LINKÖPINGS TEKNISKA HÖGSKOLA
Tekniska fakultetskansliet

FÖRSLAG TILL PROGRAMNÄMND INFÖR ÅR 2017

NÄMND/NÄMNDER: EF

Förslagsställare (Namn, funktion, Inst/Enhet)

Emil Björnson, kursansvarig. Klas Nordberg, studierektor

FÖRSLAGET GÄLLER:

a) EXISTERANDE KURS (Ange kurskod och kursnamn)

TSKS01 Digital kommunikation

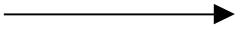
b) NY KURS (Ange kursnamn, årskurs, önskad läsperiod, schemablocksplacering. Bifoga utkast till kursplan.)

c) ÄNDRING I EXISTERANDE PROFIL/INRIKTNING (Ange Program och Profil/Inriktning. Bifoga beskrivning över vad förslaget går ut på.)

d) NY PROFIL/INRIKTNING (Ange Program och Profilnamn. Bifoga utkast till Profilbeskrivning.)

e) ÖVRIGT (Bifoga beskrivning över vad förslaget går ut på.)

PROGRAMNÄMNDENS BESKED:



FÖRSLAGET I DETALJ:

Vi föreslår att

1) Kursen ges enbart i HT2 istället för som tidigare över hela höstterminen. Det ger oss bättre möjlighet att hantera schemaläggning och personalplanering i andra kurser.

2) Mindre justeringar görs i kursplanen enligt bilaga.

Förslagen är en del av den planerade moderniseringen av kurspaketet på avancerad nivå inom kommunikationssystem.

Vi önskar att förslaget godkänns så att den nya texten till studiehandboken (punkt 2) gäller från och med HT-2016. Schemaförändringen (punkt 1) behöver inte träda i kraft förrän 2017. Text till studiehandboken på svenska tillhandahålles när förslaget är godkänt.

Nuvarande text i studiehandboken:

TSKS01 Digital Communication, 6 ECTS credits.
/Digital kommunikation/

For: D ELE I Ii IT SY Y

Prel. scheduled hours: 56
Rec. self-study hours: 104

Area of Education: Technology

Main field of studies: Electrical Engineering

Advancement level (G1, G2, A): A

Aim:
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.

Prerequisites: (valid for students admitted to programmes within which the course is offered)
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.

Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshhold requirements for progression within the programme, or corresponding.

Supplementary courses:
Digital communication Continuation Course, Wireless systems, Radio communication, Error correcting codes, Source coding, Image and audio coding.

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

Course contents:

- 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.

Course literature:
Mikael Olofsson, Introduction to Digital Communication, Institutionen för Systemteknik (ISY), Linköpings universitet, with accompanying problem material, and also some extra material that will be handed out during the course.

Examination:

Written examination	5 ECTS
Laboratory work	1 ECTS

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) examine the course aim ”with experimental purpose...”

Föreslagen ny text i studiehandboken:

TSKS01 Digital Communications 6 ECTS credits. / Digital kommunikation /

Area of Education: Technology

Main field of studies: Electrical Engineering

Advancement level: A

Prel. scheduled hours: 56
Rec. self-study hours: 104

Course Aims:
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, throughput, and related concepts.
- be able, to some extent, to perform calculations for solutions to practical engineering problems that arise in communication.
- be able, to some extent, to implement and evaluate communication systems of the kinds treated in the course.

Prerequisites: (valid for students admitted to programmes within which the course is offered)
From Calculus: Foremost integrals.
From Linear algebra: Everything related to linear spaces.
From Signals and systems: Fourier transforms, convolution, LTI systems.
From either “Signals, information and communication” or “Signals, information and images”: pulse-amplitude modulation, white noise, baseband representation of narrowband signals, channel capacity.

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.

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

Organization:

Teaching is given as lectures, tutorials and laboratory exercises.

Course contents:
Baseband and passband communication: Pulse functions that satisfy the Nyquist criterion, typical orthogonal basis functions, single-carrier and multi-carrier signals (e.g., OFDM), relationship between bandwidth and symbol time.
Channels: Delay spread, dispersive and non-dispersive channels, and their relation to inter-symbol interference.
Digital modulation in AWGN channels: ML detection of symbols, coherent and non-coherent detection. Exact error probabilities and common bounds, soft decisions. Common signal constellations (e.g., FSK, PSK, ASK, QAM).
Digital modulation in dispersive channels: ML detection of symbol sequences, complexity considerations, Viterbi algorithm.
Codes for error control: Binary linear codes, binary field, generator and parity check matrices, weights and distances. Error detection and error correction capabilities. Example of binary codes (e.g., repetition codes, parity check codes, Hamming codes, product codes). Bounds and asymptotic behaviors. Convolutional and CRC codes.
Implementation aspects: Eye patterns, synchronization, link adaptation in packet transmission.

Course literature:
Mikael Olofsson, Emil Björnson, “Introduction to Digital Communication,” Institutionen för Systemteknik (ISY), Linköpings universitet, with accompanying problem material. Some extra material will be handed out during the course.

Examination:

TEN1	Written examination	5 ECTS
LAB1	Laboratory work	1 ECTS

The exam (TEN1) examines the first three course aims, while the laboratory work (LAB1) examines the last course aim. The final grade is determined by the exam result. The exam is normally written, but the course director can decide to use oral examination, as complement to or as replacement for a written exam, in case there are few students taking the exam, or in other special cases.