Signals and Systems, and Transform Theory

Programme course

8 credits

Signaler och system samt transformer

TSDT84

Valid from: 2017 Spring semester

Determined by
Board of Studies for Computer Science and Media Technology

Date determined
2017-01-25

Main field of study

Applied Mathematics, Electrical Engineering

Course level

First cycle

Advancement level

G2X

Course offered for

- Computer Science and Engineering, M Sc in Engineering

Entry requirements

Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites

Calculus, Linear Algebra, Basic Electronics.

Intended learning outcomes

This course will give basic knowledge about analysis and synthesis of continuous-time and discrete-time linear systems, primarily through the use of mathematical tools from transform theory. Students who pass the course are expected to:

- Define and interpret system properties such as linearity, time invariance, causality, and stability, as well as manage the consequences of those associated with problem solving.
- Interpret and mathematically manage time and frequency characteristics of deterministic continuous-time and discrete-time signals and linear time invariant (LTI) systems.
- Sketch the Bode plot of an LTI system and analyze how it is influenced by the

positions of the poles and zeros of the transfer function.
- Calculate the output signal for given LTI systems, both in the time domain and in the frequency/transform domain - in the latter case, by means of appropriate transformations.
- Model problems from different application areas (such as electrical engineering, mechanical engineering, biotechnology, economics, and more) via LTI system models and analyze these models, both in the time domain and the frequency/transform domain.
- Describe the sampling theorem and its consequences, and use this theorem in problem solving and to design and analyze simple sampled systems.
- Give a well structured and logically coherent account - using adequate terminology - of the connections between different concepts in the course, both in Swedish and in English.

Course content

- About signals and systems.
- Fundamental transform theory - Fourier series, the Fourier transform, the Laplace transform, the z-transform.
- System properties - in particular linearity, time invariance, causality and stability.
- Impulse response and step response. Convolution.
- Differential and difference equation description of linear continuous-time and discrete-time systems, respectively.
- Frequency analysis of signals and systems. Frequency spectrum, amplitude and phase spectrum. Frequency response. Magnitude and phase characteristics.
- About passive frequency selective filters.
- Laplace transform and z-transform analysis of signals and systems. The transfer function. Pole-zero diagrams.
- Cascade couplings and feedback.
- Sampling and reconstruction - time properties and spectral relations. The Poisson summation formula, the sampling theorem and pulse amplitude modulation.
- Application examples.

Teaching and working methods

Lectures, lessons, and laboratory work using Matlab.

Examination

TEN3	Written examination	U, 3, 4, 5	5 credits
LAB1	Laboratory work	U, G	1 credits
KTR1	Written test	U, G	2 credits

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses: Subsequent courses in areas such as signal and image processing, telecommunications, electronics, control engineering, biomedical engineering, etc.

Department

Institutionen för systemteknik

Director of Studies or equivalent

Klas Nordberg

Examiner

Lasse Alfredsson

Course website and other links

http://www.cvl.isy.liu.se/education/undergraduate/TSDT84

Education components

Preliminary scheduled hours: 76 h
Recommended self-study hours: 137 h

Course literature

Additional literature

Books

Other

Choose one of the books that are suggested as suitable course books on the course web page. The lectures are primarily formed according to "Linear Systems and Signals", 2nd Edition, B. P. Lathi, Oxford Univ. Press.

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.