Linear Systems for Communication

Programme course

10 credits

Linjära system för kommunikation

TSKS06

Valid from: 2019 Spring semester

Determined by
Board of Studies for Computer Science and Media Technology

Date determined
2018-08-31

Main field of study
Information Technology, Applied Mathematics

Course level
First cycle

Advancement level
G2X

Course offered for
- Information Technology, 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 and linear algebra.
Fundamental knowledge in Matlab is recommended (or some other programme language - for generating simple graphs).

Intended learning outcomes

The course will give basic knowledge about time and frequency analysis of continuous-time signals and continuous-time linear systems. In particular, the course focuses on analog electrical circuits and applications in analog and digital communication. The course will also give knowledge about the mathematical tools used in the course.
In short, after completed course the student should be able to:

For Electrical Circuits:

Calculate, with structured methods, currents, voltages, and power in general dc and ac circuits. Calculate the voltage gain for circuits with operational amplifiers. Describe the construction and the function of electrical filters. Calculate and in practice measure the cutoff frequencies and center frequency for electrical filters.

For Linear Systems:

Determine, interpret and mathematically handle time domain properties of deterministic signals and linear systems. By using Fourier series, the Fourier transform and the Laplace transform determine, interpret and mathematically handle frequency domain properties and general transform representations of both signals and systems. Define various properties of linear systems and, in connection with problem solving, handle the consequences of these properties. By using appropriate methods, for a given input signal calculate the output signal from a linear time-invariant system, and also give an account of the possibilities and limitations of different methods. With some precision, perform time and frequency analysis of various analog and digital modulation methods.

General:

Give a well structured and logically coherent account - using adequate terminology - of the connections between different concepts in the course.

Course content

For Electrical Circuits:

Electric circuit fundamentals. Thévenin's and Norton's theorems. Node-voltage analysis. Sinusoidal steady-state analysis, phasors, impedance, power. Introduction to electrical filters. Ideal operational amplifiers.

For Linear Systems:

Signal properties, system properties. Differential equation representation of linear systems. Linearization of non-linear systems. Impulse response and step response. Convolution. Fourier series analysis of periodic signals. Fourier transform analysis of signals and systems. Frequency spectrum. The frequency response function. Laplace transform analysis of signals and systems. The transfer function, Pole-zero diagrams. Time-continuous passive frequency selective filters.

For Communication:

Principles of analog and digital communication, from a linear systems perspective. Amplitude modulation, frequency and phase modulation. Digital modulation methods.

Teaching and working methods

Lectures, exercises, and laboratory work. Group work and problem based learning. The report is done in a group and is presented in the form of a technical report, requiring a good level of report design and content.
Some of the lectures may be formed as "flipped classroom" lectures.
The course runs over the entire spring semester.

Examination

TEN1	Written examination	3 credits	U, 3, 4, 5
BAS1	Tutorial work	2 credits	U, G
LAB1	Laboratory work	1 credits	U, G
UPG1	Assignment	4 credits	U, G
KTR1	Vouluntary assignments	0 credits	U, G

The course grade are based on the result of the written exam together with the result of the written reports. Detailed information is given on the course web page.

Grades

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

Department

Institutionen för systemteknik

Director of Studies or equivalent

Lasse Alfredsson

Examiner

Lasse Alfredsson

Course website and other links

http://www.cvl.isy.liu.se/education/undergraduate/TSKS06

Education components

Preliminary scheduled hours: 86 h
Recommended self-study hours: 181 h

Course literature

Rekommenderade böcker är i första hand: Tidskontinuerliga Signaler & System, Sune Söderkvist (Tryckeriet Erik Larsson) Kretsteori, Från Alfa till Omega eller Kretsteori & Elektronik, Sune Söderkvist, med tillhörande övningsböcker (Tryckeriet Erik Larsson) Analog och Digital Modulation, Mikael Olofsson
Kompletterande material av examinatorn