

Digital Signal Processing SS 2019/20

Exercise Sheet 6

Due date: 02.07.2019
(time of the lecture)

Problem 1

Compute the Fourier Transforms of the time-continuous signals

a) $x(t) = e^{-100|t|}$.

b) $x(t) = \begin{cases} 1 & \text{if } -a \leq t \leq a; \\ 0 & \text{otherwise,} \end{cases}$ with $a > 0$.

c) $x(t) = \begin{cases} -|t| + 1 & \text{if } 0 \leq |t| < 1; \\ 0 & \text{otherwise.} \end{cases}$

Problem 2

The time-continuous signal $x(t) = e^{-100|t|}$ is sampled at a sampling rate of 500/s, yielding the discrete-time signal $x_1[n]$. Draw the magnitude of $X_1(e^{j\omega})$, the DTFT of $x_1[n]$.

Repeat for the sampling rate 1000/s.

Problem 3

The time-continuous signal $x_c(t) = \sin(20\pi t) + \cos(40\pi t)$ is sampled with a sampling period T , obtaining the discrete-time signal $x[n] = \sin(0.2\pi n) + \cos(0.4\pi n)$.

- State one value of T that led to the given result.
- Is the value of T unique? If not, give all possible values of T .

Problem 4

The Nyquist rate of the time-continuous signal $x(t)$ is Ω_s . Find the Nyquist rates of the following signals:

- $x(2t)$.
- $x(t/3)$.
- $x^2(t)$.
- $x(t) * x(t)$.