Anders Västberg

Syllabus for Wireless Systems, v9

Course IK1330, 7.5 HEC

Intended learning outcomes

This course provides an overview of wireless systems. It describes the basic design of radio links and radio networks, and describes the system architecture and function of different existing standards for wireless systems.

To pass, the student should be able to:

- Give an overview how a fading radio channel affects the link performance of wireless communication systems
- Dimensioning a radio link in terms of range and channel capacity based on given conditions
- Explain how multiple access methods works
- Estimate the capacity of a radio network and describe the relation between system capacity, deployment strategy, cost and available spectrum
- Describe structure and actors of a telecom market
- Give an overview of the system architecture of the various existing wireless communication systems
- Explain, in a wide sense, the environmental and sustainability challenge of the ICT-industry. (Electromagnetic radiation, energy, limited natural resources, environmentally harmful effects).

For the highest grade, the student should be able to:

- Explain wave propagation mechanisms and make judgments based on how these mechanisms affect the wave propagation
- Solve a general design problem for the radio links and radio networks by using simple formulas
- In a telecom market, be able to explain, the main actors business model and how the make money
- Given an overview of various existing systems for wireless communications and compare the capacity, performance and environmental aspects of them
- Be able to judge the economic and social advantages of providing affordable telecommunication in relation to its environmental effects.

Fulfilling parts of the learning outcomes of the highest grade results in grades D to B.

Course main content

Channel capacity, transmission, multplexing,
Antennas, wave propagation, spectrum fading,
Digital Modulation, Spread spectrum FHSS, DSSS,
Multiple access FDMA, TDMA, CDMA, OFDMA,
Error detection and error correction, Wireless networks using standards for cellular mobile broadband systems, wireless LAN, sensor networks and PAN,
Environmental, social, market and economic effects of wireless systems.

Eligibility

IX1303 Algebra and geometry and IX1304 Calculus or similar courses.
IK1203 Networks and communication or similar course.

Recommended prerequisites

IK1501 or equivalent

Literature

Wireless Communications & Networks, Beard, Cory and William Stallings Edition: 1:st, Publisher: Pearson: 2015 or similar book.

Examination

- INL1 - Problem Assignments, 4.5, grade scale: A, B, C, D, E, FX, F
- LABA - Laborative Work, 1.5, grade scale: P, F
- SEM1 - Seminars, 1.5, grade scale: P, F

Requirements for final grade

Seminars SEM1: 1.5 HEC, Grading P/F
Laborative work LAB1: 1.5 HEC, Grading P/F
Assignments: INL1: 4,5 HEC, Grading A-F

Course Information

Teaching Methods

The course consists of lectures, seminars and laboratory exercises with supervision. The lectures consist of a combination of theory and problem-solving. Difficult parts of the course are presented during the lectures and other parts of the course must be studied on your own.

The seminars consist of discussion and review of problems. Prior to each seminar, a number of problems will be distributed. Before the seminar you will try to solve all the problems and bring your suggested solutions. During the seminar, you review the solutions in a group of students. After your group has reviewed all the solutions for all the problems, one member in each group presents a selection of the problems for the class. Attendance at the seminars is mandatory.

Missed seminars can be completed by a home exam at the end of the course. The kind of tasks at home exam is depended on the missed seminars.

You will also make two case studies in the course, one on radio links and radio networks and one for telecommunications markets. Each case study consists of an open-ended problem, where you will design a solution to the problem. Case studies are made in groups of three randomly chosen students. The solutions should be reported as a series of slides containing explanatory text, figures and calculations. You should also (individually) make an critical review for other students case-studies and write a review report for these (one A4 per assignment). Case studies determine the grade of the course. You get an individual grade based on your part of the case studies and your own review reports.

The laboratory sessions shall provide an opportunity to practice newly acquired knowledge of wireless systems, as well as demonstrate different aspects of wireless communication and the handling of hardware.

In addition, the following applies to laboratory work:
• Attendance on laboratory work is mandatory.
• Laboratory work will include preparatory tasks that must be solved before entering the laboratory.

Grading Criterias

The course consists of three parts, LABA, 1,5 HEC, SEM1, 1,5 HEC och INL1 , 4,5 HEC. INL1 consists of three case studies and three opposition reports which are combined to a final A-F grade. The grade of the course is dependent on the grade of INL1 (provided that all the other parts have the grade P).

Teachers, Examiner and Course Coordinater

Jan Markendahl	08/790 93 58	janmar@kth.se	Teacher
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Anders Västberg	08/790 44 55	vastberg@kth.se	Course Coordinator, Examiner and Teacher.

Detailed Syllabus

The course consists of 13 lectures of two teaching hours, 3 seminars of two teaching hours and two half-class laboratory exercises of four teaching hours. Each teaching hour is 45 minutes.

F1 Introduction
Introduction to the course and overview of the development of wireless systems
Stallings chapter 1, 2.4 (-), Appendix 2A

F2 Introduction to transmission
Analogue and digital signals, the relationship between bandwidth and data rate, decibels
Stallings chapter 2.1, 2.2, Appendix B

Start of Case study 1a

F3 Introduction to Radio links
Stallings chapter: 6.1, 6.2

F4 Introduction to Radio links
Stallings chapter: 6.3-6.6

F5 Modulation
Digital modulation, Analog modulation, PCM
Stallings chapter: 7

F6 Channel capacity, multiplexing and spread spectrum technology
Channel capacity, transmission and multiplexing
Stallings chapter: 2.3, 2.5, 8, 9

Seminar 1: Radio links

F7 Coding and Error Control
Stallings chapter: 10

Review of Case study 1a

F8 Radio network 1
Stallings chapter: 13.1, Appendix A

Start of Case study 1b

Seminar 2: Capacity in radio systems

L1 Measurement of signal strength from base station

F9 Telecommunications markets and mobile operators

Case study 2

F10 Telecommunications markets and mobile operators

F11 Telecommunications markets and mobile operators

F12 Radio network 2
Stallings Chapter 13.2-13.6, 14

Seminar 3: Radio network

F13 Wireless Communications System
Stallings chapter: 11, 12

L2 Cell planning

Reporting of Case study 1b

Seminar: Reporting of case study 2