TECHNISCHE HOCHSCHULE LÜBECK

Module: Signals and Systems

Level	Bachelor	**Short Name**	SigSys
Responsible Lecturers	Prof. Dr. Djahanyar Chahabadi, Prof. Dr. Ralph Hänsel		
Department, Facility	Electrical Engineering and Computer Science		
Course of Studies	Elektrotechnik - Kommunikationssysteme, Bachelor		
Compulsory/elective	Compulsory	**ECTS Credit Points**	5
Semester of Studies	5	**Semester Hours per Week**	4
Length (semesters)	1	**Workload (hours)**	150
Frequency	WiSe	**Presence Hours**	60
Teaching Language	English	**Self-Study Hours**	90

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type	Written Exam	**Exam Language**	English
Exam Length (minutes)	120	**Exam Grading System**	One-third Grades

Learning Outcomes	After completing this module, students should be familiar with the most important elementary signals, such as being able to describe the properties of harmonic signals, the Dirac impulse and the unit step function, which are particularly often used in the signal and system theory. The handling of the mathematical analysis methods like Fourier series, Fourier transformation, Laplace transformation should be mastered safely. The effect of the sampling should be explained in the frequency domain by means of a sketch. Students learn the properties of linear and time-invariant systems (LTI systems) and methods for calculating the response of LTI systems in time and frequency domain to a given input signal. They should be able to check the stability conditions in the time and frequency domain for LTI systems. The students learn beside others the terms system function, transfer function, amplitude and phase response, phase and group delay and pole zero diagram. They know and can describe the amplitude responses of the different types of frequency-selective circuits and the different ways to approximate an ideal low-pass filter through a realizable transfer function. It is shown how the other filter types: high-pass, bandpass and band-stop filter are formed by transforming the frequency axis of a low-pass filter. Finally, students learn the definition and properties of the autocorrelation function for energy and power signals and can calculate them for harmonic signals and rectangular pulses.
Participation Prerequisites	

The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues	✔ Use of gender-neutral language (THL standard) ✔ Target group specific adjustment of didactic methods

	✔ Making subject diversity visible (female researchers, cultures etc.)
Applicability	Recommended as a prior knowledge of the module Digital Signal Processing. Basis for control and communication technology.
Remarks	

Module Course: Signals and Systems (Lecture)

(of Module: Signals and Systems)

Course Type	Lecture	**Form of Learning**	Presence
Mandatory Attendance	no	**ECTS Credit Points**	5
Participation Limit		**Semester Hours per Week**	4
Group Size		**Workload (hours)**	150
Teaching Language	English	**Presence Hours**	60
Study Achievements ("Studienleistung", SL)		**Self-Study Hours**	90
SL Length (minutes)		**SL Grading System**	

The following section is filled only if there is a course-specific exam.

Exam Type		**Exam Language**	
Exam Length (minutes)		**Exam Grading System**	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents

1 Introduction

Basic Terminology: Message, Signal, Time Function, System

2 Signals

Classification of Signals

Fourier Series

Fourier Transform

Laplace Transform

Sampling

3 Systems

Classification of Systems

Response of a linear time-invariant system

Convolution

System Function

Systems without Distortion

Pole Zero Map

4 Filters

	Overview of different Filter Types Filter Design, Butterworth, Chebyshev, Elliptic, Bessel Implementation Aspects Frequency transform 5 Autocorrelation function (ACF) ACF of power and energy signals and time and frequency domain Parsevals's Theorem
Literature	• Simon Haykin, Barry Van Veen, "Signals and Systems", Second Edition, Wiley, 2003, ISBN 0471-37851-8 • Ziemer, Rodger E., „Signals and Systems: Continuous and Discrete", Prentice Hall, 4th edition, 1998, ISBN-10 013496456X, ISBN-13 978-0134964560 • Ziemer, Rodger E., „Signals and Systems: Continuous and Discrete", Maxwell MacMillan International, New York, 1993, ISBN 0-02-431641-5 • Hsu, „Signal and Systems, Schaums Outline", McGraw Hill, 2019, ISBN 978-1260454246
Remarks	