IK2510 Wireless Networks 7.5 credits

Radionät

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

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

Establishment

Course syllabus for IK2510 valid from Autumn 2022

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Electrical Engineering

Specific prerequisites

Knowledge in Wireless Communication Systems, 7,5 credits, corresponding to completed course IK2507.

Knowledge in Wireless Transmission Techniques 7,5 credits, corresponding to completed course IK2508.

Course from Upper Secondary School corresponding to the course English B/6 according to the Swedish upper secondary school system.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

Upon the completion of the course, the student should be able to:

- apply the most important techniques for analyzing the capacity, design, resource management, and performance of Wireless Networks
- use and modify simulation tools for performance evaluation of Wireless Systems
- read the current literature at both conference and journal levels.

Course contents

This course provides a comprehensive and systematic introduction to the theory and practice of mobile data networks. Covering basic design principles as well as analytical tools for network performance evaluation, and with a focus on system-level resource management, you will learn how state-of-the-art network design can enable you flexibly and efficiently to manage and trade-off various resources such as spectrum, energy, and infrastructure investments. Topics covered range from traditional elements such as medium access, cell deployment, capacity, handover, and interference management, to more advanced network design elements such as MIMO (multiple-input, multiple-output) antenna technologies, heterogeneous networks, energy -efficiency, considering different generation of wireless networks such as 4G and 5G.

– Fundamentals of wireless area communication systems:
Structure and functional blocks.

– Performance measures:
Coverage, quality, capacity, Traffic models. Quality of Service (QoS) classes and negotiation.

– Wireless Network Models:
Models for Wireless Access Networks, Services Scenarios and Performance Metrics, Radio Resource Management in Wireless Access Networks, Orthogonal Signal Sets, Guaranteed Service Quality – Blocking, Best Effort - Non-Blocking.

– Medium Access Control:
Data Traffic and Performance Measures, Contention-Free Access Protocols, Contention-Based Access Protocols, Applications, IEEE 802.11, Cellular Networks.

– Scheduling:
Issues in Wireless Scheduling, Wireless Scheduling and Capacity Region, Round Robin Scheduling, Max Throughput Scheduling, Proportional Fair Scheduling, Max-Min Scheduling, Max Utility Scheduling, Scheduling in OFDMA Systems.

– Principles of Cellular Systems:
Orthogonal Multiple Access Cellular Systems, Coverage Planning, Static channel allocation, Traffic-Based Capacity Analysis, best Effort Data Services, Outage Based Capacity Analysis, Directional Antennas and Sectorisations, CDMA Cellular Systems, Uplink Capacity of DS-CDMA Systems, Traffic-Based Capacity of DSCDMA Systems, Down-Link Capacity of DS-CDMA Systems, Multi-Service DS-CDMA Systems.

– Transmitter Power Control:
Performance Metric and Conditions of Achievability, Centralized Power Control, SIR Balancing, Admission Control, Distributed Power Control, Power Control for Elastic Traffic, Distributed Power Control for Wireless Data.

– Interference Management:
Classification of Interference Management Techniques, Interference Avoidance, Interference Randomization, Interference Cancellation, Interference Management for Heterogeneous Networks.

– Association and Handover:
Anatomy of Handover, Handover Decision Problem, Handover Resource Management, Soft Handover, Soft Handover Procedure in Practical Systems, User Association.

– Energy-Efficient Design:
Energy Consumption in Wireless Networks, Energy-Efficient Transmission, Tradeoff in Network Resource Utilization, Energy-Efficient MAC Design, Energy-Efficient Network Management.

– 4G (LTE) and 5G Networks:
Architecture, numerology and resource allocation in 4G and 5G networks.

– Introduction to Multiple Antenna Communications:
Introduction to beamforming, computation with multiple antennas at the base station, brief look at MIMO communications.

Examination

- LABA - Laboratory work, 1.0 credits, grading scale: P, F
- TENA - Examination, 6.5 credits, grading scale: A, B, C, D, E, FX, 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.

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.