COURSE DESCRIPTION CARD - SYLLABUS

Course name

Signal theory

Course

Field of study	Year/Semester
Electronics and Telecommunications	I/II
Area of study (specialization)	Profile of study
	general academic
Level of study	Course offered in
First-cycle studies	english
Form of study	Requirements
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
30	0	
Tutorials	Projects/seminars	
30	-/-	

Number of credit points

5

Lecturers

Responsible for the course/lecturer:

dr inż. Tomasz Grajek,
tomasz.grajek@put.poznan.pl

Responsible for the course/lecturer:

Prerequisites

Has a systematic knowledge of mathematical analysis, algebra, and trigonometry. Has a basic, structured knowledge of physics.

Can apply calculus for functions of one and two independent variables. Can analyse the variation of a function and draw function plots. Can operate on complex numbers. Can calculate limits of a function and check the convergence of a series.

Knows the limits of his own knowledge and abilities, understands the need for ongoing education.

Course objective

Understanding of Fourier analysis of periodic and non-periodic deterministic signals, introduction to signal processing by linear systems, and sampling of continuous signals. Ability to solve basic signal theory problems in order to get the knowledge and for the practical needs of research and design of signal processing solutions in telecommunications.

Course-related learning outcomes

Knowledge

Has a structured and theoretically underpinned knowledge on one-dimensional signal theory which is necessary for understanding the representations of signals in time domain and frequency domain.

Knows and understands basic notions related to linear circuit description in time and frequency. Understands, how properties of systems affect the spectra of signals being processed by them.

Skills

Can solve typical problems related to signal analysis in time and frequency domains.

Social competences

Is open for the possibilities of sustained learning and understands the neccessity of increasing the level of expertise.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired in the lecture is verified on the written and / or oral exam. The exam consists of several open questions with different levels of difficulty with the assigned number of points. The questions relate to the content presented during the lectures. Credit threshold: 50% of points.

Skills acquired as part of the tutorials are verified on the basis of two colloquiums (first in the middle of the semester, second at the end of the semester) covering several tasks to be solved with the assigned number of points and on the basis of the ongoing assessment of student progress during individual problem solving at the blackboard during exercises. Credit threshold: 50% of points.

Programme content

Lecture:

Signals and models (deterministic and stochastic, discrete and continuous, analog and quantized). Properties of periodic and non-periodic signals. Real and complex-valued harmonic (sinusoidal) signals. The notions of DC and AC components. Power and energy of a signal, the RMS value). Distributions as signals.

Analysis of periodic signals by the use of Fourier series. Orthogonality, norm, orthogonal signals and series. Trigonometric Fourier series and its properties. Complex exponential Fourier series, and its properties. Harmonic spectrum, magnitude and phase spectra. The shift property. Properties related to signal symmetries. The Gibbs phenomenon. The Parseval theorem.

The integral Fourier transformation (definition of forward and inverse transformation, basic properties and interpretation, amplitude and phase spectrum). The linearity of Fourier transformation. The symmetries of transforms of a real signal. The properties of Fourier transformation: time shift, frequency shift, scaling, differentiation, integration, symmetry. The transforms of infinite energy signals. The Parseval theorems for energy and power. The spectral power density and energy density.

Signal processing by linear systems. The LSI system (static and dynamic) and its transfer function. The impulse response of an LSI system, the response for arbitrary signal, the convolution formula and the properties of convolution. The convolution theorem for Fourier transformation. The transfer function in frequency domain. Types of frequency characteristics of LSI systems. Ideal filters and their properties.

Correlation functions and their properties (auto and cross-correlation for finite energy and finite power signals. The correlation of the input and output of a linear system.

Introduction to discrete signals and systems. Sampling, and spectrum of a sampled signal. Signal reconstruction from its samples. The Shannon sampling theorem.

Tutorials:

Simple operations on signals (change of amplitude, shift on the time axis, rescaling of the time axis, sum of signals, product of signals, etc.).

Average value, energy, power and RMS signal value.

Analysis of periodic signals using the orthogonal series. Trigonometric and complex Fourier series. Signal spectrum. Parseval's theorem for periodic signals.

Analysis of signals using the Furier transformation.Parseval's theorem for Fourier transform.

Signal transmission through LTI systems.

Teaching methods

Lecture - a traditional lecture interspersed with solution of examples. Discussing issues accompanied by information about their practical application.

Tutorials - solving the tasks given by the teacher. Interpretation of the received solution and drawing conclusions. Discussion of the practical application of the issues / theorems being the subject of exercises.

Bibliography

Basic

A. Oppenheim, A. Wilsky, I. Young, Signals and Systems, Prentice Hall

R.A. Gabel, R.A. Roberts, Signals and Linear Systems, Wiley 1986

B.P. Lathi, Linear Systems and Signals, Oxford University Press, 2004

E. Kamen, Introduction to Signals and Systems, MacMillan, 1987

Additional

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,0
Classes requiring direct contact with the teacher	70	3,0
Student's own work (literature studies, preparation for tutorials, homeworks, preparation for tests/exam) [1]	55	2,0

[1] delete or add other activities as appropriate