Digital Communication

Programme course

6 credits

Digital kommunikation

TSKS01

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical Engineering, Physics and Mathematics

Date determined
2017-01-25

Offered for the last time
Autumn semester 2023

Replaced by
TSKS35

Main field of study
Electrical Engineering

Course level
Second cycle

Advancement level
A1X

Course offered for
- Communication Systems, Master's Programme
- Electronics Engineering, Master's Programme
- Computer Science and Engineering, M Sc in Engineering
- Industrial Engineering and Management - International, M Sc in Engineering
- Industrial Engineering and Management, M Sc in Engineering
- Information Technology, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical 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
From Calculus: Foremost integrals.
From Linear algebra: Everything related to linear spaces.
From Signals and systems: Fourier transforms, convolution, LTI systems.
From Signals, information and communication: Channel models, baseband representation of narrowband signals, the entropy concept.
From Signals, Information and Images: Fourier transforms, convolution, LTI systems, channel models, baseband representation of narrowband signals, the entropy concept.

Intended learning outcomes

After passing the course, the student should

- be able to reliably perform standard calculations regarding digital modulation and binary (linear) codes for error control coding.
- be able to, with some precision, analyze and compare various choices of digital modulation methods and coding methods in terms of error probabilities, minimum distances and related concepts.
- be able to account for practical problems that arise in communication, and be able to account for possible solutions to those problems.
- to some extent be able to perform calculations for solutions to practical problems that arise in communication.
- with experimental purpose be able to evaluate and to some extent implement such communication systems that are treated in the course.

Course content

- Signal-theoretic basics: Auto-correlation, power spectral density hypothesis testing, sufficient statistics.
- Digital modulation: The vector model, ML detection, MAP detection, error probabilities, coherent detection. Common signal constellations, like FSK, PSK, QAM. Multi-dimensional signal constellations: OFDM.
- Codes for error control: Binary-symmetric channels. Binary linear codes, repetition codes, simple parity check codes, Hamming codes, dual codes, product codes, cyclic codes and CRC codes. The sphere packing bound and the Singleton bound. Basic parameters like length, dimension, size and minimum distance. Weight and distance distributions. Error detection and correction capabilities.
- Practical aspects: Eye patterns, synchronization, colored noise, intersymbol interference, non-coherent detection.

Teaching and working methods

Teaching is given as lectures, tutorials and laboratory exercises.
The course runs over the entire autumn semester.

Examination

LAB1	Laboratory work	1 credits	U, G
TEN1	Written examination	5 credits	U, 3, 4, 5

The exam (TEN1) consists of three parts:

- One introductory task that examines the course aims "be able to reliably perform standard calculations...". At least 1/2 of this task has to be solved correctly in order to pass the exam.
- A question part, examining the learning outcome "be able to account for..."
- A problem part, examining the learning outcomes "be able to, with some precision,..." and "to some extent...".

The grade on the exam is based on the number of points obtained from the second and third part, provided that the first part is OK.
The laboratory exercises (LAB1) examines the course aim

- with experimental purpose...

Grades

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

Other information

Supplementary courses: Detection and estimation of signals, Wireless communication, Multiple antenna communication, Modern channel coding, inference and learning

Department

Institutionen för systemteknik

Director of Studies or equivalent

Klas Nordberg

Examiner

Emil Björnson

Course website and other links

http://www.commsys.isy.liu.se/en/student/kurser/TSKS01

Education components

Preliminary scheduled hours: 56 h
Recommended self-study hours: 104 h

Course literature

Additional literature

Books

Mikael Olofsson, Emil Björnson, *Introduction to Digital Communication*
Institutionen för Systemteknik (ISY), Linköpings universitet, (with accompanying problem material)

Compendia

some extra material that will be handed out during the course.

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.