical calculations for 4 of the 6 items as desired.

Plotting signals

Using the two signals in Figure 1-1, draw the following signals. (Make the necessary settings.)

A. $Y_1(t) = X1(t)\; X2(t-1)$

B. $Y_2(t) = X1(t-1)\; X2(-t)$

C. $Y_3(t) = X1(t)\; X2(-1-t)$

D. $Y_4(t) = \sum_{k=-5}^{5} X1(t-2*k)\; X2(-1-t+2*k)$

E. $Y_5(t) = \Pi\big(Y_4(t)\big)$

F. $Y_6(t) = \Lambda(Y_4(t))$

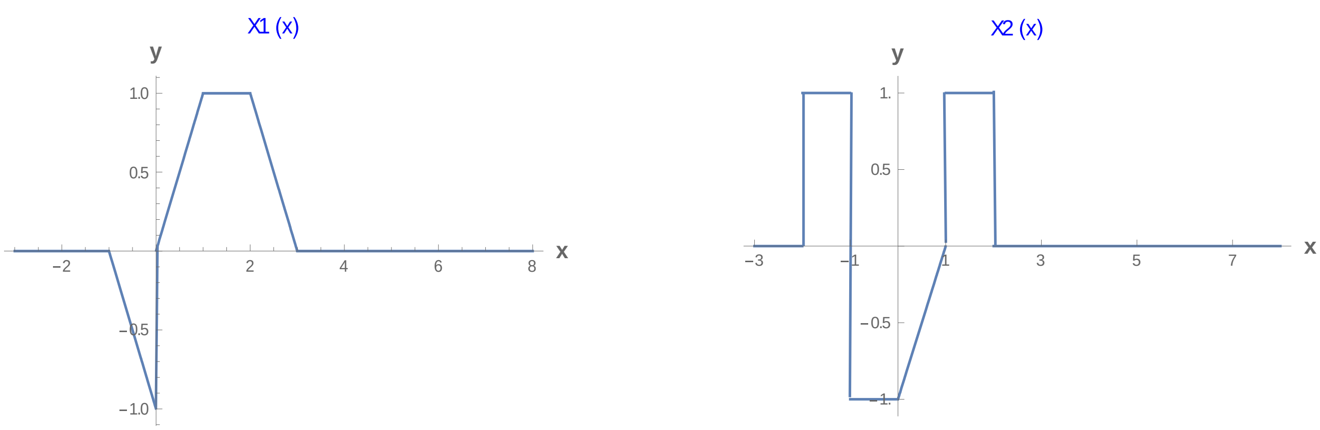

Figure 1-1

Even and odd parts of the signal

Draw the even and odd part of each of the signals below (make the necessary settings) And include their simplified form in the report.

A. $X_1(t) = Cos(t) + Sin(t) + Cos(t)\, Sin(t)$

B. $X_2(t) = 1 + t\, Cos(t) + t^2\, Sin(t)$

C. $X_3(t) = (1 + t^3)\, Cos(10\, t)^3$

periodicity of a signal

For each of the following signals, determine whether it is periodic or not (theoretically) and if it is periodic, obtain its periodicity. Finally, draw each of the signals and compare them with the results of the theory.

A. $X_1(t) = \sum_{n=0}^{\infty} u(t - 2\, n)\, u(1 + 2\, n - t)$

B. $X_2(t) = \sum_{n=-\infty}^{\infty} u(t - 2\, n)\, u(1 + 2\, n - t)$

C. $X_3(t) = Cos(2\, t) + Sin(3\, t)$

D. $X_4(t) = Cos\left(\frac{\pi t}{5}\right)\, Sin(\frac{\pi t}{3})$

E. $X_5(t) = X_e(t)\, , s.t.\; X(t) = Sin(t)\, u(t)$

F. $X_6(t) = X_e(t)\, , s.t.\; X(t) = Cos(t)\, u(t)$

G. $X_7(t) = \sum_{k=-\infty}^{\infty} \Lambda(t - 0.3\, k)$

Calculate the integral using the properties of the Dirac Delta

Using the properties of the impact delta Dirac, obtain the following integrals both in theory and in simulation.

A. $\int_{-\infty}^{\infty} e^{3*t}\delta''(t-2)\,dt$

B. $\int_{5}^{10} Cos(2\,\pi\,t)\,(\delta(t-2)+\delta(t-7))\,dt$

C. $\int_{-\infty}^{\infty} \left(e^{-3\,t}\,Cos\left(\frac{\pi\,t}{2}\right) + \Lambda(0.5\,t-1)\right)\delta'(t-0.5)\,dt$

Definition of the Dirac delta function

A) Consideration

For each of the signals given below, check whether it is possible to define the Dirac delta function. Examine the conditions required both in theory and simulation.

A. $X_1(t,\varepsilon) = \lim_{\varepsilon\to 0}\frac{1}{\varepsilon}\,Sinc\left(\frac{t}{e}\right)^2$

B. $X_2(t,\varepsilon) = \begin{cases} \lim_{\varepsilon\to 0}\frac{\left(1-\frac{|t|}{\varepsilon}\right)}{\varepsilon} & |t| \le \varepsilon \\ 0 & O.w. \end{cases}$

C. $X_3(t,\varepsilon) = \lim_{\varepsilon\to 0}\frac{1}{2\,\varepsilon}\,\Pi\left(\frac{\mathrm{t}}{2\,\varepsilon}\right)$

D. $X_4(t,\varepsilon) = \lim_{\varepsilon\to 0}\frac{1}{\varepsilon}\,e^{-\frac{t}{\varepsilon}}\,u(t)$

E. $X_5(t,\varepsilon) = \lim_{\varepsilon\to 0}\frac{e^{-\frac{t^2}{2\,\varepsilon^2}}}{\sqrt{2\,\pi\,\varepsilon^2}}$

B) Create animation

In this part, we want to observe the signal's variation by changing the ε parameter. As you know, with the Manipulate command, you can see the changes resulting from several parameters in the signal output, but these changes can be done manually. Use the Animate command instead of Manipulate to make the parameter changes automatically in the given interval. Consider the changes of ε in range [10,0.1] ,and assume a downward direction of motion.

Compare the results with section A.

Save two arbitrary generated outputs in .gif format using the Export command and insert them in the delivery folder.

Check the Energy/Power of the signals

For each of the signals given below, both in theory and in simulation, specify the type of power or energy and declare the amount of energy/power. (* You can use signal plotting to better understand the behavior of their changes - * In periodic signals, pay attention to the integration interval to reduce computational complexity)

A. $X_1(t) = A\, e^{-a\,t}\, u(t), \Re(a) > 0$

B. $X_2(t) = A\, Cos(\omega\, t + \theta)$

C. $X_3(t) = \frac{u(t-3)}{\sqrt[4]{t}}$

D. $X_4(t) = t\, e^{-2\,t}\, u(t)$

E. $X_5(t) = e^{-2\,t}\, Cos(0.5\,\pi\, t)\, u(t)$

F. $X_6(t) = \sum_{k=-\infty}^{\infty} X(t - 4\,k)\,, s.t.\; X(t) = \left(1 - \Pi(Sinc\left(\frac{\pi t}{3}\right)\right)\, Sinc\left(\frac{\pi t}{3}\right)$

Final Points

1. Finally, place the delivery code for each question in a. nb file. Also, in each. nb file, separate the different parts of each question with the help of sections.
2. The evaluation of your work is determined by having a proper report, so be sure to include the output of the graphs and the answers to the different parts in your report. Exercises without a report will not be awarded a grade.
3. The Computer exercise aims to help you learn new concepts, so you will get a low score if there is an unjustifiable similarity in your reports or codes.
4. If you have any questions or concerns about the exercise, you can contact me via email (sh.vassef@ut.ac.ir) or in the telegram group.

Good luck.