Opasraportti

Courses in English for Exchange Students ITEE (2016 - 2017)

This Weboodi Course Catalogue lists courses taught in English (sometimes courses are in mainly Finnish but there is English way to take the course) for exchange students during the academic year 2016-2017 at the Faculty of Information Technology and Electrical Engineering (ITEE)

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

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

Faculty 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 ITEE studies should be addressed to:

international.itee@oulu.fi:

Maritta Juvani

Juha Iisakka

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

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

521281S: Application Specific Signal Processors, 5 op
811395A: Basics of Databases, 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
813316A: Business Process Modeling, 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
811312A: Data Structures and Algorithms, 5 op
521290S: Distributed Systems, 5 op
521115S: EMC Design, 5 op
521443S: Electronics Design II, 5 op
521321S: Elements of Information Theory and Coding, 5 op
815303A: Embedded Software Development Environments, 5 op
813626S: Emerging Technologies and Issues, 5 op
811600S: Emerging Trends in Software Engineering, 5 op
811601S: Emerging Trends in Software Testing, 5 op
812351A: Enterprise Systems, 5 op
812351A-02: Enterprise Systems, exam, 0 op
812351A-01: Enterprise Systems, exercise work, 0 op
521145A: Human-Computer Interaction, 5 op
812651S: ICT and Behaviour Change, 5 op
817604S: ICT and Organizational Change, 5 op
812349A: IT Infrastructure, 5 op
813623S: Information Security Policy and Management in Organisations, 5 op
813625S: Information Systems Theory, 5 op
812331A: Interaction Design, 5 op
031025A: Introduction to Optimization, 5 op
521289S: Machine Learning, 5 op
521096S: Measurement Systems, 5 op
521074S: Microelectronics and Micromechanics, 5 op
521385S: Mobile Telecommunication Systems, 5 op
521147S: Mobile and Social Computing, 5 op
521318S: Modern Topics in Telecommunications and Radio Engineering, 3 - 7 op
521288S: Multiprocessor Programming, 5 op
812342A: Object Oriented Analysis and Design, 5 op
815657S: Open Source Software Development, 5 op
811392A: Preparatory Course for MSc Studies, 5 op
521089S: Printed Electronics, 5 op
521260S: Programmable Web Project, 5 op
817609S: Project Seminar, 3 op
521225S: RF Components and Measurements, 5 op
521386S: Radio Channels, 5 op
521326S: Radio Engineering 1, 5 op
521327S: Radio Engineering II, 6 op
815305A: Real Time Distributed Software Development, 5 op
813621S: Research Methods, 5 op
817612S: Research and Development Project, 10 op
813620S: Software Business Management, 5 op
811346A: Software Engineering, 5 op
815662S: Software Engineering Management, Measurement and Improvement, 5 op
815663S: Software Engineering Research, 5 op
817614S: Software Factory Project, 10 op
815312A: Software Production and Maintenance, 5 op
815311A: Software Quality and Testing, 5 op
521149S: Special Course in Information Technology, 5 - 8 op
817603S: System Design Methods for Information Systems, 5 op
521322S: Telecommunication Engineering Project, 5 op

521098S: Testing techniques of Electronics, 5 op
521148S: Ubiquitous Computing Fundamentals, 5 op
812671S: Usability Testing, 5 op
811375A: User Interface Programming, 5 op
521323S: Wireless Communications I, 5 op
521317S: Wireless Communications II, 8 op
521097S: Wireless Measurements, 5 op
521097S-01: Wireless Measurements, exam, 0 op
521097S-02: Wireless Measurements, exercise work, 0 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Guoying Zhao
Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall, periods 1
Learning outcomes:
1. is able to explain the emotion theory and modeling

2. is able to implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities

3. is able to use the basic tools to synthesize facial expressions and speech

4. 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

Vastuuyksikkö: Electrical Engineering DP

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 ECTS credits / 135 hours of work
Language of instruction:
English
Timing:
Spring, period 4
Learning outcomes:
1. knows antenna terminology and understands the role of antennas as a part of different radio systems.

2. is familiar with the theories explaining the electromagnetic radiation of usual antenna types and antenna arrays.

3. will be able to design wire antennas, micro strip antennas and antenna arrays for different radio systems.

4. will be able to design and analyze various antenna types and arrays using 3D electromagnetic simulation software.
Contents:
Introduction to different antenna types. Fundamental parameters of antennas. Antennas as a part of a radio system. Radiation of an antenna from the Maxwell's equations. Typical linear wire antennas. Loop antennas. Microstrip antennas. Antenna arrays. Antennas for wireless devices. Antenna - human body interaction. Base station antennas. 3D electromagnetic simulation.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and exercises 40 h / Compulsory antenna design work with an electromagnetic simulation 25 h / Self-study 70 h
Target group:
1st or 2nd year M.Sc. and WCE students
Prerequisites and co-requisites:

The required prerequisite is the completion of the following courses prior to enrolling for the course: Basics of Radio Engineering 521384A

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:
Recommended literature: 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 0.5 and that for the design work 0.5.
Read more about assessment criteria at the University of Oulu webpage.

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

Person responsible:
Markus Berg

Working life cooperation:
No

Other information:
Course will be given every second year in even years. Will be held next time in the spring of 2018.

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

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:
1. Can distinguish the main types of signal processors

2. Can design basic customized transport triggered architecture processors

3. Is capable of assembling a signal processor out of basic entities

4. Can match the processor performance and the application requirements

5. 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 processing.

Prerequisites and co-requisites:
521267A Computer Engineering or 521286A Computer Systems (8 ECTS cr) or 521287A Introduction to Computer Systems (5 ECTS cr) and 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.

811395A: Basics of Databases, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 133 hours of work.

Language of instruction:
Finnish. If at least four non-Finnish students take the course, an English exercise group will be organised.
Timing:
The course is held in the spring semester, during period 3. It is recommended to complete the course in the 1st spring semester.
Learning outcomes:
In addition, they have knowledge of modern non-relational database solutions (such as data warehouses and NoSQL-databases) and they have
commanding knowledge of making use of those non-relational databases (such as data mining and Big data techniques).
Contents:
Conceptual modelling (ER- and EER-diagrams), relational model (theory, databases, query techniques and normalization), transactions.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 45 h, compulsory exercises 24 h, reading 20 h, exams 21 h and self-studying 23 h.
Target group:
Bachelor students
Prerequisites and co-requisites:
The student knows basics of programming.
Recommended or required reading:
Silberschatz, Korth & Sudarshan: Database system concepts. Elmasri & Navathe: Fundamentald of database systems.
Assessment methods and criteria:
The course is divided to five parts. All parts must be passed in a year. Students must show they achieve at least half of required knowledge of each part.

Grading:
fail, 1-5
Person responsible:
Jua Iisakka

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Susanna Pirttikangas
Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
English
Timing:
Period IV. It is recommended that the course is taken on the fourth year Spring.
Learning outcomes:
1. Can explain the big data phenomena and the possibilities it has in data processing and exploitation

2. Can analyse concrete technologies for big data management and processing

3. Can explain the common solutions available for cloud services, and understand the benefits, risks and restrictions of them

4. 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

Working life cooperation:
Lecturers from industry.

521284S: Biomedical Engineering Project, 5 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapio Seppänen
Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English.
Timing:
As part of the master level studies, in any period suitable to the student.
Learning outcomes:
1. has develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation.
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 and the interests of student. 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 that are interested in biomedical engineering. 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. 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
Vastuuyksikkö: Electrical Engineering DP
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

Vastuuyksikkö: Computer Science and Engineering DP

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:
1. knows special characteristics of the biosignals and typical signal processing methods

2. can solve small-scale problems related to biosignal analysis

3. implement small-scale software for signal processing algorithms
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, at their master's level studies.
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", R.M Rangayyan, 2nd edition (2015). + Lecture slides + 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.
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

Vastuuyksikkö: Computer Science and Engineering DP

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:
Period 4
Learning outcomes:
1. knows the special characteristics of neural signals and the typical signal processing methods related to them

2. can solve advanced problems related to the neural signal analysis

Contents:
Introduction to neural signals, artifact removal, anesthesia and natural sleep, topographic analysis and source localization, epilepsy, evoked potentials.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures (8 h) and laboratory work (20 h), written exam.
Target group:
Engineering students, medical and wellness technology students, and other students interested in biomedical engineering. 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:
-
Recommended or required reading:
The course is based on selected parts from books "EEG Signal Processing", S. Sanei and J. A. Chambers, "Bioelectrical Signal Processing in Cardiac and Neurological Applications", L. Sörnmo and P. Laguna, and "Neural Engineering", B. He (ed.) as well as 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:
-

521316S: Broadband Communications Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

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:
1. Student can distinguish the basic transmission technologies used in the most important commercial wireless communication systems.

2. The student can differentiate and compare the key points behind these technologies, why they are used and what are their advantages and disadvantages.

3. Student can explain how the wireless channel impacts the design of the overall system.

4. The most relevant standards are introduced and explained, so that student can attain information from past and

especially the forthcoming wireless standards.

5. Observe and explain the performance of these technologies with variable system and channel parameters through the course laboratory exercise.

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 32h, exercises 14h and the compulsory design work with a simulation program (20h).
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:
-

813316A: Business Process Modeling, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.
Language of instruction:
English

Timing:
The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 2nd autumn semester.
Learning outcomes:
After completing the course, students are able to model and develop business processes, as well as use a computer-based process modeling tool. The students are able to distinguish between business process change on the enterprise level, business process level and the implementation level, and to and evaluate these business process changes.

Contents:
Process architecture and how it can be fitted to the organisation, process modelling, process performance measurement, understanding process-related problems, process development, software tools for modelling and analysing processes, exercises.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:

Lectures 26h (or exam), exercises 12h, individual assignments (lecture assignments, small process model, etc.) 25h, case study assignment (group
work) 30h, large process model (group work) 40h.
Target group:
BSc students.
Recommended optional programme components:
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Recommended or required reading:
Harmon, Paul (2007). Business Process Change. A Guide for Business Managers and BPM and Six Sigma Professionals. Morgan Kaufmann Publishers. Additional material to be announced during the course.
Assessment methods and criteria:
This course unit utilizes continuous assessment. Students can either participate in the lectures (min. 85% attendance required) or take the exam. All students will write lecture assigments, a case study report, and will create a process models with a software tool. The assessment of the course unit is based on the learning outcomes of the course unit.
Grading:
Numerical scale 1-5 or fail.

Person responsible:
Karin Väyrynen (on leave, substitute Jukka Kontula)
Working life cooperation:
No

521324S: Communication Signal Processing I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

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 3. It is recommended to complete the course during the first year of master studies.
Learning outcomes:
1. is able to use the methodology of statistical signal processing in the design communication transceivers.

2. will be able to design and simulate various receiver algorithms.

3. use linear algebra, estimation theory and optimization theory to solve algorithm design problems.

4. knows the pricinples of adaptive filtering and filter parameter selection.

5. can use Matlab to model and simulate receiver algorithms and linear algebraic operations.

6. can use Simulink for performance simulations.

7. understands the principles of receiver algorithm design based on statistial models and optimization theory.
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 and independent simulation project group work.
Learning activities and teaching methods:
Lectures 32h, exercises 14h, group project work 30h, 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.
Recommended optional programme components:
Supports learning in Wireless Communications II. It is recommended to take the courses in parallel.
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 simulation work 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:
Markku Juntti
Working life cooperation:
No

521325S: Communication Signal Processing II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

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:
1. is able to design and model communication receiver algorithms.

2. will be able to model and simulate the performance of a receiver modeling implementation imperfections.

3. knows how to design algorithms for fixed point and finite precision implementations.

4. can model and simulate a timely multiantenna receiver performance as an entity of several algorithms.

5. knows how to use baseband design tools to implement a receiver algorithm.

6. can model algorithms with c models and embed those in Matlab simulations.

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 and independent simulation and design project.
Learning activities and teaching methods:
Lectures 16h, group project work 50h, 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:
Comminications Signal Processing I, 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 simulation work 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:
Markku Juntti
Working life cooperation:
No

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivana Kovacevic, Savo Glisic

Opintokohteen kielet: English

ECTS Credits:
5 ECTS cr / 132,5 hours of work
Language of instruction:
English
Timing:
Fall, period 2
Learning outcomes:
1. 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

2. 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.

3. The student is able to describe the basic protocol model of the UMTS and LTE/LTEA radio interface and radio access network.

4. The student knows the basic properties of routing protocols in fixed, wireless and ad hoc networks.

5. He will achieve skills to describe the main principles of mobility control, network security, cross-layer optimization.

6. The course also gives the student the ability to explain the essential features of sensor networks.

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. The goal 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.
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:
The course is an independent entity and does not require additional studies carried out at the same time.
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 and Maria Kangas
Working life cooperation:
No

521377S: Communications Networks II, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Savo Glisic, Maria Kangas

Opintokohteen kielet: English

ECTS Credits:
7 ECTS cr / 158,5 hours of work
Language of instruction:
English
Timing:
Spring, periods 3-4
Learning outcomes:
1. Upon completing the required coursework, the student is able to construct simple theoretical queuing theory models and analyze the simulation results of these models.

2. The student achieves skills to explain simple Markovian birth-death process and apply that model in queuing systems.

3. The course gives skills for the student to describe functionalities of a communication network with game theoretic models.

4. The student knows the decomposition methods of network utility function and is capable of using that knowledge for network optimization.

5. 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

6. 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.

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. The course presents the basic principles of queuing theory giving mathematical tools to apply the theory to practical communication systems.

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

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 and Maria Kangas

Working life cooperation:
No

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

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:
1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clipping

2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling

3. is able to explain the relationship between the 2D and 3D versions of such algorithms

4. 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 30 h / Self-study and programming assignments 104 h
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 or 521286A Computer Systems or 521287A Introduction to Computer Systems.
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, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English) 5) 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

811312A: Data Structures and Algorithms, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ari Vesanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521144A	Algorithms and Data Structures	6.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work.

Language of instruction:
Finnish. One English exercise group will be arranged.
Timing:
The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 2nd study year.

Learning outcomes:
After completing the course, the student can describe the concept of algorithm and explain what correctness and time complexity of algorithms
mean. Furthermore, the student is able to explain the design paradigms presented in the course and to describe

the complexity classes of relevant sorting algorithms. The student can analyse simple algorithms, i.e. to prove their correctness and evaluate their time complexity. Moreover, the student is able to describe the basic data structures and apply essential graph algorithms. Finally, the student can construct suitable data structures and algorithms for given problems; the student can also justify the choice of a data structure or an algorithm for an application.

Contents:
The concept and analysis of algorithms, sorting and searching algorithms and their complexity, algorithm design paradigms, the concept of data
structure and basic data struc-tures, hash tables, binary search trees, graphs and their algorithms.

Mode of delivery:
Face-to-face teaching.

Learning activities and teaching methods:
Lectures 48h, exercises 21h, assignment (27), independent work 39h.

Target group:
BSc students.

Prerequisites and co-requisites:
Mastery of subject matter of the course “Discrete Structures” is required.

Recommended optional programme components:

Recommended or required reading:
Cormen, Leiserson, Rivest, Stein: Introduction to algorithms, 2nd edition, MIT Press 2001 (or later). From this edition chapters 1–4, 6–13, 15–16, 22–24, Appendix A and B are covered.

Assessment methods and criteria:
Exam and assignment. Exam will be graded 1-5 if accepted. Assignment graded accepted/failed. Final grade will be the same as exam's grade.

Grading:
Numerical scale 1-5 or fail.

Person responsible:
Ari Vesanen

Working life cooperation:
No

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

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:
1. is able to explain the key principles of distributed systems

2. apply the principles in evaluating the major design paradigms used in implementing distributed systems

3. solve distributed systems related problems

4. 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.

521115S: EMC Design, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannu Sorvoja

Opintokohteen kielet: Finnish

Leikkaavuudet:

521172S	EMC Design	4.0 op
521172S-02	EMC Design, Exercise work	0.0 op
521172S-01	EMC Design, Exam	0.0 op

ECTS Credits:
5

Language of instruction:
Finnish. English, if there are more than 2 foreign students.

Timing:
Period 4.

Learning outcomes:
1. is able to name common EMC standards

2. is able to use EMC testing equipment and methods

3. can explain the noise coupling mechanisms

4. is able to use good design practices related to analogue and digital electronics design

5. is able to use good design practices related to analogue and digital electronics grounding

6. is able to use good design practices related to analogue and digital electronics filtering

7. is able to use good design practices related to analogue and digital electronics 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:
The course includes 20 h lectures and calculation exercises, laboratory exercises 16h and 100 h self-studies.

Target group:
Primarily students studying electrical engineering. In addition, other students studying in the University of Oulu can carry out the course.
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:
The course replaces previous courses with same name, but different credits and code.

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 exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grade is based on exam and grade is on numerical scale 1-5.
Person responsible:
Hannu Sorvoja
Working life cooperation:
-

521443S: Electronics Design II, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

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:
1. 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
2. should be able to analyze and design integrated electronic blocks based on these components, such as operational amplifiers, comparators and sampling circuits
3. should be able to estimate and minimize the effects of noise in electrical circuits
4. should be able to explain the terminology used with DA and AD conversion and converters

5. should be able to analyze and outline the main architectural principles and also to evaluate the characteristics of DA and AD converters

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:
Students of Electrical engineering. Other students of the University of Oulu may also participate.

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:
-

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

Voimassaolo: 14.11.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

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:
English.

Timing:
Fall, period 2

Learning outcomes:
1. can use basic methodology of information theory to calculate the capacity bounds of communication and data compression systems.

2. can estimate the feasibility of given design tasks before the execution of the detailed design.

3. understands the operating principles of block codes, cyclic codes and convolutional codes.

4. 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.

5. can represent the operating idea of a convolutional encoder as a state machine.

6. is able to apply the Viterbi algorithm to decoding of convolutional codes.

7. is capable of specifying principles of turbo coding and coded modulation.

8. can evaluate error probability of codes and knows practical solutions of codes by name.

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 and the course support each other. Their simultaneous studying is recommended.
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 and possible additional course tasks defined in the beginning of the course.
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 / Timo Kokkonen
Working life cooperation:
No

815303A: Embedded Software Development Environments, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juustila, Antti Juhani

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work
Timing:
The course is held in the spring semester, during period 4. It is recommended to complete the course at the 1st spring semester.
Learning outcomes:
After completing the course, a student is able to work with the essential software development tools of a selected embedded platform. The student is able to implement memory and power efficient applications by exploiting existing libraries and knowledge of the programming interfaces provided by the platform.
Contents:
The focus of the course is in the software development environments and tools for mobile and embedded platforms, such as Android, iOS, and Windows Phone. In addition, the course covers memory and power management, core services of the platform, and the utilisation of existing libraries. One platform will be selected

for deeper study, and the course introduces its essential software development tools and libraries. The emphasis is on application development for the platform as an exercise.
Mode of delivery:
Blended teaching
Learning activities and teaching methods:
Lectures and exercises about 40 h, exercises and exercise work 93 h
Target group:
MSc students
Prerequisites and co-requisites:
Course “815309A Real-time Distributed Software Development”, C/C++ and/or Java programming skills or similar knowledge obtained from other courses.
Recommended or required reading:
Course material, the documentation of selected technologies, and other related literature
Assessment methods and criteria:
Exercise work
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Antti Juustila

813626S: Emerging Technologies and Issues, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Piiastiina Tikka

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.
Language of instruction:
English
Timing:
The course is held in the autumn semester, during period 1. It is a recommended to compelete the course at the 1st autumn semester.
Learning outcomes:
After completing the course, the student is able to **:**

- Analyse the on-going changes in online and consumer behaviour, customer requirements, ICT markets and technological development;
- Evaluate key enabling web technologies and become an effective participant in web-enabled business endeavours and initiatives;
- Design ways for leveraging information and communication technologies to improve intra- and inter-organisational processes and enhance a firm’s competitive position;
- Plan ways for searching innovations; and
- Develop his/her skills for building careers and taking advantage of entrepreneurial opportunities through emerging technologies, in particular related to the web.

Contents:
1. A shift in thinking about the web and emerging technologies
2. How to social web is transforming businesses, software design, our perception of people as well as skills required of us
3. How to accelerate innovation creation through web-based and other emerging technologies: Ecosystem thinking, strategies, core business values
4. Transformation of the social web into humanized web

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24h, exercises 8h, reflective personal exercises 19h, independent work and exam (required reading) 83h.

Target group:
MSc students
Prerequisites and co-requisites:
None
Recommended optional programme components:

Recommended or required reading:
Oinas-Kukkonen Harri & Oinas-Kukkonen Henry (2013) Humanizing the Web: Change and Social Innovation. Palmgrave Macmillan, Basingstoke, UK (required reading).

Assessment methods and criteria:
Exam.

Grading:
Numerical scale 1-5 or fail.
Person responsible:
Piiastiina Tikka
Working life cooperation:
No

811600S: Emerging Trends in Software Engineering, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Mäntylä

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits /133 hours of student work
Language of instruction:
English
Timing:
The course is held in the autumn semester, during period 1.
Learning outcomes:
After completing the course, a student understands the recent trends in software engineering. The student is able to argue and discuss the
significance of the trends to one's own work and to software engineering discipline in general. The student is able to perform trend mining to discover new trends.
Contents:
- Software engineering trends (varies yearly) -
Trend mining - Writing, arguing and discussing
about the trends
Mode of delivery:
Face-to-Face teaching.
Learning activities and teaching methods:
Lectures 24h, execercises 18h, essays 30h, project 30h, independent study 30h.
Target group:
MSc students
Prerequisites and co-requisites:
Basics on software engineering
Recommended optional programme components:
No
Recommended or required reading:
Articles + lectures.
Assessment methods and criteria:
Active lecture participation, exercises, assignments, essays.
Grading:
Numerical scale 1-5 or fail.

Person responsible:
Mika Mäntylä
Working life cooperation:
No

811601S: Emerging Trends in Software Testing, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Mäntylä

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.

Language of instruction:
English
Timing:
The course is held in the spring semester, during period 3.
Learning outcomes:
After completing the course, a student understands advanced software testing techniques, their benefits and limitations. The student is also able to
apply these techniques in practice to simple software testing problems with software test automation tools.
Contents:
Advanced testing techniques: Model-based testing, search-based testing, mutation, exploratory testing, combinatorial testing, static testing, static
analyzers, test environments, virtualization, OS system containers, test automation.
Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures 24h, execercises 18h, lecture questions 15h, lab reports 15h, project 30h.
Target group:
MSc students
Prerequisites and co-requisites:
Basics on software testing.
Recommended optional programme components:

Recommended or required reading:
Articles + lectures.
Assessment methods and criteria:
Active lecture participation, exercises, assignments, term project.
Grading:
Numerical scale 1-5 or fail
Person responsible:
Mika Mäntylä
Working life cooperation:
No

812351A: Enterprise Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Li Zhao

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.
Language of instruction:
English
Timing:
The course is held in the spring semester, during period 3. It is a recommended to compelete the course at the 1st autumn semester.

Learning outcomes:
After completing the course, the student understands Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Inventory
Management, CRM, Knowledge Management, Online Business systems, Marketing systems, etc., and also understands the intellectual capital and
organizational competitive advantage. The student should be able to describe how processes integrate the internal functions of the firm and allow the firm to interact with its environment, and be able to recognize, model, and improve processes to help the firm achieve efficiency and effectiveness.
Contents:
1. Principles of enterprise systems, and business
processes that integrate the internal functions of
the enterprise and connect the enterprise with its
business environment;
2. Manage enterprises' intellectual capital to achieve competitive
advantage;
3. Enterprise resource planning (ERP);
4. Supply chain management (SCM);
5. Global supply chain & inventory management systems
6. Knowledge management systems;
7. Customer relationship management (CRM);
8. Internet-based Business and Marketing Systems;
9. Enterprise application integration (EAI)
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 20h, exercises 18h, homework 25h, essays 35 h, examination 36h.
Target group:
MSc students
Prerequisites and co-requisites:
Understanding of the business process modeling helps.

Recommended optional programme components:

Recommended or required reading:
Refer to the course webpages
Assessment methods and criteria:
Exercises, assignments, essay, and examination.

Grading:
Numerical scale 1-5 or fail.
Person responsible:
Li Zhao
Working life cooperation:
No

812351A-02: Enterprise Systems, exam, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Partial credit
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Li Zhao
Opintokohteen kielet: English

Ei opintojaksokuvauksia.

812351A-01: Enterprise Systems, exercise work, 0 op

Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Ei opintojaksokuvauksia.

521145A: Human-Computer Interaction, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
In English.
Timing:
Autumn, periods 2
Learning outcomes:
1. Knowledge of the Human Computer Interaction (HCI) fundamentals

2. Knowledge of evaluation techniques

3. Knowledge of prototyping techniques

4. Knowledge of 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:
While no specific courses are not required, elementary programming and design skills are desired.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time. The course involves some basic programming.
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 4 individual exercises throughout the semester: 1: Using questionnaires; 2: Grouping & clustering; 3: Fitts' law; 4: Advanced evaluation & visualisations. Passing criteria: all 4 exercises 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:
Jorge Goncalves
Vassilis Kostakos
Working life cooperation:
-

812651S: ICT and Behaviour Change, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Piiastiina Tikka

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work

Language of instruction:
English
Timing:
The course is held in the autumn semester, during period 2.

Learning outcomes:
After successfully completing the course, a student will be able to analyze methods and techniques that are used in and for persuation; apply these methods in an ethical manner as design guidelines for developing applications that target change in human behaviour or attitudes.

Contents:
Attitudinal theories from social psychology have been quite extensively applied to the study of user intentions and behaviour. These theories have been developed mostly for predicting user acceptance of information technology rather than for providing systematic analysis and design methods for developing software solutions that aim at attitude or behaviour change. At the same time a growing number of information technology systems and services are being developed for these purposes. This course will focus on persuasive technology. It will address the process of designing and evaluating persuasive systems, the types of content and software functionality in such systems, the underlying assumptions behind these, methods for analysing the persuasion context, and principles for persuasive system design. Positive examples of
persuasive systems include motivating knowledge workers to do their work better or safer and embracing citizens for healthy living habits.
Negative examples are games that inflict addiction. Both sides of influence will be discussed.
Mode of delivery:
Blended teaching
Learning activities and teaching methods:
Lectures 24h, reflective personal exercises 30h, independent work 80h (of which reading for lectures 12h and assignments 68h).
Target group:
MSc students
Prerequisites and co-requisites:
Understanding the roles of humans as users and developers of ICT.
Recommended optional programme components:
Emerging Technologies and Issues
Recommended or required reading:

Research articles to be announced more specifcally during the course implementation.
Assessment methods and criteria:
Participation in lectures, personal reflection reports, course assignments.
Grading:
Numerical scale 1-5 or fail
Person responsible:
Piiastiina Tikka
Working life cooperation:
No

817604S: ICT and Organizational Change, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.
Language of instruction:
English
Timing:
The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course at the 2nd autumn semester.
Learning outcomes:
After completing the course the student is able to distinquish various roles of information and communication technology (ICT) in change of
organization and its context, and be able to analyze the role of ICT in relation with change taking place in an organization.
Contents:
The course studies organisations at four levels: individuals, practices, organizational structures and transformations, and the societal context of organisations. The organizational role of ICT and the relation between ICT and knowledge are also discussed. A method for analysing organisations as networks of activity systems is presented. The role of power, trust and control in the change process is discussed. The different aspects of change agents are presented and analysed.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Introductory lectures 20h, seminar sessions 14h, individual work 100h (for a review and analysis of selected course materials and making a presentation for the seminar).
Prerequisites and co-requisites:
Recommeded to take Emerging Technologies and Issues before this course.

Recommended optional programme components:

Recommended or required reading:
A list of research articles will be provided for the lectures and assignments. Readings for the background and theoretical framework are:
- Gareth R. Jones (2010) Organizational Theory, Design, and Change: Global Edition (6. Ed.) Chapters 1-3, 10-12, Prentice Hall.
- K. Kuutti (1996) Activity Theory as a potential framework for human-computer inter-action research, in Context and Consciousness: Activity Theory and Human Com-puter Interaction, B. Nardi, Editor. 1996, MIT Press: Cambridge. p. 17-44.
- Frank Blackler (1995) Knowledge, knowledge work and organizations: an overview and interpretation. Organization studies, 1995. Pp. 1021-1046
- Frank Blackler et al. (2000) Organizing Processes in Complex Activity Networks. Organization, vol. 7 no. 2. Pp. 277-300.

Assessment methods and criteria:

Lecture and seminar participation, assignment (literature review, analysis, seminar presentation). Alternatively by examination and personal assignment report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Minna Isomursu
Working life cooperation:
No

812349A: IT Infrastructure, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Aryan Firouzian, Petri Pulli

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work

Language of instruction:
English
Timing:
The course is held in the spring semester, during period 4. It is recommended to complete the course at the 1st spring semester.

Learning outcomes:
After completing the course, students are able to judge, compare and apply data communications concepts and computing solutions to various
situations encountered in industry; identify general concepts and techniques of data communications in different organizational environment; Explain core elements of IT infrastructure, principles underlying layered system architectures and the technology of the Internet; identify the most important server and storage architectures and the main mechanisms for providing high-capacity processing and storage capacity; Understand the principles of service virtualization, and concepts of IP networks and protocols; Explain structure of large-scale organizational IT infrastructure, and role of IT service management as organizational IT infrastructure solution; Understand opportunities for virtual computing service and configure IT infrastructure and security solution for small organization. The course aims to enable effective communication with technical, operational, managerial and service provider communities through improvement in technical knowledge and terminology. The course provides IT consultants with capabilities to make intelligent decisions regarding computing platform and service architectures by considering organizational flexibility.
Contents:
1. Introduction to IT Infrastructure 1.1. System Architecture & System Organizing Structure 1.2. Components of computer-based systems 1.3. Role of IT Infrastructure in a modern organization 2. Architecture, Technologies, Services and Standards in IT Infrastructure 2.1. Operating system 2.2. Networking 2.3. Data Centers 2.4. Securing IT Infrastructure 2.5. Grid computing 2.6. Cloud computing 3. Emerging Technologies and Trends 3.1. Internet of Things (IoT) 3.2. Augmented Reality/ Virtual Reality 3.3. Wearable Technologies.
Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures 28 h, Student project guidance sessions 6h, student project work 85 h and examination 16 h
Target group:
MSc students
Prerequisites and co-requisites:
Basic knowledge on computer, network and Internet architecture.
Recommended optional programme components:

Recommended or required reading:

Lecture notes, scientific articles.
Assessment methods and criteria:
Accepted project work and examination.
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Petri Pulli ja Aryan Firouzian
Working life cooperation:
No

813623S: Information Security Policy and Management in Organisations, 5 op

Voimassaolo: 01.08.1950 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Li Zhao

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.
Language of instruction:
English
Timing:
The course is held in the autumn semester, during period 2. It is recommended to complete the course at the 2nd autumn semester.

Learning outcomes:
After completing the course, the student is able to: • Develop BCP (Business Continuity Planning); • Develop organisation specific information security policies and sub-policy systems in organisations; • Improve employees' compliance with the information security procedures through training, campaigning and other measures; • Carry out risk management in practice; • Estimate the economical investment in information security; • Understand the strengths and weaknesses of information security management standards; • Understand the certifications in the area of information security management; • Understand the security risks related to cloud computing and Internet of Things; • Design information security policies at organisations.
Contents:
1. BCP;
2. Development of organisation specific information security policies and sub-policy systems at organisations;
3. Measuring employees' compliance with information security policies;
4. Improving employees' compliance with the information security procedures through training, campaigning and other means;
5. Information security risk management in practice, estimation of economical investment in information security;
6. Information security management standards;
7. Certifications related to information security.

Mode of delivery:
Face-to-face teaching
Target group:
MSc students
Prerequisites and co-requisites:
Bachelor degree or other equivalent degree and course "811168P Introduction to Information Security" or principles of information security, or similar knowledge obtained from other courses.
Recommended optional programme components:

Recommended or required reading:
Raggad, Bel G.: Information security management, Concepts and practice, CRC Press 2010, Chapters 1, 2.7. – 2.13, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, and 15
Assessment methods and criteria:
Examination.
Grading:
Numerical scale 1-5 or fail.

Person responsible:
Li Zhao
Working life cooperation:
No

813625S: Information Systems Theory, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.
Language of instruction:
English
Timing:
The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course at the 2nd autumn semester.

Learning outcomes:
After completing the course, students will have a good knowledge and understanding of a broad array of research topics and themes within the field of information systems; will have good knowledge and understanding of information systems research and the process by which that research is produced; will have competence in critiquing research articles published in some of the leadingacademic journals and conference proceedings; will have competence in critical thinking, and analysis and synthesis of academic sources; will have competence in verbally presenting arguments in an academic fashion; will know how to write a literature review on an information systems research topic.
Contents:
Information Systems Research Overview, A contemporary selection of Information Systems research themes.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, seminars 10 h, individual and group assignments 100 h; or self-study: opening lecture 2 h, assignments 132 h.

Target group:
MSc students
Prerequisites and co-requisites:
Bachelor's degree or similar, Research Methods course. Recommended to take before Master's Thesis.
Recommended optional programme components:

Recommended or required reading:
Selection of scientific articles.
Assessment methods and criteria:
Accepted assignments
Grading:
Numerical scale 1-5 or fail
Person responsible:
Netta Iivari
Working life cooperation:
No
Other information:
Course material can be found at OPTIMA e-learning environment, Urkund is used for course work submissions.

812331A: Interaction Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta Iivari

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits/133 hours of work
Language of instruction:
English
Timing:
The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 1st autumn semester.
Learning outcomes:
Objective: The course explains the role of human interaction with IT products, systems, and services, explains the factors and problems related to it to motivate interaction design, and teaches some user-centered methods for analysis, evaluation and design of interactions.
Learning Outcomes: After completing the course, the student can assess the role of human interaction with IT products, systems, and services and identify factors and problems related to it within a practical design case. The student is able to:

- use methods for analysis and evaluation of existing interfaces;
- understand the role of requirements, plan and conduct a simple requirements collection and analysis;
- use basic principles of usability and user experience for user interface design;
- use interaction design methods in designing for target user experiences.

Contents:
The course provides an overview of interaction design, introducing the terminology and fundamental concepts, the main activities, and the importance of user involvement in the design process. The course addresses establishing requirements for IT products, systems, and services. The focus is on usability and user experience from the viewpoint of the intended users, their tasks and the context of use. The course covers user-centered methods for designing for and evaluating usability and user experience of IT products, systems, and services. All the main activities of interaction design are carried out in a practical design case.
Mode of delivery:
Face-to-face teaching, self-study
Learning activities and teaching methods:
Lectures 20 h, exercises and seminar 25 h, individual and group assignments 90 h; or self-study: an opening lecture 2 h, one larger
assignment 110 h and individual tasks 21 h.
Target group:
MSc students
Prerequisites and co-requisites:
Basic knowledge on human-computer interaction with usability and user-centered design.
Recommended or required reading:
Sharp et al. (2007) Interaction Design, chapters 1-2, 4-5, 7-13 (pages 1-88, 134-215, 290-643) OR more recent version in electronic format NEEDS TO BE DISCUSSED WITH LIBRARY.
Assessment methods and criteria:
Accepted assignments.

Grading:
Numerical scale 1-5 or fail.
Person responsible:
Netta Iivari
Working life cooperation:
No
Other information:
The course book will be available in electronic format that would be very useful, as the book is updated regularly and we are using a very old
version.

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
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
Vastuuyksikkö: Computer Science and Engineering DP
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:
1. can design simple optimal classifiers from the basic theory and assess their performance.

2. can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers.

3. can apply the basics of gradient search method to design a linear discriminant function.

4. 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, guided laboratory work and independent assignment.
Learning activities and teaching methods:
Lectures 10h, Laboratory work 20h, Self-study 20h, Independent task assignment, written examination.
Target group:
Students who are interested in data analysis technology. 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.
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

521096S: Measurement Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: Finnish

Leikkaavuudet:

521110S Measuring and Testing Systems 6.0 op

521110S-01 Measuring and Testing Systems, exam 0.0 op

521110S-02 Measuring and Testing Systems, exercise work 0.0 op

ECTS Credits:
5 ECTS credits / 128h
Language of instruction:
Finnish. English, if there are more than 2 foreign students.
Timing:
Period 2.
Learning outcomes:
1. is able to design a multisensor measurement systems which store the measurement data.
2. is able to assembly a multisensor measurement systems which store the measurement data.
3. is able to program with LabView.
Contents:
Basics of measurement and testing systems, especially wired and wireless data transmission. Data acquisition cards. Basics of LabView programming.
Mode of delivery:
face-to-face teaching.
Learning activities and teaching methods:
The course includes 28h lectures and guided exercises. 100 h self-studies.
Target group:
Master level students regardless of master's programme.
Prerequisites and co-requisites:
None.
Recommended optional programme components:
This course compensates earlier courses with same core content but different course code or credit named Measuring and Testing Systems.
Recommended or required reading:
Course material is in English and Finnish and can be found in Optima.
Assessment methods and criteria:
Final exam and passed laboratory works.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grade is based on exam and grade is on numerical scale 1-5.
Person responsible:
Juha Saarela
Working life cooperation:
No.

521074S: Microelectronics and Micromechanics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

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:
Students of the University of Oulu.
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.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading 1-5.
Person responsible:
Krisztian Kordas
Working life cooperation:
-

521385S: Mobile Telecommunication Systems, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Katz, Marcos Daniel

Opintokohteen kielet: English

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

1. Upon completing the required coursework, the student will be able to determine and fit the values of the main parameters for modern mobile telecommunication systems network planning. The course gives skills to describe mobility management, adaptive resource control and dynamic resource allocation in mobile networks.
The goal of this course is to provide the basic understanding of dimensioning and performance of mobile communications systems. In addition, the current mobile communications system standards as well as the ones being developed are also studied, preparing students to understand the structure, functionality and dimensioning of these systems.

Contents:
Concept and structures of modern mobile communications systems. Basics of radio network planning and capacity. Distributed transmission power control and mobility management. Resource allocation techniques: adaptive resource control, dynamic resource allocation. Cooperative communications. Examples of digital mobile telecommunication systems in practice.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures 30 h, exercises 16 h and the compulsory design work with a simulation program (16 h)

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

Prerequisites and co-requisites:
Telecommunication Engineering, Broadband Communications Systems and Wireless Communications I.

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 material will be defined at the beginning of the course.

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

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

Person responsible:
Marcos Katz

Working life cooperation:
-

Other information:
Objective: The goal of this course is to provide the basic understanding of dimensioning and performance of mobile communications systems. In addition, the current mobile communications system standards as well as the ones being developed are also studied, preparing students to understand the structure, functionality and dimensioning of these systems.

521147S: Mobile and Social Computing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

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

Proficiency level:
English B2 - C2

ECTS Credits:
5

Language of instruction:
In English.

Timing:

Spring, periods 3-4
Learning outcomes:
1. Ability to implement mobile user interfaces

2. Ability to implement online social network applications

3. Ability to explain the fundamental concepts of context awareness

4. Ability to explain the fundamental concepts of 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 + independent work.
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:
Object oriented 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:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
The assessment is project-based. Students have to complete individual assignments throughout the semester and a final pair-based project: build a mobile application, conduct or analysis of data. Passing criteria: the assignments and 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:
Denzil Ferreira
Working life cooperation:
None.

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

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Opettajat: Matti Latva-aho, Petri Luoto

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

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Nyländen

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:
-

812342A: Object Oriented Analysis and Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812342A Object Oriented Analysis and Design (OPEN UNI) 5.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work.
Language of instruction:
Finnish. If at least four non-Finnish students take the course, an English exercise group will be organised.
Timing:
The course is held in the autumn semester, during period 1. It is recommended to complete the course in the 2nd autumn semester.
Learning outcomes:
After completing the course, the students know possibilities of UML-language family to describe different views. They can picture a task using Use
cases and scenarios. Moreover they can produce detailed descriptions using activity-, class-, interaction- and state diagrams. They know
principles of object-orientedness and can use abstract as well interface classes. Additionally they can model user interface by state diagrams. They
understand what design patterns are and how they are described and categorised.
Contents:
Principles of object orientation and object-oriented programming; quality criteria of object orientation; design patterns; case use; activity, class, interaction and state machine diagrams; class realisation.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 30h, compulsory exercises and assignments 28h, independent work 85 h.

Target group:
Bachelor students.
Prerequisites and co-requisites:
Course of elementary object-oriented programming is a compolsory prerequisite. Basic knowledge of object programming and information systems
analysis and design are assumed.

Recommended or required reading:
Bennet, McRobb & Farmer: Object-oriented systems analysis and design, Using UML.

Assessment methods and criteria:
Examination. At least 50% on points needed for passing the course.
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Juha Iisakka

815657S: Open Source Software Development, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Henrik Hedberg
Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English
Timing:
The course is held in the autumn semester, during periods 1 and 2.
Learning outcomes:
After passing the course, a student will be able to

- define the historical background and the ideology of Open Source Software (OSS),
- participate in OSS development project,
- evaluate the impact of the usage of OSS and OSS licenses on software development and exploitation, and
- view the phenomenon through the essential scientific research.

Contents:
The course introduces OSS development paradigm and current topics in OSS research. OSS affects both the way to produce software and the decisions of user organizations. It can be understood, for example, from different social, legal, economical, software engineering and data security viewpoints. The aim is to study from different perspectives, for example, what OSS is and what it is not, the history and organisation of OSS projects, methods of OSS development and usage, as well as licensing models and possible risks. The emphasis is on research work.
Mode of delivery:
Blended teaching.
Learning activities and teaching methods:
Lectures and seminars about 40 h, exercises and peer reviews about 20 h, seminar article and presentation about 70 h
Target group:
MSc students
Prerequisites and co-requisites:
Compulsory prerequisites are Bachelor degree or other equivalent degree and basic knowledge on software engineering and research work. The course allows passing Project following the OSS development principles, or writing Master's thesis on a OSS topic.
Recommended or required reading:
Fogel, K. (2005): Producing Open Source Software - How to Run a Successful Free Software Project, O'Reilly Media; Rosen L. (2004): Open Source Licensing: Software Freedom and Intellectual Property Law, Prentice Hall; scientific articles covering the topic.
Assessment methods and criteria:
Active participation, seminar article and other assignments

Grading:
Numerical scale 1-5 or fail.
Person responsible:
Henrik Hedberg

811392A: Preparatory Course for MSc Studies, 5 op

Voimassaolo: 01.03.2014 - 31.12.2018
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Arto Lanamäki
Opintokohteen kielet: English

ECTS Credits:
2 ECTS credits / 53 hours of work.
Language of instruction:
English.
Timing:
The course is held in the autumn semester, during period 1. It is recommended to complete the course in the 1st autumn semester.
Learning outcomes:
After completing the course, the student is able to participate in courses requiring basic knowledge of project work. The student is able to apply the basic concepts of project work, act in different roles in projects and is able to describe the significance of the different project outcomes, such as project plan, mid-reports and final reports. The student is able to define the principles of project coordination and communication with the project interest groups. Additionally, the student is able to consider the principles of referenced and scientific writing.
Contents:
The focus of the course is in the people, process and tools of a project in information technology field. Course covers the basic principles of project management, planning, coordination and communication within the project as well as outside the project. Course presents the different outcomes of the project, related to internal and external communication – project plans, mid-report, final reports and other project specific outcomes, as well as internal reports, memos and non-written communication and coordination techniques in a project. The latter include unofficial and official meetings held within the project as well as among the external interest groups of the project (for example, customers and the project steering group). Finally, the course presents the basics of written referenced and scientific communication – how to use references, how to acknowledge work of others, how to format an article and what is plagiarization and how to avoid plagiarization.

Mode of delivery:
Blended teaching.
Learning activities and teaching methods:
Lectures and exercises 20h, independent learning methods 34h.
Target group:
Msc students. The course is meant especially for those master's students who have not studied in our bachelor's program. Note that it is not possible to take both this and these related courses: 811311A Project management principles and 811382A Introduction to research work.

Recommended optional programme components:
Especially recommended to take before these courses: Project II, Software factory project course.
Recommended or required reading:
Provided when the course starts
Assessment methods and criteria:
Active participation in the lectures and exercises; learning diary.
Grading:
Pass or fail.
Person responsible:
Arto Lanamäki
Working life cooperation:
No

521089S: Printed Electronics, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
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:
1. Knows the most typical materials and printing methods suitable for their processing
2. Can explain the principles of materials and printing methods
3. Can utilize the material and manufacturing process knowledge to design fabrication processes for electrical components
4. Can analyse how the selected materials and printing methods influence on the performance of electrical 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:
Combined lectures and exercises 30 h and self-study 100 h
Target group:
Primarily for the students of electrical engineering
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:
D.R. Gamota, P. Brazis, K. Kalyanasundaram and J. Zhang, "Printed organic and molecular electronics", handout
Assessment methods and criteria:
Course is completed by final examination.
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:
Not included.

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -
Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S Programmable Web Project (OPEN UNI) 5.0 op

Status:
The course is mandatory for International Master's Programme in Computer Science and Engineering and Master's Programme in Computer Science and Engineering. It is optional for other degree and master programmes.

ECTS Credits:
5

Language of instruction:
In English.

Timing:
Spring, periods 3-4.

Learning outcomes:
1. Understands the main design concepts related to REST architectural style and ROA architecture

2. Is able to design, test and implement different components of a RESTful Web API

3. Understands what hypermedia is and how can it be used to build RESTful Web APIs

4. Is able to implement simple clients using Web technologies

5. Becomes familiar with basic technologies to store persitent data on the server and serialize data in the Web

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 15 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 enough space in the classes.

Prerequisites and co-requisites:
Elementary programming. Applied Computing Project I is recommended.

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:
Mainly course slides and links to different Web resources announced during the first lecture. Course books: * Leonard Richardson, Mike Amundsen & Sam Ruby. RESTful Web APIs. O'Reilly Media 2013. ISBN: 978-1-4493-5806-8. * Leonard Richardson & Sam Ruby,RESTful Web Services. O'Reilly Media 2007. ISBN: 978-0-596-52926-0.

Assessment methods and criteria:
This course unit utilizes continuous assessment. The project work is divided in different deadlines that students must meet to pass the course. Each deadline will be assessed after completion.
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:
Ivan Sanchez Milara

Working life cooperation:
None.

Other information:
This course replaces the course “521260S Representing structured information”.

817609S: Project Seminar, 3 op

Voimassaolo: 01.08.2013 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Tonja Molin-Juustila
Opintokohteen kielet: English

ECTS Credits:
3 ECTS credits / 80 hours of work.
Language of instruction:
English.
Timing:
The timing of the course is dependent on the “Research and Development Project (817612S)” course and will immediately follow the project in
the next semester. It is recommended to complete the course at the 2nd spring semester, period 3.
Learning outcomes:
After completing the course, the students should demonstrate their abilities to work as academic experts in challenging ICT projects. Students will learn to acquire and apply research articles and other new knowledge like an academic expert in a selected topic of their project (“Research and Development Project” course). Students will also learn to analyse and report their experience-basednew knowledge on the topic to peer students. By completing this course, students are able to act as reflective, independent academic experts in ICT projects and have learnt expertise in some topic area of their project. As an expert in the selected topic area, the student is able to: search research articles and literature on the topic (review); report practical experiences gained during the project on the topic; evaluate the results of the project and reflect the practical experiences against previous literature and research on the topic; disseminate the (increased) expertise in the topic in a credible
way to peers both by a written report and orally.
Contents:
Starting lecture, independent analysis and reporting of the expertise on the selected project topic and an expert seminar (1-2 days) with the presentations of each topic.
Mode of delivery:
Blended teaching.
Learning activities and teaching methods:
Attendance at the starting lecture (4h) and the expert seminar (1-2 full days) is mandatory. Independently writing the seminar paper and
preparing the seminar presentation (n. 50h).
Target group:
MSc students.
Prerequisites and co-requisites:
Mandatory: Research and Development Project (817612S) during autumn semester, periods 1&2. This course will immediately follow the project
course on the project topics. For the students of the Master’s degree programme on Software, Systems, and Service Development (GS3D), Software Factory Project Course (817611S) is mandatory before this course.

Recommended or required reading:
Research articles and materials are to be independently collected and studied by the students.
Assessment methods and criteria:
Expertise in the topic area will be reported on the seminar paper. Seminar presentation will also be evaluated. Assessment criteria in detail will be
given at the starting lecture and in the web-based learning environment of the course.
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Tonja Molin-Juustila
Working life cooperation:
No

521225S: RF Components and Measurements, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Teirikangas, Merja Elina
Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 123,5 hours of work
Language of instruction:
Finnish. English, if there are at least 3 international students in class.
Timing:
The course is held in the 4th period. It is recommended to complete the course during Master level studies.
Learning outcomes:
1. 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.

2. The student also knows the operating principles of transfer lines, antennas and filters and of their design.

3. 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 d

4. 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 24 h, design execises 20 h, laboatory exercises 20 h, independent work 68,5 h.
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:
The course is an independent entity and does not require additional studies carried out at the same time.
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:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Merja Teirikangas
Working life cooperation:
No.

521386S: Radio Channels, 5 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Markus Berg

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 130 hours of work
Language of instruction:
English
Timing:
The course is held in the spring semester, during period IV.
Learning outcomes:
1. will be able to define what the radio channel is and is able to distinguish it into modellable parts.

2. knows different radio wave propagation mechanisms.

3. can apply physical and empirical radio channel models.

4. is able to analyse which are the dominating propagation mechanisms in different environments.

5. will know how to measure the properties of different radio channels.
Contents:
The radio channels of different radio systems. Characterization of radio waves and propagation media. Different mechanisms of radio wave propagation: direct free-space propagation, absorption, scattering, reflection, refraction, diffraction, surface and ground waves, ionospheric waves and multipath propagation. Principles of the radio channel modelling. Noise calculations. Radio wave propagation phenomena over fixed terrestrial, ionospheric and satellite links. Radio channel modelling for outdoor mobile systems. Radio wave propagation inside or into buildings. Radio channels of mobile satellite links. Slow fading. Multipath propagation and its effects on narrowband and wideband radio channels. MIMO radio channels. Ultra wideband radio channels. Measurement methods of radio channels.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h / Exercises 12 h / compulsory laboratory work 14 h / Self-study 80 h.
Target group:
1st or 2nd year M.Sc. and WCE students
Prerequisites and co-requisites:
The required (or recommended) prerequisite is the completion of the following courses prior to enrolling for the course: Basics of Radio Engineering, Signal Analysis
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:
Simon R. Saunders & Alejandro Aragón-Zavala: Antennas and propagation for wireless communication systems. Second edition. John Wiley & Sons Ltd, 2007.
Assessment methods and criteria:
The course is passed with a final examination and the accepted laboratory work report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Markus Berg
Working life cooperation:
No
Other information:
Course will be given every second year in odd years.

521326S: Radio Engineering 1, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail
Opettajat: Risto Vuohtoniemi
Opintokohteen kielet: Finnish
Leikkaavuudet:

521326S-01	Radio Engineering	0.0 op
521326S-02	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:
1. The student recognizes different kind of impedance matching methods and can design the impedance matching network using lumped components and microstrip lines.

2. She/he can also explain factors, which are limiting the bandwidth of impedance matching networks.

3. The student can design the impedance matching for a low noise amplifier.

4. 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.

5. The student can explain the principle of a single ended, balanced and double balanced mixer and the advantages and the disadvantages of these mixers.

6. She/he can design a power divider and a directional coupler.

7. The student can also explain the principle of an automatic gain control (AGC).

8. The student can classify power amplifiers and can in the basic case design the matching network for a power amplifier.
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:
The course is an independent entity and does not require additional studies carried out at the same time.
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:
No

521327S: Radio Engineering II, 6 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
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:
1. The student recognizes the blocks of a transceiver and can explain the operating principle of a transceiver.

2. She/he can classify different architectures used in a single and a multi-antenna transceiver and understand the basis for them.

3. 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.

4. She/he can explain nonlinear distortion and can design the automatic gain control in the system level.

5. 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.

6. The student can also explain the principles of frequency synthesis in a transceiver.
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:
The course is an independent entity and does not require additional studies carried out at the same time.
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:
No

815305A: Real Time Distributed Software Development, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Petri Pulli

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.
Timing:
The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 1st autumn semester.
Learning outcomes:
After completing the course, the student:

- Is able to analyse the characteristics of real-time distributed systems;
- Is able to acquire an object-oriented, model-based approach to solve the design problems found in real-time systems;
- Is able to detect and derive specific problems facing the real-time software designer, and to suggest design patterns to solve those problems.

Contents:
Introduction 1. Characteristics of real-time systems; 2. Resource management; 3. Safety and reliability; 4. Time constraints; 5. Concurrency; 6.
Scheduling; 7. Interrupts Characteristics of Distribution 1. Distribution architectures 2. Concept of time; 3. Synchronisation; 4. Latency and
jitter; 5. Quality of service; 6. Service discovery; 7. Networking primitives Real-Time UML Modelling Methodology Real-Time Design Patterns Design
Examples: Embedded, Ubiquitous, Mobile, Web/Internet.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 40h, design exercises 15h, student project 80h.
Target group:
MSc students
Prerequisites and co-requisites:
Computer architecture, object-oriented analysis and design (UML), programming language C and/or Java.
Recommended or required reading:
Lecture notes. Course book: Douglass B.P. (2009) Real-Time Design Patterns – Robust Scalable Architecture for Real-Time Systems. Addison-
Wesley ISBN 0-201-69956-7. 500 p.
Assessment methods and criteria:
Exam and project evaluation
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Petri Pulli

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Arto Lanamäki
Opintokohteen kielet: English
Leikkaavuudet:

521146S Research Methods in Computer Science 5.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work

Language of instruction:
English
Timing:
The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:
Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in information systems and software engineering. The student is able to identify and describe the main research approaches and methods in information systems and software engineering and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master's thesis and find more information on the method from scientific literature.
Contents:
Introduction to general scientific principles, scientific research practices and quality of scientific publications, qualitative research approaches and selected research methods, quantitative research approaches and selected research methods, design science research and selected methods, requirements and examples of Master's theses, evaluation of research.

Mode of delivery:
Face-to-face teaching.

Learning activities and teaching methods:
Lectures 40h, exercises 30h and individual work 65h. Learning diary is written about the lectures and exercises. Exercises include group work.

Target group:
MSc students
Prerequisites and co-requisites:
Completion of Bachelor's studies

Recommended optional programme components:

Recommended or required reading:
Lecture slides and specified literature

Assessment methods and criteria:
Accepted learning diary.
Grading:
Pass or fail.

Person responsible:
Arto Lanamäki
Working life cooperation:
No

817612S: Research and Development Project, 10 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Tonja Molin-Juustila
Opintokohteen kielet: English

ECTS Credits:
10 ECTS credits / 260 hours of work.
Timing:
The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 2nd autumn semester.
Learning outcomes:
After completing the course, the students should demonstrate their abilities to work on a challenging ICT project. Students will learn to acquire and apply professional expertise in the topic of the project. Students will also demonstrate their skills to conduct an ICT project in a professional way. By completing this course, students are able to act as independent professional members of an ICT project and have advanced professionalism in project work and management. The topics for the course can be anything from the ICT field. As a professional expert conducting a successful project in a managed way, the student is able to: collectively produce, monitor and update the plan of the project (project with fixed time and human resources); search up to date information on the subject matter of the project in order to build professional expertise on the topic and apply this in the project work; build professional working knowledge and skills focused in the subject area of
the project (e.g. software development, user experience evaluation); develop analytical and creative skills for successful completion of the
project; monitor and communicate the status (time & human resources used) of the project in real time within the project team (weekly/daily meetings); use systematic means (e.g. ICT tools) to enable communication and transparency of the project work; develop skills to communicate with the customer in a professional context; manage a successful project review with the steering group/project team organization; report and explain the status (progress, results and future estimations of the project) to the steering group to support the decision making and problem resolution concerning the project's future; work as responsible project team member; as an expert and/or project manager; work as a project team member with people from different technical and/or cultural backgrounds; produce a realistic outcome in relation to the project time and human resources (ok, good, excellent); reflect the relationship between the process model(s) selected for the project (waterfall, evolutionary, agile etc.) and the management practices followed in the project. management practices followed in the project.

Contents:
Starting lecture, where the steps of carrying out the course will be described together with other important information. Allocation of the project teams will immediately follow the starting lecture. The project work will take two periods (one semester).
Mode of delivery:
Face-to-face teaching.

Learning activities and teaching methods:
Project work 260h per student. Working hours reported during the project. Attendance at the starting lecture (4h) is mandatory. Praparing a
project portfolio in the end (3h).
Target group:
Master's level students.
Prerequisites and co-requisites:
Mandatory: B.Sc. degree or other equivalent degree. Students enrolling directly to the Master's programme should take the "Preparatory course for MSc studies (811392A)" course first (see the timetable for the autumn semester, period 1) or otherwise master the basics of project work and
management as in Pressman, R.S. Software Engineering: A Practitioner's Approach, the chapters related to project management. The
expertise gained during this project course will be further elaborated during the "Project Seminar (817609S)" course, which will immediately follow this course during spring semester, period 3.

Recommended or required reading:

Unique project material provided by the customer of the project and/or material to be collected and studied by the project team.

Assessment methods and criteria:
Skills will be reported by a project portfolio. Detailed assessment criteria will be given at the starting lecture and they will also be available in
the web-based learning environment.

Grading:
Numerical scale 1-5 or fail.

Person responsible:
Tonja Molin-Juustila

Working life cooperation:
Yes. Learning by doing, i.e. managing authentic, resource-limited project work and integrating the practices of an academic expert into the unique project assignment.

Other information:
Enrollment for the course is well beforehand, i.e. until the end of July between 1 st and 2 nd study year.

813620S: Software Business Management, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Marianne Kinnula

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.

Language of instruction:
English

Timing:
The course is held in the spring semester, during period 3.

Learning outcomes:
Upon completion of the course, the student will be able to assess the main problem areas in software business management and is able to describe how to manage these problems; will be able to use different kinds of tools for managing this diverse and ambiguous environment; will understand the differences between leading and managing and be able to apply these to practice; will be able to analyse a company situation in a continually changing, unpredictable and even hostile environment, and is able to make well-grounded recommendations for the company courses of action.

Contents:
The software business environment and context is complex and under continuous change. Competences and creativity of company employees
are needed for creating value and growth to the company. Managing a software business is a challenging task as traditional, rational
management models are often inadequate for the needs of the managers. This course provides an overview of the strategic management of the
software business in a software company.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures and exercises 32h, group work 30h, course assignments and independent work 71 h.

Target group:
MSc students

Prerequisites and co-requisites:
Basic knowledge of academic writing technique is needed. Basic understanding of the software business is an advantage.

Recommended optional programme components:

Recommended or required reading:
Lecture slides and specified literature.
Assessment methods and criteria:
Participation in lectures/exercises, group work, course assignments.
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Marianne Kinnula
Working life cooperation:
No

811346A: Software Engineering, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Lappalainen, Jouni Esko Antero

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 133 hours of work.

Language of instruction:
Finnish
Timing:
The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 2nd study year.
Learning outcomes:
After completing the course, a student is able to explain various aspects of software engineering areas such as process models, requirementspecification, analysis and design methods, quality management and project management, their importance and know how to use them for small-scale task solving. A student is familiar with software engineering practices and activities (review, testing, software product management, risk management, project management) and knows how to use them in software development at different levels. A student can explain the maintenance and redesign of software evolution and its importance.
Contents:
Software process, software requirements, software design methods, software engineering practices, software quality management, software project
management.

Mode of delivery:
Face-to-face teaching.

Learning activities and teaching methods:
Implementation methods of the course vary: a) Lectures 32h, exercises 24h, study group working 40h, and self-study 24h; b) Lectures 32h, exercises 24h, essay 64h, and self-study 24h (Lectures in Finnish, exercises can be completed also in English).
Target group:
BSc students.
Prerequisites and co-requisites:
Course “Introduction to Information Systems Design” and “Object Oriented Analysis and Design” or similar knowledge.

Recommended optional programme components:

Recommended or required reading:
Pressman R., Software Engineering, A Practitioner’s Approach, 7 th edition, McGraw-Hill, 2010, lecture material.
Assessment methods and criteria:

Essay and assignment, or study group work and assignment.
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Jouni Lappalainen
Working life cooperation:
No

815662S: Software Engineering Management, Measurement and Improvement, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Oivo, Markku Tapani

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.
Timing:
The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 2nd autumn semester.
Learning outcomes:
After completing the course the student understands the fundamental principles of software processes and their development in professional
software engineering. The course extends the quality understanding based on individual techniques (e.g. reviews) so that after completing
the course the student is able to: - Evaluate different methods and techniques; - Select from them appropriate ones for different software
engineering environments; - Have capabilities to participate in systematic efforts for improvement in software companies.
Contents:
The course covers the most fundamental process centred software quality improvement and management approaches, methods and latest research results, as well as approaches to software measurement. The topics of the course include: traditional waterfall, agile (extreme programming, scrum, rational unified process, crystal, feature driven development, adaptive software development, dynamic systems development method) and lean methods, process improvement approaches, software process and product measurement, agile and lean practices, process improvement at the enterprise level and practical examples from software industry.
Target group:
MSc students
Prerequisites and co-requisites:
B.Sc. or other equivalent degree and basic knowledge of software engineering
Recommended or required reading:

- CMMI: Guidelines for Process Integration and Product Improvement. Mary Beth Chrissis, Mike Konrad, Sandy Shrum. Addison-Wesley, ISBN 032-115496-7, 2004.
- Agile Project Management with Scrum. Ken Schwaber, Microsoft Press, ISBN 0-7356-1993-X. 2004.
- Dingsøyr T., Dybå T., Moe N.B., Agile Software Development: Current Research and Future Directions, Springer, 2010
- C. Jones, Applied Software Measurement: Global Analysis of Productivity and Quality, 3rd ed. McGraw-Hill Osborne Media, 2008.
- Craig Larman and Bas Vodde, Scaling Lean & Agile Development: Thinking and Organizational Tools for Large-Scale Scrum, Addison-Wesley, 2009

Assessment methods and criteria:
Active and regular participation to lectures and seminars AND report evaluation AND seminar presentations
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Markku Oivo

815663S: Software Engineering Research, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.
Language of instruction:
English
Timing:
The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 2nd autumn semester.

Learning outcomes:
After completing the course the student will know the current research areas in software engineering and the most important software engineering research methods. The student understands academic research and publishing in software engineering, and is able to critically analyse scientific articles from the viewpoint of the content and research methods used in the article. The student is able to present academic research and actively participate in an academic discussion of research papers and research results.
Contents:
State of the art research methods and topics in software engineering.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and seminars 28h, exercises/ assignments 78h, weekly study 42h.
Target group:
MSc students
Prerequisites and co-requisites:
B.Sc. or other equivalent degree
Recommended or required reading:

Assessment methods and criteria:
Active Participation to lectures and attendance. Final grade is composed of attendance, assignments and term paper. No remote
participation or distance learning.
Grading:
Numerical scale 1-5 or fail.

Person responsible:
Burak Turhan
Other information:
It is not possible to complete the course remotely or with self-study options.

817614S: Software Factory Project, 10 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Oivo, Markku Tapani
Opintokohteen kielet: English

ECTS Credits:

10 ECTS credits / 267 hours of work.

Language of instruction:

English

Timing:

The course is held in the spring semester, during periods 3 and 4. It is recommended to complete the course in the 1st spring semester.

Learning outcomes:

After completing the course, the students should demonstrate their abilities to work on a challenging ICT project. Students will learn to acquire and apply professional expertise in the topic of the project. Students will also demonstrate their skills to conduct an ICT project in a professional way. By completing this course, students are able to act as independent professional members of an ICT project and have advanced professionalism in project work and management. The topics for the course can be anything from the ICT field. As a professional expert conducting a successful project in a managed way, the student is able to: collectively produce, monitor and update the plan of the project (project with fixed time and human resources); search up to date information on the subject matter of the project in order to build professional expertise on the topic and apply this in the project work; build professional working knowledge and skills focused in the subject area of the project (e.g. software development, user experience evaluation); develop analytical and creative skills for successful completion of the project; monitor and communicate the status (time & human resources used) of the project in real time within the project team (weekly/daily meetings); use systematic means (e.g. ICT tools) to enable communication and transparency of the project work; develop skills to communicate with the customer in a professional context; manage a successful project review with the steering group/project team organization; report and explain the status (progress, results and future estimations of the project) to the steering group to support the decision making and problem resolution concerning the project's future; work as responsible project team member; as an expert and/or project manager; work as a project team member with people from different technical and/or cultural backgrounds; produce a realistic outcome in relation to the project time and human resources (ok, good, excellent); reflect the relationship between the process model(s) selected for the project (waterfall, evolutionary, agile etc.) and the management practices followed in the project.

Contents:

Starting lectures (4x2h) and two workshops (2x8h), where the steps of carrying out the course will be described together with other important
information. Allocation of the project teams will immediately follow the starting lectures. The project work will take two periods (one semester).

Mode of delivery:

Blended teaching.

Learning activities and teaching methods:

Project work 260h per student. Working hours reported during the project. Attendance at the starting lectures (8h) and wokshops (16h) is
mandatory.

Target group:

MSc students.

Prerequisites and co-requisites:

Mandatory: B.Sc. degree or other equivalent degree. Students enrolling directly to the Master's programme should take the "Preparatory course for MSc studies (811392A)" course first (see the timetable for the autumn semester, period 1) or otherwise master the basics of project work and
management as in Pressman, R.S. Software Engineering: A Practitioner's Approach, the chapters related to project management.

Recommended or required reading:

Unique project material provided by the customer of the project and/or material to be collected and studied by the project team.

Assessment methods and criteria:

Skills will be reported by a project portfolio. Detailed assessment criteria will be given at the starting lecture and they will also be available in
the web-based learning environment.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Markku Oivo

Working life cooperation:

Yes. Learning by doing, i.e. managing authentic, resource-limited project work and integrating the practices of an academic expert into the unique
project assignment.

Other information:

Enrollment for the course is well beforehand.

815312A: Software Production and Maintenance, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Mäntylä

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits/133 hours of work
Timing:
The course is held in the spring semester, during period 3. It is recommended to complete the course in the 1st spring semester.
Learning outcomes:
After completing the course, the student:

- Can apply the framework of product line engineering in large scale software production;
- Can apply the maintenance process and techniques in software production.

Contents:
Product line engineering: 1. Product line variability; 2. Domain engineering; 3. Application engineering; 4. Transition strategies and organisational issues. Principles and practices of software evolution and maitenance.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24h, exercises/ assignments 18h, weekly study and learning diary 42h, term project 45h.
Target group:
MSc students
Prerequisites and co-requisites:
Basic knowledge of software engineering and software architectures.
Recommended or required reading:
Pohl, K., Böckle, G., van der Linden, F. Software Product Line Engineering. Foundations, Principles, and Techniques, Springer-Verlag, 2005; chapters 1-5, 10, 15, 19-20. Chastek G.J., Donohoe P., McGregor J.D., Formulation of a Production Strategy for a Software Product Line, Technical Note CMU/SEI-2009-TN-025, Carnegie Mellon, 2009. Software Evolution and Maintenance, Priyadarshi Tripathy, Kshirasagar Naik, ISBN: 978-0-470-60341-3, 416 pages, January 2015.
Assessment methods and criteria:
Active Participation to lectures and attendance. Final grade is composed of attendance, learning diary, assignments and term project.
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Mika Mäntylä

815311A: Software Quality and Testing, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Burak Turhan

Opintokohteen kielet: English

Leikkaavuudet:

ay815311A Software Quality and Testing (OPEN UNI) 5.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work.
Language of instruction:
English
Timing:
The course is held in the autumn semester, during period 1. It is recommended to complete the course in the 1st autumn semester.
Learning outcomes:
The student understands different views on software quality and the role of testing as a part of software engineering validation and verification
activities, and defect identification/ removal techniques. The student knows testing levels, strategies and techniques, can create test cases
and conduct unit testing with appropriate testing tools. The student knows the basics of test driven development and test automation.
Contents:
Software quality and quality assurance. Software quality management and metrics. Fundamental concepts of software testing. Functional and
structural testing. Unit, integration, system, acceptance and regression testing. Hands on test-driven development. Test automation
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, exercises/ assignments 24 h, weekly study 42 h, term project 42 h
Target group:
MSc students
Prerequisites and co-requisites:
Working knowledge of Java programming language is required. Basic knowledge of software engineering.
Recommended optional programme components:

Recommended or required reading:
Pezze M.,Young M., “Software Testing and Analysis: Process, Principles and Techniques”, John Wiley&Sons, 2008 *** Lasse Koskela, “Test Driven:
Practical TDD and Acceptance TDD for Java Developers”, Manning Publications, 2007 *** • Galin D., “Software Quality Assurance: From theory
to implementation”, Addison-Wesley, 2004
Assessment methods and criteria:
Active Participation to lectures and attendance. Final grade is composed of attendance, assignments and term project. No remote
participation or distance learning.
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Muhammad Farooq
Working life cooperation:
No

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

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

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 degree program professors.
Working life cooperation:
-

817603S: System Design Methods for Information Systems, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pasi Karppinen

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.

Language of instruction:
English
Timing:
The course is held in the autumn semester, during period 1. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:
After the course the student understands the complexity of business, organiza-tional, technical, and human aspects that affect ISD and the
selection of meth-ods in ISD. The student also understands the defects of traditional waterfall model and how other methods aim to answer to
these defects and to other chal-lenges in ISD. In particular, with socio-technical methods (e.g., SSM, ETHICS) and their techniques the student is able to re-plan and develop the sub-systems (automated and non-automated)

of organization into a coherent whole and to take into account job satisfaction issues in addition to efficiency demands in ISD and in planning workflows in organization. The student is also able to assess and give arguments which method is suitable for an ISD project in an organization.

Contents:

After the course, the student understands the complexity of business, organizational, technical, and human aspects that affect ISD and the
selection of methods in ISD. The student also understands the defects of traditional waterfall model and how other methods aim to answer to the
defects of it and also answer to other challenges in ISD. In particular, with socio-technical methods (e.g., SSM, ETHICS) and their techniques, students are able to re-plan and develop the sub-systems (automated and non-automated) of organization into a coherent whole and to take into account job satisfaction issues in addition to efficiency demands in ISD and in planning workflows in organization. The student is also able to assess and give arguments on which method is suitable for an ISD project in an organization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 20h, exercises 18h, homework 36h, essay 26 h, examination 34h.

Target group:

MSc students

Prerequisites and co-requisites:

Bachelor studies recommended

Recommended optional programme components:

Recommended or required reading:

Avison, D., Fitzgerald, G. (2006) Information Systems Development, methodologies, techniques & tools. Fourth Edition. London: McGraw-Hill.
Research articles (to be announced during the course implementation).

Assessment methods and criteria:

Exercises, assignments, essay, and examination.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Pasi Karppinen

Working life cooperation:

No

521322S: Telecommunication Engineering Project, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Markus Berg

Opintokohteen kielet: Finnish

Leikkaavuudet:

521387S	Telecommunication Engineering Project	4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English/Finnish

Timing:

Fall or Spring, periods 1-4

Learning outcomes:

1. osaa saamastaan aihealueesta riippuen joko ratkaista, suunnitella, rakentaa, mitata, simuloida, testata tai analysoida rajattuja pienimuotoisia tietoliikenne- ja radiojärjestelmiä tai niiden osakokonaisuuksia.

2. osaa soveltaa teoreettisissa opinnoissa saamiaan tietoja käytännön insinöörityöhön.

3. osaa dokumentoida teknillisen tai tieteellisen työnsä tuloksia.

Contents:
Varies depending on the topic.
Mode of delivery:
Independent work.
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:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Varies depending on the topic.
Assessment methods and criteria:
Written work report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Markus Berg / Antti Tölli
Working life cooperation:
No

521098S: Testing techniques of Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Fabritius

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
Finnish. English, if there are more than 2 foreign students.
Timing:
Period 4.
Learning outcomes:
1. After completing the course the student is able to analyze different kinds of testing strategies, and is able to enhance the testability of electronics through the use of design for testability.
2. The student can also compare different testing techniques of analogue and digital electronics, which have been implemented using either embedded testing methods or external automatic testing equipment.
3. Additionally, the student is able to analyze tests made using an automatic test instrument, compare different test interfaces and data busses, and recognizes principles of design of a high-quality printed test circuit board.
4. Additionally, the student is able to operate boundary-scan technique.
Contents:
Overview of different testing methods, constructions of testers, test fixtures, test signal generation and measurement, mixed-signal test buses, DC- and parametric measurements, dynamic tests, AD/DA converter tests, DSP-based tests, data analysis, embedded testing, design for testability, Boundary scan, test applications.
Mode of delivery:

Face-to-face teaching.
Learning activities and teaching methods:
Lectures 24h/Exercises 12h/laboratory work 4h and self-studying 100h.
Target group:
Course is compulsory for the Electrical engineering students in the advanced module of Testing techniques and printed electronics.
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the following courses prior to enrolling for the course unit: Electronics Design I, Electronic Measurement Techniques.
Recommended optional programme components:
This course compensates 521167S Testing Techniques of Electronics or 521173S Mixed-signal Testing if the student hasn't got credits from either one of those.
Recommended or required reading:
M. Burns, G. W. Roberts: An Introduction to Mixed-Signal IC Test and Measurement, Lecture slides. Additional material will be announced at the beginning of the course.
Assessment methods and criteria:
Exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grade is based on exam and grade is on numerical scale 1-5.

Person responsible:
Tapio Fabritius
Working life cooperation:
No.

521148S: Ubiquitous Computing Fundamentals, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannu Kukka

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
In English.
Timing:
Autumn, periods 1-2.
Learning outcomes:
1. has gained a good overview of the history and current state of ubiquitous computing

2. has learned to design, implement, and evaluate a ubiquitous computing system

3. has learned how to carry out a research project, from initial research problem formulation to concept development, and further to in-the-wild evaluation and reporting using an academic format
Contents:
Ubiquitous computing systems, privacy, field studies, ethnography, interfaces, location, context-aware computing, processing sequential sensor data.
Mode of delivery:
Lectures, group project
Learning activities and teaching methods:
Lectures 20 h, exercises 22 h, project work 50 h, self-study 43 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 graded based on the following criteria: - Attendance - Summaries of selected scientific publications - Interim reports during project work - Final project report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical scale 1-5; zero stands for a fail.
Person responsible:
Adjunct Professor Hannu Kukka
Working life cooperation:
The course teaches students how to design, implement, and evaluate an academic research project. Especially helpful to those students planning post-graduate studies.

812671S: Usability Testing, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Rajanen

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.

Language of instruction:
English and Finnish
Timing:
The course is held in the spring semester, during periods 3 and 4.

Learning outcomes:
After completing the course, the student can:

- Design and follow through a usability testing process;
- Design usability test scenarios and tasks;
- Select test subjects;
- Plan and follow through usability tests as laboratory tests or field tests;
- Analyse and report the findings from usability tests.

Contents:
Basic terms and types of usability testing, usability tests process, usability test tasks and scenarios, test subjects, following through a usability test, analysing usability test material, reporting the findings from usability tests.

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24h, assignment tutoring 13h, assignment 90h, seminar 7h.
Target group:
MSc students

Prerequisites and co-requisites:
Student is familiar with most common user interface design terms, design and evaluation methods as in “Introduction to Human-Computer Interactions” course.
Recommended optional programme components:

Recommended or required reading:
Dumas, J. S. & Redish, J. C. (1993): A Practical Guide to Usability Testing. Ablex Publishing Corporation. Rubin, J. (1994): Handbook of
Usability Testing: How to Plan, Design, and Conduct Effective Tests. Chichester: John Wiley & Sons, Inc.
Assessment methods and criteria:
Assessment of the course is based on the learning outcomes of the course based on the written usability test plan, supervised usability tests, written usability test report and oral seminar presentation

Grading:
Numerical scale 1-5 or fail.
Person responsible:
Mikko Rajanen
Working life cooperation:
No
Other information:

811375A: User Interface Programming, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Lappalainen, Jouni Esko Antero

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits/133 hours of work

Language of instruction:
Finnish
Timing:
3 rd year, autumn semester, periods 1 + 2
Learning outcomes:
After completing the course, the student can implement a software application that utilises a database for storage and has a graphical user interface. The GUI (as well as the entire application) must be developed by implementing usability design principles from the beginning of the development process.

Contents:
The course deals with the following: UI elements, foundations of the Swing library, UI design principles, layout managers, MVC-paradigm, event-driven programming, web-usability, JSP, programmatically utilising databases, JDBC, web-programming.

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Exercise 33h, coursework 75h, independent study 26h.
Target group:
BSc students
Prerequisites and co-requisites:
Knowledge and skills of the course “811380A Basics of Databases” and fundamentals of user interface design. In addition, the knowledge and skills of object-oriented programming are needed.
Recommended optional programme components:

Recommended or required reading:
Lectures in textual format within the course web space. In addition (if needed), for example Kosonen, Peltomäki & Silander (2005). Java 2 ohjelmoinnin peruskirja. Docendo. In addition, Lauesen, S. 2005. User Interface Design: A Software Engineering Perspective.
Assessment methods and criteria:

The student must submit coursework that fulfils the given requirements (defined during the course).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Jouni Lappalainen
Working life cooperation:
No

521323S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
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 ECTS cr / lecture 28 h, exercises 14 h and the compulsory design work with a simulation program (20 h)
Language of instruction:
English
Timing:
Fall, period 2
Learning outcomes:
1. can analyze the performance of multilevel digital modulation methods in AWGN channel

2. can explain the effect of fading channel on the performance of the modulation method and can analyze the performance

3. recognizes the suitable diversity methods for fading channel and related combining methods

4. can define the basic carrier and symbol synchronization methods and is able to make the performance comparison of them

5. can explain design methods signals for band-limited channels

6. can classify different channel equalizers, and perform the performance analysis
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 WCE students and M.Sc. students (i.e., 4th year in EE degree programme)
Prerequisites and co-requisites:
521330A Telecommunication Engineering 521316S Broadband Communications Systems
Recommended optional programme components:
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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:
No

521317S: Wireless Communications II, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Antti-Heikki Tölli

Opintokohteen kielet: English

ECTS Credits:
8
Language of instruction:
English
Timing:
Spring, periods 3-4
Learning outcomes:
1. Upon completing the required coursework, the student is familiarised with the channel capacity as the basic performance measure of wireless communication links, and can explain the effect of fading channel on the capacity in a single-user single-antenna se

2. After learning the basics in a single-user multiple-input multiple-output (MIMO) communications, the student is acquainted with the capacity optimal multi-antenna transmission and reception schemes in both multiple access and broadcast channels.

3. After the course, the student has also gained understanding on the applicability of multiuser MIMO communication schemes in realistic multi-cell scenarios.

4. Finally, it is explained how these technologies are deployed in current and future wireless systems and standards.

5. Target is to deepen the understanding of the fundamental multiantenna transmission and reception concepts used in broadband wireless and in particular mobile systems.
Contents:
Capacity of point-to-point and multiuser wireless channels, point-to-point MIMO communications, multiuser multiple antenna communications in uplink and downlink, opportunistic communications, scheduling and interference management, coordinated multi-cell transmission.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 45 h, exercises 25 h and the compulsory design work with a simulation program (25 h)
Target group:
Primarily in electrical engineering students. Other University of Oulu students can complete the course
Prerequisites and co-requisites:
In addition to the course Wireless Communications I, a working knowledge in digital communications, random processes, linear algebra, and detection theory is required. Also, students are asked to read chapters 1-4 from the textbook before attending the course.
Recommended optional programme components:
Prior knowledge of information theory and convex optimisation is very useful but not mandatory.

Recommended or required reading:
D. N. C. Tse and P. Viswanath, Fundamentals of Wireless Communication. Cambridge University Press, 2005, Chapters 5-10, as well as, a few recent journal publications related to multiuser MIMO downlink. Supporting material: Cover & Thomas, "Elements of Information Theory", John Wiley & Sons; Boyd & Vandenberghe, "Convex Optimization", Cambridge University Press, 2004.
Assessment methods and criteria:
The course is passed with a final examination and the accepted simulation work report. The final grade is a weighted sum of exam (70%), homeworks (20%), and work report (10%).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5.
Person responsible:
Antti Tölli
Working life cooperation:
No
Other information:
Course replaces the old course 521317S Wireless Communications III.

521097S: Wireless Measurements, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

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 ECTS credits / 128h
Language of instruction:
In Finnish or in English if two or more foreign students participate.
Timing:
Period 3.
Learning outcomes:
1. can tell and justifying argument the benefits and challenges of using wireless measurement solutions
2. can apply the most important standards when designing wireless measurement solutions
3. can apply wireless technologies in industrial, traffic, environmental, home and healthcare measurements
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:
Lectures 22h. Seminars 6-12h depending on the number of students participating the course. The students prepare seminar presentations about contemporary topics selected by themselves or proposed by the teacher and give 15-20 minutes presentation to other students in the seminars.
Target group:
Master level students regardless of master's programme.
Prerequisites and co-requisites:
No prerequirements, but basics of measurements systems are recomended.
Recommended optional programme components:
The course replaces previous courses with same name, but different credits and code.
Recommended or required reading:

Lecture notes and seminar reports is Optima.
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:
Grade is on numerical scale 1-5.
Person responsible:
Juha Saarela
Working life cooperation:
No.

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

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Saarela
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

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

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Saarela
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.