

TSKS13 WIRELESS COMMUNICATIONS

VT117

Course Syllabus

1. Course overview

The purpose of this course is to provide fundamental knowledge about design and analysis of modern wireless communication links and systems. The course builds on the knowledge acquainted during previous courses within the area of telecommunications and puts this knowledge in a system perspective.

The central point of the course are digital wireless links. We are going to treat system oriented antenna- and wave propagation theory and perform link-budget calculations as well.

We are going to shed some light on various ways to describe the radio channel through deterministic and stochastic channel models. Further, different modulation techniques will be presented and their performance in fading environment will be investigated. Special attention will be paid on OFDM (Orthogonal Frequency Division Multiplexing). Technical methods to obtain effective transmission over radio channels like diversity methods, channel coding and band spreading techniques will be discussed. Some wireless access protocols and automatic repeat request (ARQ) schemes will be considered during the course. Basic concepts of wireless cellular networks will be presented.

2. Scope

The course is worth **6** ECTS credits and consists of 48 hours lectures/exercises with one compulsory project work as well.

3. Teachers

Responsible for the course: Danyo Danev (DD), LiTH, tel 28 13 35, e-mail: danyo.danev@liu.se

Lecturers: Danyo Danev
Pål Frenger (PF), Ericsson AB

Tutorial sessions' leader: Danyo Danev

Division responsible for the course: Communication Systems, Dept. of EE (ISY).

4. Course Literature

Lars Ahlin, Jens Zander, Ben Slimane, *Principles of Wireless Communications*, Studentlitteratur, 2006.

The course book can be ordered at the Campus' bookshops: Akademibokhandeln in house Zenit (<https://www.akademibokhandeln.se>) or Bokakademien in house Kårallen (<http://www.bokab.net/>). Direct links to order the book are available on the course's web page.

5. Project work

One compulsory project work is part of the course. The project work includes search for a suitable literature, studying of a particular topic within the area of radio communications, writing of a report and oral presentation. Suggestions for suitable topics are available on the course's web page. Well performed project work gives extra credits for the Part B of the exam.

6. Examination

There is one written examination which is divided in two parts. Part A consists of 10 short answer questions worth 0.5 credits each. Part B consists of 4 problems which can give at most 5 points each. For grade 3(ECTS grade C) a total of at least 11 credits are required of which at least 2 have to be gained from Part A of the exam. For other grades the limits are the following: 4(B) -> 16(3) and 5(A) -> 21(3.5).

It will be possible for you to use the course book for Part B of the exam.

You have to pass the project work in order to pass the whole course.

The written examination during the ordinary exam period is on Thursday March, 16th at 8.00. The retakes are on Monday June, 5th at 14.00 and on Friday August, 18th at 8.00.

7. Lecture topics

Lecture 1	Historical overview, spectrum, radio wave propagation (ch 1-2)
Lecture 2	Antennas, channel models, fading, correlation properties (ch 3.1-3.6)
Lecture 3	Link-budgets (ch 3.7-3.10)
Lecture 4	Modulation – performance in fading channels (ch 4.1-4.6)
Lecture 5	OFDM, W-LAN (ch 4.7 + extra)
Lecture 6	Spread spectrum: basics, frequency hopping, direct sequence (ch 4.8)
Lecture 7	Diversity (ch 5.3, 5.5, 5.6) Channel coding: convolutional codes(ch 6.3-6.4)
Lecture 8	Channel coding: coded modulation (ch 6.5) Access protocols and ARQ (ch 8)
Lecture 9	Wireless networks (ch 9.1-9.3)
Lecture 10	MIMO and OFDM in LTE and 5G (guest lecture)
Lectures 11&12	Presentation of the projects

8. Tutorial sessions topics

Ex 1	Radio wave propagation
Ex 2	Channel models, Fading
Ex 3	Link-budgets
Ex 4	Modulation
Ex 5	Modulation (contd.), OFDM
Ex 6	OFDM (contd.), Spread spectrum
Ex 7	Diversity methods
Ex 8	Diversity(contd.), Channel coding
Ex 9	Channel coding
Ex 10	ARQ
Ex 11	Access protocols
Ex 12	Wireless networks, Repetition