



BLG 354E – HOMEWORK 4

Every question will be solved using MATLAB. In the report; signal plots, MATLAB outputs and comments are needed. For every question, you should create different scripts. **Do not submit only one file containing all the codes.**

1-) (25 pts) Remember the 3rd question from HW3. There was a signal $h[k]$ where

$$h[k] = \begin{cases} 1, & |k| \leq N \\ 0, & N+1 \leq k \leq K-N-1 \end{cases}$$

and the fundamental period is K and $K > (2N + 1)$.

- a) Create a MATLAB function which calculates the discrete-time Fourier series coefficients of that signal, plots their magnitudes for P periods and returns a_k and corresponding k values for a period. The function should take K, P and N values as parameters. The function should be called with the following command.

`[a_k, k] = functionname(10,1,2) %K=10 N=1 P=2`

- b) Create a MATLAB script uses the values calculated by the function in Part A where K is 10 and N is 1. Use Synthesis formula to reobtain $h[k]$. Compare original $h[k]$ with reobtained signal.

2-) (25 pts) Determine the DTFS coefficients of the periodic discrete-time sequence

$$x[n] = 3 \sin\left(\frac{2\pi}{7}n + \frac{\pi}{4}\right)$$

using MATLAB.

3-) (25 pts) A function is defined as $x(t) = e^{-t}$ in the in one of its periods $0 \leq t \leq 3$.

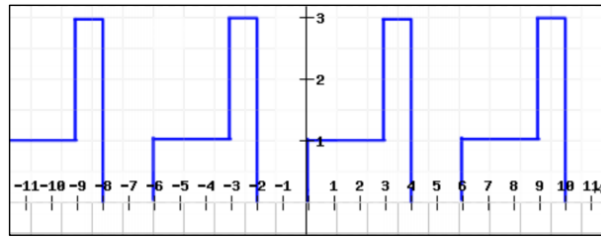
- a) Plot the function in the given interval.
b) Remember that, in continuous-time, a signal can be defined using infinite Fourier coefficients.

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jk\omega_0 t}$$

Find the Fourier coefficients between -100 and 100 ($a_{-100} \dots a_{100}$) of the signal. You can use “syms” to define symbolic variables and “subs” function to assign values to a symbolic expression.

- c) Obtain an approximation of $x(t)$ using continuous-time synthesis formula. Plot the approximated signal and compare with the original plot.

4-) (25 pts)



As you can remember from Recitation 3, Fourier coefficients of the signal given above was calculated as

$$a_k = \frac{1}{2jk\pi} (1 + 2e^{-jk\pi} - 3e^{-jk\frac{4\pi}{3}})$$

Use the Fourier coefficients between

- i) 1-10
- ii) 1-50
- iii) 1-100
- iv) 1-200

to reobtain the signal. Plot and compare your findings.

Notes:

- Please write your answers briefly and add explanations at necessary points to make your calculations more understandable.
- If you have any questions, feel free to contact Res. Asst. Yusuf Hüseyin Şahin (sahinyu@itu.edu.tr).