# EQ2411 Advanced Digital Communications 7.5 credits

## Avancerad digital kommunikation

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

## Establishment

On 2020-10-13, the Head of School of EECS has decided to establish this official course syllabus to apply from the spring semester 2021 (registration number J-2020-2220).

## 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 EQ2310 Digital communication.

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

1. use mathematical models for describing advanced communication channels and systems such as communication systems with dispersion, interference, multiple users, multipath propagation, multiple carriers and multiple antennas
2. use mathematical models for characterising properties for advanced communication channels and systems and identify properties that limit the communication
3. explain basic principles and concepts behind advanced communication technologies such as multi carrier modulation, advanced channel coding with iterative decoding, encoding, detection in multi antenna systems and equalisation and encoding and detection in multi-user systems
4. summarise advantages and disadvantages with different advanced communication technologies and be able to discuss their optimality and complexity
5. choose and optimise design parameters (e.g., power distribution, modulation, redundancy, speed) in advanced communication technologies to adapt them to a given channel model and given requirements
6. for a given combination of channel model and communication technique use mathematical models for analysing the expected performance (e.g., error probabilities, speed) and compare the performance for different solutions.

## Course contents

The aim of the course is to introduce advanced digital communication methods and to give the students an overview of current technologies that are used in the mobile communication systems of today and the principles that they build on. The course covers three different fields; digital communication over band limited channels, modern channel coding theory and wireless communications. In the course, we will discuss:

Band limited channels and equalisation: baseband representation of band limited channels with Gaussian noise; properties and design of optimal signals; inter-symbol-interference; linear and non-linear methods for equalisation.

Modern channel coding theory: basic principles behind LDPC (low-density parity check) encoding and Turbo encoding; iterative decoding; decoding algorithms that are based on a-posteriori probabilities.

Wireless communications: basic models for wireless/radio communications; frequency selective and non frequency selective channels; slow/fast fading; Rice and Rayleigh fading; performance in fading; diversity; block encoding and interleaving; channel capacity; multi

antenna systems; multi carrier systems and OFDM; spread-spectrum communication (e.g. direct-sequence and frequency hopping spread-spectrum); multi user communications and CDMA.

## Examination

- TENT - Written exam, 7.0 credits, grading scale: A, B, C, D, E, FX, F
- INL1 - Case study, 0.5 credits, grading scale: P, 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.

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

## 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.