EQ2310 Digital Communications 9.0 credits

Digital kommunikation

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

On 04/15/2021, the Head of the EECS School has decided to establish this official course syllabus to apply from autumn semester 2021, registration number: J-2021-0915.

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Electrical Engineering

Specific prerequisites

Completed course equivalent to EQ1220 Signal theory or EQ1270 Stochastic signals and systems.

Active participation in a course offering where the final examination is not yet reported in Ladok is considered equivalent to completion of the course.

Registering for a course is counted as active participation.

The term 'final examination' encompasses both the regular examination and the first re-examination.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After passing the course, the student should be able to

- justify the fact that the implementation and the development of modern communication technology require mathematical modelling and problem solving
- explain basic principles and theoretical concepts behind different technologies in modern digital communications, especially in modulation and detection, channel modeling, carrier modulation, channel coding and error protection
- formulate a mathematical model that is applicable and relevant for a given problem in the area
- use a given or individually formulated mathematical model for solving a given technical problem in the area and analyse the result and its reasonableness
- compare different technologies in modern digital communication techniques, contrast different technologies against one another and assess the suitability of individual technologies in different situations
- carry out, analyse and report simple hardware based experiments in the area
- develop simple programme code, e.g., by means of the tool Matlab, and use this code to simulate and analyse problems in the area, and report the implementation and the result.

Course contents

The course gives a broad introduction to the principles of digital communication systems and summarises the underlying theory. The theories behind modulation, demodulation, detection, parameter estimation and information theory furthermore give a good basis for many different forms of information processing such as signal processing and machine learning. Problem formulation and analysis with mathematical models are an important part of the course.

Signals and modulation:

- linear signal spaces and Gram Schmidt-ortogonalization
- Nyquist theorem and the degrees of freedom of the signal with time and bandwidth limitations
- baseband signals, carrier modulation and digital modulation such as amplitude, frequency and phaseshift - (ASK, FSK, PSK) and quadrature amplitude modulation (QAM) and differential phaseshift modulation (DPSK)

- properties of stochastic processes as stationarity, ergodicity and power spectrum and properties of Gauss-processes and multivariate Gaussian distribution.

Optimal demodulation and detection for Gaussian channels:

- the receiver's signal space, sufficient statistics and matched filters and equivalent vector model for time continuous Gauss-channels
- hypothesis testing, maximum likelihood-decisions, maximum a-posteriori decisions, error probabilities and approximations.

Non-coherent communications and parameter estimation:

- important system parameters as delay, phase and frequency shift, optimal parameter estimation, modulation for non-coherent communications and optimal detection and composite hypothesis tests.

Information theory:

- information measures such as entropy, mutual information and source coding, models of communication channels, channel coding and the channel coding theorem.

Channel coding methods:

- properties of linear block codes and convolutional codes, soft and hard decoding with the Viterbi algorithm and error analysis of convolutional codes.

Examination

- LAB1 - Laboration, 0.5 credits, grading scale: P, F
- PRO1 - Project Assignment, 1.0 credits, grading scale: P, F
- TEN1 - Examination, 7.5 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.