Fachbereich Mathematik der Universität Hamburg **SuSe 2024**
Prof. Dr. T. Schmidt
Dr. H. P. Kiani, Jule Schütt

Differential Equations II for Engineering Students

Work sheet 1

Exercise 1: (Repetition of DGL I)

a) Let λ be any fixed real number. Determine a real representation of the general solution to the differential equation

$$y''(t) - \lambda\, y(t) \;=\; 0\,.$$

b) Let L be another fixed positive real number. Determine all solutions to the boundary value problem

$$y''(t) - \lambda\, y(t) \;=\; 0 \quad y(0) \;=\; y(L) \;=0\,.$$

For which $\lambda \in \mathbb{R}$ does the boundary value problem have nontrivial solutions?

The λ-values for which there exist non-trivial solutions (i.e. solutions that are not constantly equal to zero) are called eigenvalues of the problem. The corresponding solutions are called eigenfunctions.

Remark: *The solutions to this eigenvalue problem will be needed again and again during the semester!*

Exercise 2:

Determine the appropriate real Fourier series for the following functions:

a) Odd $2L-$ periodic continuation of
$f:\,[0,1[\to\mathbb{R}, \quad f(t)=\sin(4\pi x)+2\sin(6\pi x) \quad L=1\,.$

b) Even $2L-$ periodic continuation of
$f:[0,\frac{\pi}{2}[\to\mathbb{R}, \quad L=\frac{\pi}{2}$ und

$$f(t) \;=\; \begin{cases} 2, & 0\le t<\frac{\pi}{4},\\ 0, & \frac{\pi}{4}\le t<\frac{\pi}{2}. \end{cases}$$

Determine the first four non-vanishing summands of the Fourier series.

Discussion: 15-19.04.2024