



*Course syllabus*

# Kanalkodning för tillförlitlig kommunikation

## Channel Coding for Reliable Communication

**EITN70, 7,5 credits, A (Second Cycle)**

**Valid for:** 2023/24

**Faculty:** Faculty of Engineering, LTH

**Decided by:** PLED C/D

**Date of Decision:** 2023-04-18

### General Information

**Main field:** Communication Systems.

**Language of instruction:** The course will be given in English

### Aim

The aim of this course is to give an overview of existing channel coding methods for reliable communication (also known as error control coding or forward error correction). After taking this course you should understand the basic principles of block- and convolutional codes and how to characterize their performance, know different constructions that are most commonly used in digital communication systems and know how their encoding and decoding can be implemented in practice.

### Learning outcomes

*Knowledge and understanding*

For a passing grade the student must

- be able to identify and formulate problems within the area of error correcting codes
- be able to critically analyse and describe error correcting systems of low and medium complexity
- be able to understand the advantages and disadvantages of different coding schemes

### *Competences and skills*

For a passing grade the student must

- be able to implement a system for error correction of low and medium complexity
- be able to classify the level of difficulty of problems related to the his/her own level of knowledge
- be able to independently work in a creative way with advanced projects and motivate and discuss obtained conclusions

### *Judgement and approach*

For a passing grade the student must

- be able to show insight concerning possibilities and limitations of error correcting systems

## Contents

Channel coding is at the core of any modern communication system; reliable communication would not be possible without the use of coding. When digital data is transmitted from one place to another it is always prone to noise or interference occurring in the transmission medium. For this reason all modern communication systems use some error correcting codes that add redundancy to the original data in order to protect it from errors occurring during the transmission.

The course covers the following topics:

- *Principles of error control coding*: Channel models, Linear block codes, Syndrome decoding, Constructing codes from other codes, Bounds, Cyclic codes, Convolutional codes
- *Optimal decoding methods*: MD vs BMD decoding, ML Decoding, Viterbi algorithm, Trellises of block codes, Decoding error probability, Weight enumerators, APP decoding, BCJR algorithm
- *Iterative decoding of concatenated codes*: Product codes, Parallel and serial concatenation, Turbo codes, Iterative decoding, LDPC Codes, Tanner graphs, Message passing decoding, LDPC convolutional codes
- *Reed-Solomon codes*: Non-binary codes, Frequency domain representation, Encoding, Algebraic decoding, Weight enumerators

## Examination details

**Grading scale:** TH - (U,3,4,5) - (Fail, Three, Four, Five)

**Assessment:** Written examination (5 hours) normally consists of five problems.

Approved project is a requirement to be allowed to enter the examination.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

### **Parts**

**Code:** 0118. **Name:** Written exam.

**Credits:** 6,5. **Grading scale:** TH. **Assessment:** Approved written exam **Contents:** Written exam

**Code:** 0218. **Name:** Project.

**Credits:** 1. **Grading scale:** UG. **Assessment:** Approved Project. **Contents:** Project

## Admission

**Assumed prior knowledge:** For students from the E, D, C or Pi programmes: FMSF45, FMSF20 eller FMSF55 Mathematical Statistics, Basic Course. For students from the MWIR programme: EITG05 Digital Communications.

**The number of participants is limited to:** No

**The course overlaps following course/s:** EDI042

## Reading list

- Shu Lin, Daniel J Costello Jr: Error Control Coding, Second Edition. Pearson, 2004, ISBN: 978-0-130-42672-7.
- Martin Bossert: Channel Coding for Telecommunications. Wiley, 1999, ISBN: 978-0-471-98277-7. Alternativ läsning.

## Contact and other information

**Course coordinator:** Michael Lentmaier, michael.lentmaier@eit.lth.se

**Course homepage:** <http://www.eit.lth.se/course/eitn70>

**Further information:** With less than 16 participants, the course may be given with reduced teaching and more self studies.