Opasraportti

Courses in English for Exchange Students CSE DCE EE (2015 - 2016)

This Weboodi Course Catalogue lists courses taught in English for exchange students during the academic year 2015-2016 at the Departments of

- Electrical Engineering: http://www.oulu.fi/eeng/
- Communications Engineering: http://www.oulu.fi/dce/
- Computer Science and Engineering: http://www.oulu.fi/cse/

When planning your exchange studies and the required learning agreement, please use the information provided under the **Courses** tab in this Study Guide. Please read carefully the information of each course you wish to take (language of instruction, target group, course content, timing, preceding studies, additional information etc.).

All exchange students must submit their exchange application through SoleMOVE.

Accepted exchange students are required to register to all courses. Course registration takes place once you have arrived in Oulu and received your University of Oulu login information. More information on registration will be provided during orientation. When registering you will be able to find detailed information on teaching and schedule under **Instruction** tab.

Individual course codes include information on the level of course.
xxxxxxP = basic, introductory level courses
xxxxxxA = for 2-3 year students, mostly Bachelor level courses
xxxxxxS = for 4-5 year students, Master level courses

Departmental information: http://www.oulu.fi/eeng/node/12575

Further information on application process for incoming exchange students:
http://www.oulu.fi/english/studentexchange
international.office(at)oulu.fi

Any general questions about courses in English at the above departments should be addressed to:

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Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

521285S: Affective Computing, 5 op
521388S: Antennas, 5 op

521281S: Application Specific Signal Processors, 5 op
521283S: Big Data Processing and Applications, 5 op
521284S: Biomedical Engineering Project, 5 op
521093S: Biomedical Instrumentation, 5 op
521273S: Biosignal Processing I, 5 op
521282S: Biosignal Processing II, 5 op
521316S: Broadband Communications Systems, 5 op
521324S: Communication Signal Processing I, 5 op
521325S: Communication Signal Processing II, 5 op
521340S: Communications Networks I, 5 op
521377S: Communications Networks II, 7 op
521493S: Computer Graphics, 7 op
521290S: Distributed Systems, 5 op
521172S: EMC Design, 4 op
521443S: Electronics Design II, 5 op
521321S: Elements of Information Theory and Coding, 5 op
521145A: Human-Computer Interaction, 5 op
031025A: Introduction to Optimization, 5 op
521289S: Machine Learning, 5 op
521110S: Measuring and Testing Systems, 6 op
521074S: Microelectronics and Micromechanics, 5 op
521173S: Mixed-signal Testing, 4 op
521147S: Mobile and Social Computing, 5 op
521318S: Modern Topics in Telecommunications and Radio Engineering, 3 - 7 op
521288S: Multiprocessor Programming, 5 op
521089S: Printed Electronics, 5 op
521260S: Programmable Web Project, 5 op
521225S: RF Components and Measurements, 5 op
521326S: Radio Engineering 1, 5 op
Compulsory
521326S-01: Exam, Radio engineering 1, 0 op
521326S-02: Exercise work, Radio engineering 1, 0 op
521327S: Radio Engineering II, 6 op
521149S: Special Course in Information Technology, 5 - 8 op
521322S: Telecommunication Engineering Project, 5 op
521148S: Ubiquitous Computing Fundamentals, 5 op
521323S: Wireless Communications I, 5 op
Compulsory
521323S-01: Wireless Communications I, Exam, 0 op
521323S-02: Wireless Communications I, Exercise, 0 op
521097S: Wireless Measurements, 5 op
Compulsory
521097S-02: Wireless Measurements, exercise work, 0 op
521097S-01: Wireless Measurements, exam, 0 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course

Arvostelu: 1 - 5, pass, fail
Opettajat: Guoying Zhao
Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall, periods 1
Learning outcomes:
Upon completing the required coursework, student is able to explain the emotion theory and modeling, implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities, use the basic tools to synthesize facial expressions and speech as well as has the ideas of wide applications of affective computing.
Contents:
The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, bio-signals like heart rate, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.
Mode of delivery:
Face to face teaching
Learning activities and teaching methods:
The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.
Recommended optional programme components:
-
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
The assessment of the course is based on the exam (100%) with mandatory exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Guoying Zhao
Working life cooperation:
-

521388S: Antennas, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Markus Berg
Opintokohteen kielet: English
Leikkaavuudet:

521380S	Antennas	4.0 op
521380S-01	Antennas, partial credit	0.0 op
521380S-02	Antennas, partial credit	0.0 op

ECTS Credits:

5

Language of instruction:
English

Timing:
Spring, period 4

Learning outcomes:
After completing the course the student can apply antenna terminology and calculate the antenna characteristics of different kind of radio systems. Furthermore, the student can apply electromagnetic theory to calculate the properties of the fields radiated by basic antenna types and antenna arrays. The student is also able to design wire antennas, micro strip antennas and antenna arrays for different radio systems. In addition, the student can use electromagnetic simulators to analyse and design antennas.
Objective: After having passed the course the student knows antenna terminology, understands the role of antennas as a part of different radio systems and is familiar with the theories explaining the electromagnetic radiation of usual antenna types and antenna arrays. In addition, the student masters the preliminary design of various antenna types and arrays, as well as, knows the feasibility of electromagnetic simulators in the antenna design.

Contents:
Introduction to different antenna types. Antenna parameters. Antennas as a part of a radio system. Radiation of an antenna from the Maxwell's equations. Typical linear wire antennas: infinitesimal dipole, small dipole, finite length dipole, half-wavelength dipole. Antennas near the conducting plane. Loop antennas. Microstrip antennas. Antenna arrays.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures 24 h, exercises 16 h and the compulsory antenna design work with an electromagnetic simulation software 10 h.

Target group:
1st or 2nd year M.Sc. and WCE students

Prerequisites and co-requisites:
Basics of Radio Engineering

Recommended optional programme components:
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Recommended or required reading:
C.A. Balanis: Antenna Theory, Analysis and Design (Third Edition). John Wiley & Sons, 2005. Chapters 1-6 and 14.

Assessment methods and criteria:
The course is passed with a final examination and the accepted design work report. In the final grade of the course, the weight for the examination is 0.75 and that for the design work 0.25.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course unit utilizes a numerical grading scale 1-5.

Person responsible:
Markus Berg

Working life cooperation:
-

Other information:
Course will be given every second year in even years.

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Boutellier, Jani Joosefi

Opintokohteen kielet: English

ECTS Credits:
5

Language of instruction:
In English.

Timing:
Autumn, period 1. Will be held next time in the autumn of 2016
Learning outcomes:
Objective: The course introduces the main types of processors used in digital signal processing. Practical skills are learned by processor construction exercises.
Learning outcomes: After completing the course the student can distinguish the main types of signal processors and design a couple of transport triggered architecture processors. The student is able to assemble a signal processor out of basic entities and match the processor performance and the application requirements. The student applies the TTA codesign environment and Altera's FPGA tools to synthesize a system.
Contents:
Examples of modern signal processing applications, main types of signal processors, parallel signal processing, transport triggered architectures, algorithm-architecture matching, TCE design environment and Altera FPGA tools.
Mode of delivery:
Lectures, independent work, group work.
Learning activities and teaching methods:
Lectures 12h (participation mandatory); Instructed labs 12h ;Independent work 111h
Target group:
Computer Science and Engineering students + other Students of the University of Oulu. This is an advanced-level course intended for masters-level students and post-graduate students, especially to those who are specializing into signal pro-cessing.
Prerequisites and co-requisites:
521267A Computer engineering, 521337A digital filters, programming skills
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Handouts.
Assessment methods and criteria:
Participation in mandatory classes and approved project work.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Jani Boutellier
Working life cooperation:
No.

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Susanna Pirttikangas

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
Finnish.
Timing:
Period IV. It is recommended that the course is taken on the fourth year Spring.
Learning outcomes:
After completing the course, the student can explain the big data phenomena and the possibilities it has in data processing and exploitation. The student can analyse concrete technologies for big data management and processing. The student can explain the most common solutions available for cloud services, and understand the benefits, risks and restrictions of them. The course offers viewpoints for big data exploitation and applications. One aim is to learn to apply methods of data preprocessing, knowledge extraction, data analysis and statistics on big data platforms. The focus will be on open data. In the exercises, the student will learn the principles of the current new technologies and utilize them on a basic level.

Contents:
1. Creating understanding for the Big data framework, 2. The central technologies, solutions and services, 3. Big data and cloud services, 4. Big Data processing and applications, 5. Knowledge extraction, data mining and pattern recognition from Big Data, 6. Design exercise, 7. Seminar.
Mode of delivery:
Face-to-face teaching, seminar and opponent work.

Learning activities and teaching methods:
12h lectures, 27h exercises, 32h seminar, independent studying

Target group:
M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is space in the classes.
Prerequisites and co-requisites:
The Bachelor level studies of Computer science and engineering study programmes or respective knowledge, the exercises do not require programming skills but they are an advantage.

Recommended optional programme components:
Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.
Recommended or required reading:
Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. Instructions to necessary installations will be given.

Assessment methods and criteria:
Attending lectures and finishing a design exercise wit a report. The reports will be evaluated in seminar work through student opponents.

Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:
Susanna Pirttikangas, Mika Rautiainen

Working life cooperation:
None

521284S: Biomedical Engineering Project, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
Finnish or English, depending on the student.
Timing:
As part of the master level studie, in any period suitable to the student.
Learning outcomes:
The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The topics are from biomedical engineering and depend on the student's interest.
Contents:
A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for biomedical data processing. Often the work includes programming with Matlab, C or Java languages.
Mode of delivery:

Self-study under supervision.
Learning activities and teaching methods:
First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, and documentation. Task assignments can be applied at any time all year round.
Target group:
Master-level students of the Department of Computer Science and Engineering that are interested in biomedical engineering.
Prerequisites and co-requisites:
The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Courses such as Biosignal processing I and II, Biomedical image processing and Machine learning are recommended. Programming skills, especially the Matlab.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Literature and scientific articles depending on the task assignment.
Assessment methods and criteria:
Course assessment is based on the technical report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Tapio Seppänen
Working life cooperation:
No

521093S: Biomedical Instrumentation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

Leikkaavuudet:

521107S	Biomedical Instrumentation	6.0 op

ECTS Credits:
5
Language of instruction:
English.
Timing:
Period 3.
Learning outcomes:
After the course the student is capable to explain principles, applications and design of medical instruments most commonly used in hospitals. He/she can describe the electrical safety aspects of medical instruments and can present the physiological effects of electric current on humans. In addition the student is able to explain medical instrumentation development process and the factors affecting it. He/she also recognizes typical measurands and measuring spans and is able to plan and design a biosignal amplifier.

Contents:
Diagnostic instruments (common theories for medical devices, measurement quantities, sensors, amplifiers and registering instruments). Bioelectrical measurements (EKG, EEG, EMG, EOG, ERG), blood pressure and flow meters, respiration studies, measurements in a clinical laboratory, introduction to medical imaging methods and instruments, ear measurements, heart pacing and defibrillators, physical therapy devices, intensive care and operating room devices and electrical safety aspects.

Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:

Lectures/exercises 42 h and self-study 100 h.
Target group:
Students interested in biomedical measurements.
Prerequisites and co-requisites:
None
Recommended optional programme components:
Course replaces earlier courses Biomedical measurements and Biomedical instrumentation.

Recommended or required reading:
R. S. Khandpur: Biomedical Instrumentation, Technology and Applications, McGraw-Hill, 2005 and J. G. Webster: Medical Instrumentation, Application and Design, 4th edition, John Wiley & Sons, 2010.
Assessment methods and criteria:
The course is passed by the final exam or optionally with the assignments/test agreed at the first lecture.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1 - 5.
Person responsible:
Igor Meglinski
Working life cooperation:
No.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English. Examination can be taken in English or Finnish.
Timing:
The course unit is held in the autumn semester, during period II. It is recommended to complete the course at the end of studies.
Learning outcomes:
After passing the course, student knows special characteristics of the biosignals and typical signal processing methods. Student can solve small-scale problems related to biosignal analysis.
Contents:
Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.
Mode of delivery:
Face-to-face teaching and guided laboratory work.
Learning activities and teaching methods:
Lectures 10h, Laboratory work 20h, Self-study 20h, written examination.
Target group:
Students interested in biomedical engineering, preferably at their master's level studies.
Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:
The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab. Basic knowledge of digital signal processing.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
The course is based on selected chapters of the book "Biomedical Signal Analysis, A Case-Study Approach", R.M Rangayyan. 516 pages. + Lecture transparencies + Task assignment specific material.
Assessment methods and criteria:

Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The course ends with a written exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Tapio Seppänen
Working life cooperation:
No.

521282S: Biosignal Processing II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kortelainen

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5
Language of instruction:
Lectures and laboratory works are given in English. The examination can be taken in Finnish or English.
Timing:
Periods 4
Learning outcomes:
The course focuses on advanced digital signal processing techniques generally used with biosignals of neural origin. Hands-on guided laboratory working is arranged in parallel to the lectures.
After passing the course, students knows the special characteristics of neural signals and the typical signal processing methods related to them. Students can solve advanced problems related to the neural signal analysis.
Contents:
Introduction to EEG, fundamentals of EEG signal processing, event-related potentials, seizure signal analysis, EEG source localization, sleep EEG, brain-computer interfacing.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures (10 h) and laboratory work (20 h), written exam.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
The basic engineering math courses, digital filtering, programming skills, Biosignal Processing I.
Recommended optional programme components:
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Recommended or required reading:
The course is based on the book "EEG Signal Processing", S. Sanei and J. A. Chambers, 289 pages, lecture slides and task assignment specific material.
Assessment methods and criteria:
Laboratory work is supervised by the assistants who will also check that the task assignments are completed properly. The course ends with a written exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading of the accepted exam is in the range 1-5.
Person responsible:
Jukka Kortelainen
Working life cooperation:
No

521316S: Broadband Communications Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Latva-aho, Petri Luoto

Opintokohteen kielet: English

Leikkaavuudet:

521316A Wireless Communications 1 4.0 op

521316A-01 Introduction to Broadband Transmission Techniques, exam 0.0 op

521316A-02 Exercise, Broadband Communication Systems 0.0 op

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall, period 1
Learning outcomes:
Upon completing the required coursework, student can distinguish the basic transmission technologies used in the most important commercial wireless communication systems. Furthermore, the student can differentiate and compare the key points behind these technologies, why they are used and what are their advantages and disadvantages. Student can explain how the wireless channel impacts the design of the overall system. The most relevant standards are introduced and explained, so that student can attain information from past and especially the forthcoming wireless standards. Student can also observe and explain the performance of these technologies with variable system and channel parameters through the course laboratory exercise.
Objective: to introduce the key transmission technologies used in modern broadband wireless systems and to introduce the most common wireless standard.
Contents:
Digital transmission link, wideband radio channels, multiple access techniques, spread spectrum and CDMA techniques, OFDM techniques, applications and most common standards, future mobile communication systems
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28h, exercises 14h and the compulsory design work with a simulation program (20 h).
Target group:
1st year M.Sc. and WCE students
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Defined during the lectures; recommended reading: Wireless Communications, 2nd ed, Andreas F. Molisch, Wiley 2010.
Assessment methods and criteria:
The course is passed with a final examination and the accepted simulation work report. Grade is based on exam.
Grading:
The course unit utilizes a numerical grading scale 1-5.
Person responsible:
Matti Latva-aho
Working life cooperation:
-

521324S: Communication Signal Processing I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes

Opintokohteen kielet: English

Leikkaavuudet:

521373S Statistical Signal Processing 2 6.0 op

521373S-01 Statistical Signal Processing 2, exam 0.0 op

521373S-02 Exercise work, Communication Signal Processing I 0.0 op

ECTS Credits:
5
Language of instruction:
English
Timing:
Spring, period III. It is recommended to complete the course during the first year of master studies.
Learning outcomes:
Upon completing the required coursework, the student is able to use the methodology of statistical signal processing in the design communication transceivers. He or she will be able to design and simulate various receiver algorithms and use linear algebra, estimation theory and optimization theory to solve algorithm design problems.
Contents:
Review of linear algebra, estimation and optimization, tasks and the structure of a communications transceiver, use of statistical optimization for algorithm design, optimal linear filters, matrix and adaptive algorithms, linear and nonlinear equalizers, parameter estimation and synchronization, spatial signal processing.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 32h, exercises 16h, group project work 12h, and self-study.
Target group:
1st year M.Sc. and WCE students.
Prerequisites and co-requisites:
Statistical signal processing, Matrix Algebra, Basics of Optimization, Telecommunication Engineering, Wireless Communications I
Recommended optional programme components:
Wireless Communications II.
Recommended or required reading:
Lecture notes and material, other literature listed therein. Key references: J. Choi: Adaptive and Iterative Signal Processing in Communications, Cambridge University Press, 2006; S. Haykin: Adaptive Filter Theory, 3rd ed. Prentice Hall, 1996; J. M. Mendel: Lessons in Digital Estimation Theory, 2nd ed., Prentice-Hall, 1995.
Assessment methods and criteria:
The course is passed with a final examination and the accepted simulation work report.

Grading:
The course unit utilizes a numerical grading scale 1–5. In the numerical scale zero stands for a fail.
The course unit utilizes a numerical grading scale 1–5. In the numerical scale zero stands for a fail.
Person responsible:
Markku Juntti
Working life cooperation:
-
Other information:
-

521325S: Communication Signal Processing II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes

Opintokohteen kielet: English

Leikkaavuudet:

521360S Synchronisation for Digital Receivers 4.0 op

521360S-01 Synchronization for Digital Receivers, exam 0.0 op

521360S-02 Exercise work, Communication Signal Processing II 0.0 op

ECTS Credits:
5
Language of instruction:
English
Timing:
Autumn, period I. It is recommended to complete the course during the second year of master studies.
Learning outcomes:
Upon completing the required coursework, the student is able to design and model communication receiver algorithms. He or she will be able to simulate the performance of a receiver modeling implementation imperfections, and use baseband design tools to implement a receiver algorithm. The student can make choice on the baseband tools for receiver implementation platforms.
Contents:
The structure of a communications transceiver, design and synthesis of synchronization algorithms, sampling rate conversion and filtering, I/Q imbalance, finite precision modeling of receive processing, implementation of receiver algorithms.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 16h, group project work 40h, and self-study.
Target group:
2nd year M.Sc. and WCE students.
Prerequisites and co-requisites:
Statistical signal processing, Digital Filters, Communications Signal Processing I, Wireless Communications I.
Recommended optional programme components:
Signal Processing Systems.
Recommended or required reading:
Lecture notes and material, other literature listed therein. Key references: H. Meyr, M. Moeneclaey & S. A. Fechtel, Digital Communication Receivers: Synchronization, Channel, Estimation and Signal Processing. John Wiley, 1998; R. Fasthuber, F. Catthoor, P. Raghavan & F. Naessens, Energy-Efficient Communication Processors, Springer, 2013.
Assessment methods and criteria:
The course is passed with a final examination and the accepted simulation work report.
Grading:
The course unit utilizes a numerical grading scale 1–5. In the numerical scale zero stands for a fail.
Read more about assessment criteria at the University of Oulu webpage.
Person responsible:
Markku Juntti
Working life cooperation:
-
Other information:
-

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Maria Kangas, Savo Glisic

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall, period 2

Learning outcomes:
Upon completing the required coursework, the student is able to list and understand the functionalities of different layers of OSI and TCP/IP protocol models. The course gives the skills for the student to describe the basic structure of GSM, GPRS, EDGE, LTE, LTEA, IEEE802.xx systems and incoming 5G. The student is able to describe the basic protocol model of the UMTS and LTE/LTEA radio interface and radio access network. The student knows the basic properties of routing protocols in fixed, wireless and ad hoc networks. He will achieve skills to describe the main principles of mobility control, network security, cross-layer optimization. The course also gives the student the ability to explain the essential features of sensor networks.
Objective: The aim is to present the fundamentals of the structure, protocol and structure of digital data transmission networks. Technical implementation and application of the common data and local networks are also discussed.
Contents:
Communications architecture and protocols, adaptive network and transport layers, mobility management, cellular /multihop cellular networks, network security, network management, ad hoc and sensor networks, cross-layer optimization, complex networks, networks economics, examples of wireless communication networks.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30 h and the compulsory design work with a simulation program (15 h).
Target group:
1st year M.Sc. and WCE students
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Parts from: S. Glisic & B. Lorenzo: Wireless Networks: 4G Technologies (2nd ed.), 2009; S. Glisic: Advanced Wireless Communications: 4G Cognitive and Cooperative Technologies (2nd ed.), 2007.
Assessment methods and criteria:
The course is passed with a final examination and the accepted simulation work report. The final grade is based on examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5.
Person responsible:
Savo Glisic
Working life cooperation:
-
Other information:
-

521377S: Communications Networks II, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Maria Kangas, Savo Glisic

Opintokohteen kielet: English

ECTS Credits:
7
Language of instruction:
English
Timing:
Spring, periods 3-4
Learning outcomes:
Upon completing the required coursework, the student is able to construct simple theoretical queuing theory models and analyze the simulation results of these models. The student achieves skills to explain simple Markovian birth-death process and apply that model in queuing systems. The course gives skills for the student to describe functionalities of a communication network with game theoretic models. The student knows the decomposition methods of network utility function and is capable of using that knowledge for network optimization.

The aim is to help the student to understand the basic principles of networking by providing a balance between the description of existing networks and the development of analytical tools. The descriptive material is used to illustrate the underlying concepts, and the analytical material is used to generate a deeper and more precise understanding of the concepts. The course presents the basic principles of queuing theory giving mathematical tools to apply the theory to practical communication systems.

Contents:
Introduction to concepts in queuing theory, birth-death process, queuing systems and their measures of effectiveness, Little's result, blocking in queuing systems, open and closed (Jackson) queuing networks, advanced routing in data networks, multiple access techniques, network information theory, cognitive networks, network optimization theory, network stability theory, advanced spectra sharing schemes and networks microeconomics.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures 30 h, exercises 30 h and the compulsory design work with a simulation program (15 h).

Target group:
1 st year M.Sc. and WCE students.

Prerequisites and co-requisites:
Communication Networks I

Recommended optional programme components:
-

Recommended or required reading:
Parts from S. Glisic & B. Lorenzo: Wireless Networks: 4G Technologies, 2009, S. Glisic: Advanced Wireless Communications: 4G Cognitive and Cooperative Technologies, 2007.

Assessment methods and criteria:
The course is passed with a final examination and the accepted simulation work report. The final grade is based on examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course unit utilizes a numerical grading scale 1-5.

Person responsible:
Savo Glisic

Working life cooperation:
-

Other information:
-

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521140S	Computer Graphics	5.0 op

ECTS Credits:
7

Language of instruction:
In English.

Timing:
Spring, periods 4.

Learning outcomes:
Upon completing the required coursework, the student is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clipping, and 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling. Moreover, he is able to explain the relationship between the 2D and 3D versions of such algorithms. He also has the necessary basic skills to use these basic algorithms available in OpenGL.

Contents:

The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (OpenGL) for implementation.
Mode of delivery:
Face to face teaching.
Learning activities and teaching methods:
Lectures: 40 hours, self-study: 50 hours. Student independently solves programming assignments: 100 hours
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
Programming skills using C++; basic data structures; simple linear algebra.
Additionally recommended prerequisite is the completion of the following course prior to enrolling for course unit: 521267A Computer Engineering.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
1) Textbook: Edward Angel: Interactive Computer Graphics, 5th, Addison-Wesley 2008
2) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
3) Lecture notes (in English)
4) Materials in the internet (e.g. OpenGL redbook)

- OpenGL Programming Guide or 'The Red Book':

http://unreal.srk.fer.hr/theredbook/

- OpenGL Video Tutorial:

http://www.videotutorialsrock.com/opengl_tutorial/what_is_opengl/text.php

Assessment methods and criteria:
The assessment of the course is based on the exam (50%) and returned course work (50%).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5, zero stands for fail.
Person responsible:
Guoying Zhao, Jie Chen, Jukka Holappa
Working life cooperation:
No

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

Leikkaavuudet:

521266S-01	Distributed Systems, Exam	0.0 op
521266S-02	Distributed Systems, Exercise Work	0.0 op
521266S	Distributed Systems	6.0 op

ECTS Credits:
5
Language of instruction:
In English.
Timing:
Spring, period 3.
Learning outcomes:
Upon completing the course the student is able to explain the key principles of distributed systems, apply them in evaluating the major design paradigms used in implementing distributed systems, solve distributed systems related problems, and design and implement a small distributed system.
Contents:

Architectures, processes, com-munication, naming, synchronization, consistency and replication, fault tolerance, security, distributed object-based systems, distributed file systems, distributed web-based systems, distributed coordination-based systems.

Mode of delivery:
Face-to-face.

Learning activities and teaching methods:
Lectures 30 h, exercises 26 h, project work 50 h, self-study 54 h. Project work is completed as group work.

Target group:
M.Sc. students (computer science and engineering) and other Students of the University of Oulu

Prerequisites and co-requisites:
None.

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:
Required literature: Andrew S. Tanenbaum and Maarten van Steen, Distributed Systems – Principles and Paradigms, Second Edition, Prentice Hall, 2007, ISBN 978-0132392273, 704 pages.

Assessment methods and criteria:

The course uses continuous assessment so that there are 3 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory project work.

Read more about assessment criteria at the University of Oulu webpage.

Grading:
Numerical scale 1-5; zero stands for a fail.

Person responsible:
Professor Timo Ojala

Working life cooperation:
None.

521172S: EMC Design, 4 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Myllylä, Hannu Sorvoja

Opintokohteen kielet: Finnish

Leikkaavuudet:

521115S EMC Design 5.0 op

ECTS Credits:
4

Language of instruction:
English.

Timing:
Period 6.

Learning outcomes:
After completing the course the student is able to name common EMC standards, and is able to use EMC testing equipment and methods. The student can explain the noise coupling mechanisms, and is able to use good design practices related to analogue and digital electronics design, grounding, cabling, filtering and shielding.

Contents:
EMC standards for emission and susceptibility, interference coupling, circuit design and grounding, connections, filtering, shielding, EMC testing laboratories, EMC tests and their background.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures 24h/Exercises 12h/Laboratory work 12h.

Target group:
-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the following courses prior to enrolling for the course unit: Electronics Design I, Digital Techniques I, Electronic Measurement Techniques, Measuring and Testing Systems, RF Components and Measurements.
Recommended optional programme components:
Electronics Design I, Digital Techniques I, Electronic Measurement Techniques, Measuring and Testing Systems, RF Components and Measurements.
Recommended or required reading:
Tim Williams: EMC for Product Designers, 4th edition, Oxford: Newnes, 2007. Lecture slides.
Assessment methods and criteria:
Final exam and passed laboratory work.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Igor Meglinski
Working life cooperation:
-
Other information:
-

521443S: Electronics Design II, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
In Finnish (In English if needed).
Timing:
Autumn, period 1
Learning outcomes:
On completion of the study module students should be able to explain the structures and operating principles of the passive and active (BJT and MOS) components available for use in modern IC technologies, analyze and design integrated electronic blocks based on these components, such as operational amplifiers, comparators and sampling circuits, and estimate and minimize the effects of noise on these. They should also be able to explain the terminology used with DA and AD conversion and converters and to analyze and outline their main architectural principles and also to evaluate their characteristics.

Contents:
Modeling of BJT and MOS transistors, CMOS and BJT building blocks especially as IC-realizations, noise and analysis of noise, internal structure of operational amplifiers, critical parameters, comparators, S/H-circuits, structures and properties of A/D and D/A converters.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Face-to-face teaching: Lectures 30h, exercises 20h. Self study: a small design work 20h. Learning without guidance either privately or in a group 60h.
Target group:
-
Prerequisites and co-requisites:
Principles of electronics design, Electronics design I
Recommended optional programme components:
-
Recommended or required reading:

Lecture notes, D. A. Johns & K. Martin: Analog integrated circuit design, Wiley & Sons 1997, chapters 1, 3, 4, 5, 7, chapter 8 partially, 11, 12 and 13. OR P. E. Allen &D. R. Holberg: CMOS Analog Circuit Design, Oxford University Press 2002, chapters 1, 3, 4, 5, 6, 8 and 10.

Assessment methods and criteria:
The course unit is passed by a final exam and a passed design work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course unit utilizes a numerical grading scale 1-5.

Person responsible:
Juha Häkkinen

Working life cooperation:
-

Other information:
-

521321S: Elements of Information Theory and Coding, 5 op

Voimassaolo: 14.11.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Kokkonen, Juntti, Markku Johannes

Opintokohteen kielet: English

Leikkaavuudet:

521323S	Wireless Communications 2	5.0 op

ECTS Credits:
5

Language of instruction:
In English.

Timing:
Fall, period 2

Learning outcomes:
Upon completing the required coursework, the student is able to use the basic methodology of information theory to calculate the capacity bounds of communication and data compression systems. He can estimate the feasibility of given design tasks before the execution of the detailed design. What is more, she can independently search for information and knowledge related to communication engineering, system design and signal processing. The student understands the operating principles of block codes, cyclic codes and convolutional codes. He can form an encoder and decoder for common binary block codes, and is capable of using tables of the codes and shift register when solving problems. She can represent the operating idea of a convolutional encoder as a state machine, the student is able to apply the Viterbi algorithm to decoding of convolutional codes, and is capable of specifying principles of turbo coding and coded modulation. Moreover, he can evaluate error probability of codes and knows practical solutions of codes by name.
The Objective of the course is to learn the information theory as a discipline and its most important applications in information technology in general and in communications engineering in particular as well as the basics of forward error control coding.

Contents:
Entropy, mutual information, data compression, basics of source coding, discrete channels and their capacity, the Gaussian channel and its capacity, rate distortion theory, introduction to network information theory, block codes, cyclic codes, burst error correcting codes, error correcting capability of block codes, convolutional codes, Viterbi algorithm, concatenated codes, and introduction to turbo coding and to coded modulation.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Face-to-face teaching (lectures and exercises) 64 h and group working.

Target group:
1 st year M.Sc. and WCE students

Prerequisites and co-requisites:
Signal Analysis, Telecommunication Engineering

Recommended optional programme components:

Wireless Communications I

Recommended or required reading:
Parts from books Thomas M. Cover & Joy A. Thomas: Elements of Information Theory, 2nd ed. John Wiley & Sons, 2006 ISBN-13 978-0-471-24195-9, ISBN-10 0-471-24195-4, and S. Benedetto and E. Biglieri: Principles of Digital Transmission with Wireless Applications, 1999, Chapters 3, 10 and in part 11 and 12. Lecture notes and other literature.
Assessment methods and criteria:
The course is passed with weekly exams (only during lecture periods) or with final exam.
Grading:
The course unit utilizes a numerical grading scale 1-5.
Read more about assessment criteria at the University of Oulu webpage.
Person responsible:
Markku Juntti / Timo Kokkonen
Working life cooperation:
-
Other information:
-

521145A: Human-Computer Interaction, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
In English.
Timing:
Autumn, periods 2
Learning outcomes:
Upon completing the course the student is able to explain the Human Computer Interaction (HCI) fundamentals, explain evaluation and prototyping techniques, explain how HCI can be incorporated in the software development process.
Contents:
Human and computer fundamentals, design and prototyping, evaluation techniques, data collection and analysis.
Mode of delivery:
Face to face teaching.
Learning activities and teaching methods:
Lectures (20 h), exercises (20 h), and practical work (95 h). The course is passed with an approved practical work. The implementation is fully English.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
None. No prior courses are required.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
The assessment is project-based. Students have to complete three group-based activities throughout the semester: design & prototyping (40%), conduct an evaluation (40%), and complete a report of the activities (20%). Passing criteria: all 3 elements (designs, evaluation, report) must be completed, each receiving more than 50% of the available points.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Vassilis Kostakos

Working life cooperation:
-

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Ruotsalainen Keijo
Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall semester, periods 1-2
Learning outcomes:
After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.
Contents:
Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 40 h / Group work 20 h.
Target group:
Students in Wireless Communication Engineering
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra
Recommended optional programme components:
-
Recommended or required reading:
P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming
Assessment methods and criteria:
Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5.
Person responsible:
Keijo Ruotsalainen
Working life cooperation:
-
Other information:
-

521289S: Machine Learning, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapio Seppänen
Opintokohteen kielet: Finnish
Leikkaavuudet:

521497S-01	Pattern Recognition and Neural Networks, Exam	0.0 op

521497S-02 Pattern Recognition and Neural Networks; Exercise Work 0.0 op

521497S Pattern Recognition and Neural Networks 5.0 op

ECTS Credits:
5
Language of instruction:
English. Examination can be taken in English or Finnish.
Timing:
The course unit is held in the spring semester, during period III. It is recommended to complete the course at the end of studies.
Learning outcomes:
After completing the course the student can design simple optimal classifiers from the basic theory and assess their performance. The student can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers. The student can apply the basics of gradient search method to design a linear discriminant function. The student can apply regression techniques to practical machine learning problems.
Contents:
Introduction. Bayesian decision theory. Discriminant functions. Parametric and non-parametric classification. Feature extraction. Classifier design. Example classifiers. Statistical regression methods.
Mode of delivery:
Face-to-face teaching and guided laboratory work.
Learning activities and teaching methods:
Lectures 10h, Laboratory work 20h, Self-study 20h, Independent task assignment, written examination.
Target group:
Computer Science and Engineering students and other students of the University of Oulu who are interested in data analysis technology.
Prerequisites and co-requisites:
The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Duda RO, Hart PE, Stork DG, Pattern classification, John Wiley & Sons Inc., 2nd edition, 2001. Handouts.
Assessment methods and criteria:
Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The independent task assignment is graded. The course ends with a written exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. The final grade is established by weighing the written exam by 2/3 and the task assignment by 1/3.
Person responsible:
Tapio Seppänen
Working life cooperation:
No

521110S: Measuring and Testing Systems, 6 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tuomas Happonen, Juha Saarela

Opintokohteen kielet: Finnish

Leikkaavuudet:

521096S Measurement Systems 5.0 op

Language of instruction:
Finnish. In English if there are more than 2 foreign students in the class.
Timing:
Period 4.

Learning outcomes:
The goal of this course is to teach measurement and testing systems generally. Constructions, connections, software, data acquisition as well as widely used interfaces are included in this course. Also methods to analyze measured signals especially to take care of eliminating disturbances are considered.
Learning outcomes: After completing the course the student is able to explain the principles of measuring and testing systems, and is able to compare the properties and performance of different communication techniques used in measurement systems. The student is able to design an application which controls a measurement system and stores the measurement data. Additionally, the student is able to realize essential multisensor systems and large systems which utilize data networks, and can give examples of practical measurement systems found in the industry and in medicine.
Contents:
Basics of measurement and testing systems, data transmission in measurement systems, software and data acquisition, design of measurement system, examples of measurement systems in industry and medicine, wide measurement systems using data networks, test system applications.
Learning activities and teaching methods:
Lectures and laboratory exercises. Final exam and passed laboratory exercises.
Recommended optional programme components:
Electronic Measurement Techniques .
Recommended or required reading:
Handout. Lab-View material

521074S: Microelectronics and Micromechanics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Krisztian Kordas

Opintokohteen kielet: English

Leikkaavuudet:

521224S	Microelectronics and Micromechanics	6.0 op
521224S-01	Microelectronics and Micromechanaics, exam	0.0 op
521224S-02	Microelectronics and Micromechanics, exercise	0.0 op

ECTS Credits:
5
Language of instruction:
English
Timing:
3rd period
Learning outcomes:
Objective: The course provides advanced knowledge on the semiconductor techniques of VLSI and on special topics of micromechanics and hybrid fabrication. Especially recent progress on the field is introduced in application point of view.
Learning outcomes: After completing the course the student can give account on correlations between basic physics/chemistry and materials processing/technology in microelectronics, micromechanics and nanotechnology. The student can describe design aspects and operation principles of micro and nano-devices. The students get acquainted with working in laboratory environment similar to those in academic and industrial research labs. Laboratory work practice on either (i) thin film fabrication in clean room, (ii) inkjet printing and electrical characterization of thin film devices with nanopartciles or (iii) synthesis of carbon nanotubes and characterization by electron microscopy techniques will provide a good opportunity also to learn how to design and run experiments safely and manage laboratory reports.
Contents:
Theory and practice of VLSI semiconductor fabrication technologies to support and deepen the understanding of general fabrication and operation principles introduced during previous courses. The state-of-the-art semiconductor devices and circuits: pushing the limits of dimensions and speed. Implementation of VLSI technologies in fabrication of components for micromechanics. Sensors (flow, pressure) and actuators (valves, pumps, motors, switches and components for micro-optics) using MEMSs. Devices on the nanoscale and integration of nanomaterials in microsystems: new concepts of design, fabrication and operation.

Mode of delivery:
Lectures, laboratory exercise with supervision and guidance.
Learning activities and teaching methods:
Though the course is primarily based on lectures, the communication channel is open in both directions enabling continuous comments, questions and feedback from the students. Critical explanations and think alouds are also applied to motivate thinking and active learning.
Target group:
-
Prerequisites and co-requisites:
Passing the basic course “521070A Introduction to microfabrication techniques” before the advanced course is recommended.
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes and references therein.
Assessment methods and criteria:
Examination and completion of both laboratory exercise and report.
Grading:
Numerical grading 1-5.
Person responsible:
Krisztian Kordas
Working life cooperation:
-

521173S: Mixed-signal Testing, 4 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Kinnunen

Opintokohteen kielet: Finnish

ECTS Credits:
4
Language of instruction:
Finnish. English, if there are more than 2 foreign students.
Timing:
Period 5
Learning outcomes:
After completing the course the student can compare different testing techniques of analogue and digital electronics, which have been implemented using either embedded testing methods or external automatic testing equipment. Additionally, the student is able to analyze tests made using an automatic test instrument, compare different test interfaces and data busses, and use principles of design of a high-quality printed test circuit board.
Contents:
Design for testability, DC- and parametric measurements, dynamic tests, constructions of testers, test signal generation and measurement, mixed-signal test buses, converter tests, data analysis, diagnostics, DSP-based tests, embedded testing.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24h/Exercises 12h, independent work 75h.
Target group:
Course is compulsory to elecrical engineering students in measuring and testing techniques module.
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the following courses prior to enrolling for the course unit: Electronics Design I, Measuring and Testing systems
Recommended optional programme components:
-
Recommended or required reading:
M. Burns, G. W. Roberts: An Introduction to Mixed-Signal IC Test and Measurement. Lecture slides.

Assessment methods and criteria:
Final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Matti Kinnunen
Working life cooperation:
-
Other information:
-

521147S: Mobile and Social Computing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Denzil Teixeira Ferreira

Opintokohteen kielet: Finnish

Leikkaavuudet:

521046A	Mobile Computing	5.0 op
521045S	Mobile Computing	5.0 op

ECTS Credits:
5
Language of instruction:
In English.
Timing:
Spring, periods 3-4
Learning outcomes:
Upon completing the course the student is able to implement mobile user interfaces, implement online social network applications, explain the fundamental concepts of context awareness and online communities.
Contents:
Mobile interface design and implementation, mobile sensor acquisition, context awareness, social platforms, crowdsourcing, online communities, graph theory.
Mode of delivery:
Face to face teaching.
Learning activities and teaching methods:
Lectures, exercises, and practical work. The course is passed with an approved practical work. The implementation is fully English.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
No prior courses are required.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
The assessment is project-based. Students have to complete an individual project throughout the semester: either build a mobile application, or conduct analysis of a provided dataset. Passing criteria: the project must be must be completed, receiving more than 50% of the available points.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Vassilis Kostakos
Denzil Ferreira
Working life cooperation:

None.

521318S: Modern Topics in Telecommunications and Radio Engineering, 3 - 7 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Petri Luoto, Matti Latva-aho
Opintokohteen kielet: English
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
3-7
Language of instruction:
English
Timing:
Fall&Spring, periods 1-4
Learning outcomes:
After completing the course the student understand and is able to analyze basic principles of the topic which has been presented in the course. The final outcomes will be defined based on the contents.
Objective: Depending on each year's topic, the course gives either an overview or deepens knowledge of actual topics and applications on radio techniques and telecommunications. The course comprises varying topical subjects, applications, research areas. Depending on the subject, the course may comprise a seminar of essays that practices a student for spontaneously acquiring information, improves readiness for making a master's thesis and readiness for performing in front of an audience.
Contents:
Varies yearly based on actual topics in telecommunications and radio engineering.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and/or exercises and/or design exercise and/or seminars depending on the topic of the year. The start and implementation of the course will be informed separately. The course can be given several times with different contents during the academic year and it can be included into the degree several times.
Target group:
1 st and 2 nd year M.Sc. and WCE students.
Prerequisites and co-requisites:
Will be defined based on the contents.
Recommended optional programme components:
-
Recommended or required reading:
Will be defined in the beginning of the course.
Assessment methods and criteria:
Depends on the working methods.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5.
Person responsible:
Matti Latva-aho
Working life cooperation:
-
Other information:

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

521280S DSP Laboratory Work 5.0 op

ECTS Credits:
5
Language of instruction:
English
Timing:
Periods 3-4
Learning outcomes:
The course concentrates on implementing basic algorithms and functions of digital signal processing using heterogeneous computing platforms.
After the course the student is able to use integrated design environments and OpenCL framework for designing, implementing and testing signal processing algorithms.
Contents:
Algorithm design, GPGPU, heterogeneous computing, OpenCL coding and optimization
Mode of delivery:
Starting lecture and independent exercises.
Learning activities and teaching methods:
The course is based on a starting lecture and exercises. The exercises are performed using desktop and mobile platforms featuring different type of accelerators, and the respective software development tools. The course is passed by accepted and documented exercises.
Target group:
Students interested in signal processing, processor architectures, embedded systems programming.
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
Digital filters, computer engineering, programming skills.
Recommended optional programme components:
Signal processing systems
Recommended or required reading:
Exercise instruction booklet, processor handbooks and development environment handbooks. All material is in English.
Assessment methods and criteria:
The exercises will be passed or failed according to the functionality and overall quality.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Teemu Nyländen
Working life cooperation:
-

521089S: Printed Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Fabritius

Opintokohteen kielet: Finnish

Leikkaavuudet:

521217S Printed Electronics 4.0 op

521095S Advanced Course of Printed Electronics 3.0 op

ECTS Credits:
5
Language of instruction:

Finnish. English if more than two international students in the course.
Timing:
Period 2.
Learning outcomes:
After passing this course, student knows the most common materials and deposition methods utilized in printed electronics fabrication. He/she understands the operational principles of those materials and methods. Can utilize his/her the material and deposition method knowledge to design a fabrication processes for electrical components and is capable to analyze and compare their effects on the performance of components.
Contents:
Materials (conductive and semi-conductive polymers, photoactive polymers, dielectrics, particle based inks) and processing methods (screen printing, gravure printing, flexo printing, inkjet) utilized in printed electronics, surface wetting and film formation, printed electrical components (passive components, solar cells, light emitting diodes, transistors) and their fabrication. Possibilities and challenges of printing based processing methods and how to take them into account in the printed electronics fabrication.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lecture 24 h, supervised exercises 6 h and self-study 100 h.
Target group:
Course is mandatory in some advanced studies of module of electrical engineering
Prerequisites and co-requisites:
None.
Recommended optional programme components:
The course replaces previous courses with same name, but different credits and code.
Recommended or required reading:
D.R. Gamota, P. Brazis, K. Kalyanasundaram and J. Zhang, "Printed organic and molecular electronics", handout
Assessment methods and criteria:
exam and accepted exercise (e.g. seminar presentation)
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:
Tapio Fabritius
Working life cooperation:
No.
Other information:
-

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara, Mika Rautiainen

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

ECTS Credits:
5
Language of instruction:
In English.
Timing:
Spring, periods 3-4.
Learning outcomes:
Objective: The objective of the course is to supply the student with basic understanding of RESTful Web Services and related technologies.

Learning outcomes: Upon completing the required coursework, the student is able to design and implement different components of a RESTful Web Service including the Web client. The student becomes familiar with basic technologies to store data on the server, serialize data in the Web and to create Web based clients.
Contents:
RESTful Web APIs, hypermedia, transactional/non-transactional databases , RESTful clients (HTML5 and Javascript).
Mode of delivery:
Web-based teaching and face-to-face teaching.
Learning activities and teaching methods:
Lectures 4 h, guided laboratory work 10 h, the rest as self-study and group work. Each group implements programs and writes a report.
Target group:
M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is space in the classes.
Prerequisites and co-requisites:
Elementary programming.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Will be announced at the first lecture.
Assessment methods and criteria:
This course unit utilizes continuous assessment. The students return each chapter of the project report separately and get from the teachers feedback to each chapter.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Mika Rautiainen
Working life cooperation:
None.
Other information:
This course replaces the course “521260S Representing structured information”.

521225S: RF Components and Measurements, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Kinnunen, Jari Hannu

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
Finnish. English, if there are at least 3 international students in class.
Timing:
4th period.
Learning outcomes:
Objective: The course covers common passive components and their measurement techniques used at RF and microwave frequencies. The course provides ability to know components selection principles and ability to conduct measurements related to electromagnetic fields and high frequency circuits.
Learning outcomes: After completing the course the student has knowledge of the behavior of passive components at RF frequencies, knows the fabrication methods of components and is also able to apply the knowledge to practical applications. The student also knows the operating principles of transfer lines, antennas and filters and of their design. The student can apply the fundamentals of RF and microwave techniques to measurements, is able to make the measurements of RF components, has knowledge of the operating principles of RF region measurement equipment and is able to compare the usability of different measurement techniques in different measurement situations. In addition the student knows how to perform typical measurements of RF region magnitudes (power, frequency, impedance and noise).
Contents:

Fundamentals of RF and microwave techniques, components in microwave circuits, measurement instruments, measuring of power, frequency, impedance and noise, time-domain and active circuit measurements.
Mode of delivery:
Face-to-face teaching, independent design exercises and laboratory exercises.
Learning activities and teaching methods:
Lectures 24h/ laboratory exercises 12h/design exercises 12h.
Target group:
Masters students on electrical engineering
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the following courses prior to enrolling for the course unit: Electronic Components and Materials, Electronic Measurement Techniques, Basics of Radio Engineering.
Recommended optional programme components:
-
Recommended or required reading:
Handout, Lecture notes. A. Lehto, A. Räisänen: Mikroaaltomittaustekniikka (in Finnish), I. Bahl: Luped Elements for RF and Microwave circuits, R. Ludvig, P.Bretchko: RF circuit Desing: Theory ans Applications, Prentice Hall 2000 and literature announced at the beginning of the lectures.
Assessment methods and criteria:
Final exam, design exercises and laboratory exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5.
Person responsible:
Jari Hannu
Working life cooperation:
No.

521326S: Radio Engineering 1, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Risto Vuohtoniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521326S-01	Radio Engineering	0.0 op
521335S	Radio Engineering	6.0 op
521335S-01	Exam, Radio engineering 1	0.0 op
521335S-02	Radio engineering, partial credit	0.0 op

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall, period 1
Learning outcomes:
After completing the course the student recognizes different kind of impedance matching methods and can design the impedance matching network using lumped components and microstrip lines. She/he can also explain factors, which are limiting the bandwidth of impedance matching networks. The student can design the impedance matching for a low noise amplifier. In the impedance matching the noise figure is minimized or the gain is maximized. The impedance matching can also be made for the constant gain. The student can explain the principle of a single ended, balanced and double balanced mixer and the advantages and the disadvantages of these mixers. She/he can design a power divider and a directional coupler. The student can also explain the principle of an automatic gain control (AGC). The student can classify power amplifiers and can in the basic case design the matching network for a power amplifier.
After having passed the course the student is familiar with the basic theory and techniques of designing radio frequency circuits used in radio transceivers.

Contents:
Impedance matching using lumped components, microstrip matching networks, low noise amplifier (LNA) design, active and passive mixers, power dividers, directional couplers, automatic gain control (AGC), power amplifier design.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, exercises 16 h and the compulsory RF design work with ADS simulation software (20 h).
Target group:
1st year M.Sc. and WCE students
Prerequisites and co-requisites:
Basics of Radio Engineering
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes. Parts from D.M. Pozar: Microwave Engineering, 3rd edition, John Wiley & Sons, Inc., 2005. Also, additional material from other sources.
Assessment methods and criteria:
The course is passed with a final examination and the accepted simulation work report. In the final grade of the course, the weight for the examination is 0.75 and that for the simulation work 0.25.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5.
Person responsible:
Risto Vuohtoniemi
Working life cooperation:
-
Other information:
-

Compulsory

521326S-01: Exam, Radio engineering 1, 0 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Arvostelu: 1 - 5, pass, fail
Opettajat: Risto Vuohtoniemi
Opintokohteen kielet: Finnish
Leikkaavuudet:

521326S	Radio Engineering	5.0 op

Ei opintojaksokuvauksia.

521326S-02: Exercise work, Radio engineering 1, 0 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Arvostelu: 1 - 5, pass, fail
Opettajat: Risto Vuohtoniemi
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521327S: Radio Engineering II, 6 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Risto Vuohtoniemi

Opintokohteen kielet: English

Leikkaavuudet:

521375S Design of Tranceivers 5.0 op

521375S-01 Exam, Radio Engineering II 0.0 op

521375S-02 Design of tranceivers, partial credit 0.0 op

ECTS Credits:
6
Language of instruction:
English
Timing:
Spring, period 3
Learning outcomes:
After completing the course the student recognizes the blocks of a transceiver and can explain the operating principle of a transceiver. She/he can classify different architectures used in a single and a multi-antenna transceiver and understand the basis for them. The student can define parameters used in the transceiver system level design and can design a transceiver at the system level so that the requirements for the system are fulfilled. She/he can explain nonlinear distortion and can design the automatic gain control in the system level. The student can also explain factors, which are important for the selection of D/A- and A/D-converters and can derive various methods to create the in phase and the quadratute components of a received signal. The student can also explain the principles of frequency synthesis in a transceiver.
The aim is to understand the basic theory and techniques of a transceiver system level design. After passing the course the student knows, what should be taken into account when functional blocks of a transceiver are connected so that the performance requirements are achieved.
Contents:
Designing a transceiver at the system level, transceiver architectures, performance characteristics of transceivers, nonlinearities, factors which limit the performance of a transceiver, placement of the A/D-converter in a receiver, frequency synthesis, design and implementation examples.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h and the compulsory design exercise with ADS simulation software (40 h).
Target group:
1st year M.Sc. and WCE students
Prerequisites and co-requisites:
Radio Engineering I
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes. Parts from books: A. Luzatto, G. Shirazi: Wireless Transceiver Design, John Wiley & Sons Ltd, 2007 and Walter Tuttlebee: Software Defined Radio.Enabling Technologies, John Wiley & Sons Ltd, 2002. Also, additional material from other sources.
Assessment methods and criteria:
The course is passed with a final examination and the accepted simulation work report. In the final grade of the course, the weight for the examination is 0.75 and that for the simulation work 0.25.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5.
Person responsible:
Risto Vuohtoniemi
Working life cooperation:
-
Other information:
-

521149S: Special Course in Information Technology, 5 - 8 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Ojala, Timo Kullervo
Opintokohteen kielet: English
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5-8
Language of instruction:
English; Finnish when only Finnish-speaking students.
Timing:
Autumn and Spring, periods 1-4.
Learning outcomes:
The learning outcomes are defined based on the course topic.
Contents:
Varies yearly.
Mode of delivery:
Face-to-face teaching, also web-based teaching can be used.
Learning activities and teaching methods:
Lectures, exercises, design exercise, project work and seminars depending on the topic of the year. The implementation of the course will be informed separately. The course can be given several times with different contents during the academic year and it can be included into the degree several times.
Target group:
M.Sc. level students of Computer Science and Engineering; other students are accepted if there is space in the classes.
Prerequisites and co-requisites:
Will be defined based on the contents.
Recommended optional programme components:
No.
Recommended or required reading:
Will be announced at the first lecture
Assessment methods and criteria:
Depends on the working methods.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
CSE dept. professors
Working life cooperation:
-

521322S: Telecommunication Engineering Project, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Antti-Heikki Tölli, Markus Berg
Opintokohteen kielet: Finnish
Leikkaavuudet:

521387S Telecommunication Engineering Project 4.0 op

ECTS Credits:
5
Language of instruction:
Finnish/English

Timing:
Fall&spring, periods 1-4
Learning outcomes:
After completing the course student can - depending on the work subject - either solve, design, construct, measure, simulate, test or analyze limited telecommunication and radio system and sub-system problems. Thus student applies the technical knowledge acquired from advanced sources into practical engineering tasks. In addition, student can document technical and scientific results.
Contents:
Varies depending on the topic.
Learning activities and teaching methods:
The design exercise is done in a group of one or two students depending of work's difficulty. The design exercise can be simulation or implementation work. The work can be defined by the Department of Communications Engineering or by industry. In the later case a proposal must be submitted to the teacher before beginning of the work. Also, student must meet the schedule and deadlines given by a supervisor before starting the work. In preparing the work report document the writing instructions of DCE department's diploma thesis must be followed.
Target group:
1st or 2nd year M.Sc. and WCE students
Prerequisites and co-requisites:
Depending on the subject: advanced courses dealing with telecommunication systems, digital communications, digital signal processing or/and radio engineering.
Recommended optional programme components:
-
Recommended or required reading:
Varies depending on the topic.
Assessment methods and criteria:
The written report is graded on scale 1-5.
Person responsible:
Markus Berg / Antti Tölli
Working life cooperation:
-

521148S: Ubiquitous Computing Fundamentals, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannu Kukka

Opintokohteen kielet: Finnish

Language of instruction:
In English.
Timing:
Autumn, periods 1-2.
Learning outcomes:
Upon completing the course the student is able to apply the knowledge and methods provided in the course in the design, implementation and evaluation of ubiquitous computing systems.
Contents:
Ubiquitous computing systems, privacy, field studies, ethnography, interfaces, location, context-aware computing, processing sequential sensor data.
Mode of delivery:
Face-to-face.
Learning activities and teaching methods:
Lectures 18 h, exercises 18 h, project work 50 h, self-study 47 h. Exercises and project work are completed as group work.
Target group:
M.Sc. students (computer science and engineering) and other Students of the University of Oulu.
Prerequisites and co-requisites:
None.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:
Required literature: John Krumm (editor) Ubiquitous Computing Fundamentals, Chapman & Hall, 2010, ISBN 978-1-4200-9360-5, 328 pages; selected scientific publications.
Assessment methods and criteria:
The course is passed with an approved project work.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical scale 1-5; zero stands for a fail.
Person responsible:
Researcher Hannu Kukka.
Working life cooperation:
None.

521323S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S-01	Wireless Communications I, Exam	0.0 op
521395S	Wireless Communications I	5.0 op
521320S	Wireless Communications 2	8.0 op
521320S-01	Intermediate exam or final exam, Wireless Communications 2	0.0 op
521320S-02	Exercisework, Wireless Communications 2	0.0 op

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall, period 2
Learning outcomes:
After completing the course the student can analyze the performance of multilevel digital modulation methods in AWGN channel. She/he can explain the effect of fading channel on the performance of the modulation method and can analyze the performance. She/he recognizes the suitable diversity methods for fading channel and related combining methods. Student can define the basic carrier and symbol synchronization methods and is able to make the performance comparison of them. Student can explain design methods signals for band-limited channels and can classify different channel equalizers, and perform the performance analysis.
Objective: Understanding of the basic theory and the knowledge of different fields required in digital communication are deepened. Also, communication techniques in fading channels are discussed. An overview of wireless communication systems is given, and ability to design simple communication receivers is created.
Contents:
Digital modulation methods and their performance in AWGN-channel, radio channel models, performance of digital modulation in fading channel, diversity techniques, channel equalizers in wireless communication channel, carrier and symbol synchronization.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h, exercises 14 h and the compulsory design work with a simulation program (20 h)
Target group:
1st year M.Sc. and WCE students
Prerequisites and co-requisites:
Telecommunication Engineering, Broadband Communications Systems
Recommended optional programme components:
Recommended**:** Statistical Signal Processing
Recommended or required reading:

Parts of book: Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005. Parts of book: J. G. Proakis: Digital Communications, 4th ed, McGraw Hill, 2001.
Assessment methods and criteria:
The course is passed with final examination and accepted design exercise. Grade is based on exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5.
Person responsible:
Jari Iinatti
Working life cooperation:
-

Compulsory

521323S-01: Wireless Communications I, Exam, 0 op

Opiskelumuoto: Advanced Studies
Laji: Partial credit
Arvostelu: 1 - 5, pass, fail
Opettajat: Jari Iinatti
Opintokohteen kielet: English
Leikkaavuudet:

521395S Wireless Communications I 5.0 op

Ei opintojaksokuvauksia.

521323S-02: Wireless Communications I, Exercise, 0 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Arvostelu: 1 - 5, pass, fail
Opettajat: Jari Iinatti
Opintokohteen kielet: English
Leikkaavuudet:

521395S Wireless Communications I 5.0 op

Ei opintojaksokuvauksia.

521097S: Wireless Measurements, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Esko Alasaarela
Opintokohteen kielet: English
Leikkaavuudet:

521114S Wireless Measurements 4.0 op
521114S-01 Wireless Measurements, exam 0.0 op
521114S-02 Wireless Measurements, exercise work 0.0 op

ECTS Credits:
5
Language of instruction:
In Finnish or in English if two or more foreign students participate.

Timing:
Period 3.
Learning outcomes:
Upon completing the course, the student can apply wireless technologies in industrial, traffic, environmental and healthcare measurements. He/she can tell and argument the benefits and challenges of using wireless measurement solutions and is able to apply the most important standards in his/her engineering work. In addition, he/she can use a representing set of industrial and scientific applications of wireless measurements to develop his /her own solutions.
Contents:
Basics of wireless measurement technologies and standards, wireless sensors and sensor networks, wireless building and smart home applications, wireless measurement applications in traffic, wireless environmental measurements and wireless human health monitoring.

Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
28 h lectures and seminars. The course is lectured in one period. At the end of the period the students prepare presentations about contemporary themes selected by themselves or proposed by the teacher and give 15-20 minutes presentation to other students in the seminars.
Target group:
Last phase students.
Prerequisites and co-requisites:
Basics of measurement technology and Electronic measurement technology or equivalent basic knowledge.

Recommended optional programme components:
The course replaces previous courses with same name, but different credits and code.
Recommended or required reading:
Lecture notes (in English) prepared by the teacher and contemporary seminar presentations with their source material.
Assessment methods and criteria:
The course is passed with a written final exam (70 %) and a contemporary seminar (30 %).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5.
Person responsible:
Esko Alasaarela

Compulsory

521097S-02: Wireless Measurements, exercise work, 0 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Arvostelu: 1 - 5, pass, fail
Opettajat: Esko Alasaarela
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521097S-01: Wireless Measurements, exam, 0 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Arvostelu: 1 - 5, pass, fail
Opettajat: Esko Alasaarela
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.