Strict submission deadline: 12 June 2023 at 11:30 am.
Submit a PDF or Word document for calculations and plots. Submit Matlab source code for Matlab programs. Use the submit button.

Exercise #4

Task 4.1

Analyze the sampled time signal given in the CSV file "testsignal". The only pre-knowledge that you've got is the sampling frequency which is 1 kHz. Use Matlab for reading the file, analyzing the data, and plotting the results. Discuss your results.

Task 4.2

Given is the following random process with random noise added to it

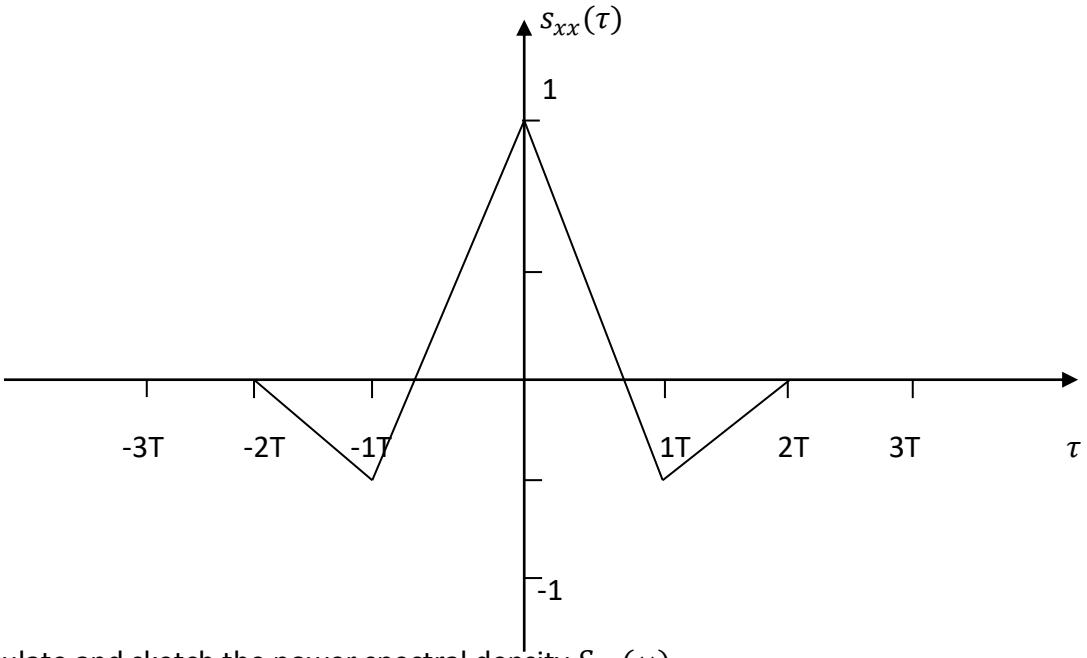
$$x(\zeta, t) = \sin(2\pi f\, t) + \alpha \cdot \eta(\zeta, t)$$

where frequency f is 8 Hz, α is 0.05, and η(ζ, t) is Gaussian random noise.

a) Find the power spectral density of the random process x(ζ, t) using the Wiener Khintchine Theorem. Sketch the result.
b) Write a Matlab program. Calculate and plot the PSD using the Wiener Khintchine Theorem. The random process is sampled at a sampling frequency of 100 Hz. The sampling buffer length is 4096. Use both, rectangular and Hamming windows. Plot the PSD with a linear and logarithmic scale. Compare the outcome of the PSD calculation concerning the window type.
c) Compare the outcome of b) with the outcome of a).

Task 4.3

This is the autocorrelation function $s_{xx}(\tau)$ of the stationary test random process x (ζ, t):



Calculate and sketch the power spectral density $S_{xx}(\omega)$.